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Barriers and Facilitators of FDI in Asia: A Quantile Approach to Regional Trends

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Abstract

This paper investigates the drivers of FDI inflows in 34 Asian countries from the period 2000 to 2021, using a quantile regression approach to take care of heterogeneity across low-, medium-, and high-FDI-receiving nations. The current analysis identifies economic growth, labor force participation, trade costs, sustainable energy consumption, and infrastructure development as significant factors that influence FDI. While GDP growth and workforce participation have been observed to positively influence FDI inflows, strong economic and labor policies become relevant in this context. In contrast, high trade costs come up as bottlenecks and hence require trade facilitation and regional market integration. The sustainable energy consumption can be seen as a representation of the rising importance of environmental considerations in attracting investment, and this is mixed with evidence on governance effectiveness and interactions with sustainable energy policies regarding institutional quality in FDI dynamics. The findings suggest that a multidimensional policy framework of economic growth, labor market reforms, trade cost reduction, infrastructure improvement, and governance improvement go a long way in the creation of an enabling environment for FDI.

Keywords: FDI, Economic Growth, Trade Costs, Sustainable Energy, Infrastructure, Governance, Quantile Regression

INTRODUCTION

FDI has long been recognized as a cornerstone of economic development. It drives growth through technology transfer, employment generation, and infrastructure development. In the Asian context, rapid globalization and economic integration have amplified the competition among countries to attract FDI. However, significant disparities persist, with some nations emerging as major FDI hubs while others struggle to achieve similar success. The existing literature shows that economic growth, quality of governance, and infrastructure have been some of the most crucial factors affecting FDI inflow (Faruq, 2023; Saini & Singhania, 2018: Ali & Rehman, 2015). With the emergence of economies, other new

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determinants are sustainable energy practices and trade costs, which need a deeper probe into their variable impacts across countries (Amri, 2016; Zhu et al., 2016; Bashir & Rashid, 2019; Shahabuddin & Ali, 2024).

Although several contributions have been made so far, previous studies have left lacuna on how such a set of determinants operate across different national contexts and across various tiers of FDI-receiving status. Most research has focused on the aggregate relationship with much heterogeneity existing in the determinants of FDI across low-, medium-, and high-FDI-receiving countries (Apostolov, 2016; Zahid, 2018; Labidi et al., 2024; Marc et al., 2025). More significantly, though, in as much as governance has been well studied as a determinant, it is understudied as a moderator between emergent factors like sustainable energy practices and FDI (Perveez, 2019; Xie & Zhang, 2023). These lacunae restrict policymakers to less granular insights and hence hold limited scope for tailoring their strategies to the particular needs of their economies.

This study tries to fill the gaps in the literature by analysing FDI inflows from 34 Asian countries based on the years 2000-2021, using an integrated framework incorporating measures of economic growth, labor participation, trade costs, efficient energy use, and good governance. Application of quantile regression in this research helps capture heterogeneity in the FDI determinant across the different levels of the FDI inflow, hence giving a better nuance on the effect of such determinants. The research also looks into the moderation role of governance in explaining how sophisticated its interaction is with sustainable energy practices in driving FDI (Mol & Spaargaren, 2000; Wang & Xu, 2022; Sadashiv, 2023).

The findings add to the existing literature some actionable points for policy makers. The findings underline the need for economic growth, reduction in trade costs, and enhancement in the contribution of laborers to build an investor-friendly environment (Luna & Luna, 2018; Sinha et al., 2020; Nasir, 2022; Tricahyono & Wijaya, 2024). Moreover, it has been identified that one of the most feasible strategies to attract green FDI, especially in countries with strong governance frameworks, is the adoption of sustainable energy practices that meet international environmental standards (Amri, 2016; Diaz & Weber, 2020; Wang & Xu, 2022). By addressing critical challenges and leveraging unique opportunities, this study equips policymakers with evidence-based strategies to enhance FDI inflows, promoting sustainable economic development across Asia.

THEORETICAL FOUNDATION AND LITERATURE REVIEW

THEORETICAL FOUNDATION

The new classical international trade theories provide the foundation for cross-border trade and investment. First, the Heckscher-Ohlin (H-O) Model (1933) explains that a country exports goods whose production requires abundant factors and imports goods whose production requires scarce factors. Transcribed into FDI terms, capital rich countries invest in a country at a shortage of capital and obtain access to cheaper resource costs, especially low cost labor. However, it does not explain the FDI patterns of the modern era when technology and access to the market have gained equal significance. The Product Life Cycle Theory was put forward by Vernon 1966, emphasis is given to the innovation perspective of the product cycle that products undergo in their development process: introduction, growth, and maturity. Production has to be moved to developing nations during growth, where cost-cutting is necessary, and demand is increasing. In that respect, PLC theory covers the market-driven FDI, whereas the H-O model puts forth the resource-driven investment flows. The Porter Hypothesis (Porter & Linde, 1995) explains that stringent environmental regulations inspire innovation, and hence countries

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with strong sustainability policies become an attractive destination for green FDI, especially in clean technology. Ecological Modernization Theory (Mol & Spaargaren, 2000) goes even further to argue that sustainable practices and economic growth can coexist, making countries with strong sustainable energy policies more attractive to FDI by firms prioritizing environmental standards. These theories together then provide a complete understanding of the determinants of international FDI flows.

LITERATURE REVIEW

Tricahyono and Wijaya (2024) conducted an analysis of the association of FDI with economic growth, proxied by GDP, for seven ASEAN countries using panel data regression. The results affirm that economic growth positively and significantly influences FDI inflow, underlining that good GDP growth in those countries is an attraction for foreign investors. Inflation was insignificant, indicating that macroeconomic stability might not be the main determining factor in the case of ASEAN nations.

Governance, in fact, plays an important role in mitigating the negative impact of conflict on FDI. Labidi et al. (2024) investigate 54 African countries during the period 1996-2021 and report evidence of a non-linear relationship between FDI and economic growth as a function of governance quality. Their results indicated that the positive impact of FDI on growth appears only beyond a certain threshold in governance quality beyond the reach of most African economies. This therefore means that poor governance enhances the negative impacts of conflict on FDI inflows. Strengthening governance structures and institutional capacities is thus important in mitigating conflict-driven risks and creating conditions that are propitious for investment.

Faruq (2023) analyzed the economic, institutional, and political determinants of FDI inflow in 24 emerging Asian economies over a period of 17 years, from 2002 to 2018. He found that market size, trade openness, inflation, natural resources, lending rates, and capital formation were the significant economic determinants. Among the institutional variables, the business disclosure index turned out to be the only significant determinant, while political stability was found to have a strong positive influence. However, government effectiveness did not show any significant impact. It brings into light the complex nature of FDI determinants, where political stability has played a major role in the attraction of foreign capital.

Xie and Zhang (2023) focused on the interaction between FDI and environmental regulation from 2010 to 2017, utilizing a two-way fixed-effects model. From their estimations, FDI influx significantly increases PM2.5 exposure, indicating the negative environmental consequence of foreign investment when stringent regulatory mechanisms are not in place. However, the authors express the opinion that rightly developed environmental policies can stabilize these kinds of impacts thus prompting them to advise the developing nations to allow policy mixes in a bid to attain sustainability of FDI amid financial crisis post.

Saini and Singhania (2018) explored FDI determinants in both the developed and developing world while considering static and dynamic panel data models. In their results, FDI comes out positive with GDP. The per-capita income is indicative of increasing standards of living and with purchasing power increasing. It attracts higher foreign investments when the return is higher. Amri (2016) provided the linkage between FDI and renewable energy consumption on economic growth in the panel of 75 countries for the period 1990 to 2010. The study found the existence of bidirectional causality between developed nations; 1% increase in the consumption of renewable energy increased FDI by 0.185%, and on the other hand, FDI was observed to increase the consumption of renewable energy by 0.292% when

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increased by the same percent. These findings underscore the great role of renewable energy adoption on reinforcing growth dynamics between FDI and sustainable development.

In particular, the ICT infrastructure contributes a great deal to making a country internationally attractive for foreign investors, as it creates both economic openness and supports international trade. Samir and Mefteh (2020) established that the development of ICT infrastructure contributes positively to FDI in both developed and developing countries. Their study highlights that better-computerized ICT systems lower the cost of transactions and increase efficiency, welcome factors to foreign companies for desired investments in the host economies.

The relationship between ICT, FDI, and economic growth is particularly evident in the Asia-Pacific region. Sinha and Sengupta, (2019) argue that ICT infrastructure acts as a catalyst for FDI inflows, which in turn drive economic growth. Their study highlights the bidirectional relationship, where ICT advancements and FDI mutually reinforce each other to foster regional development.

In Asia, digital content accessibility and the ability to absorb technology have been shown to enhance FDI inflows. Nurainy and Adipati, (2018) identified these factors as critical drivers of FDI while noting challenges in areas like education and government ICT prioritization. These findings suggest that while ICT advancements bolster FDI attractiveness, complementary investments in education and policy alignment are necessary for maximizing ICT's impact on investment.

Apostolov, (2016) highlights a strong positive relationship between exports and FDI and between GDP and FDI in Southern Europe. The findings suggest that FDI not only fosters economic growth by enhancing GDP but also strengthens the export capacity of host countries. The mutually reinforcing nature of exports and FDI underscores the critical role of trade openness and economic stability in attracting foreign investment. By boosting production efficiency and creating a favorable environment for international trade, FDI serves as a catalyst for economic development in the region.

From an institutional perspective, research has established a significant relationship between FDI inflows and factors such as the business regulatory environment, ease of doing business, and the rule of law. A stable and transparent institutional framework fosters investor confidence by reducing uncertainties and transaction costs, thereby encouraging foreign investments (North, 1991; Kaufmann et al., 2009). Conversely, weak institutions, corruption, and bureaucratic inefficiencies can deter FDI inflows by increasing the cost and risk of doing business.

Political and governmental factors play a critical role in shaping FDI inflows. Political stability, governance effectiveness, and low levels of corruption create a conducive environment for investment by ensuring predictability and minimizing operational risks. On the other hand, political instability disrupts business operations and reduces profitability, making it a significant deterrent for foreign investors. According to Dunning and Lundan, (2008), FDI decisions are heavily influenced by the perceived risks associated with political instability in the host country. This underscores the importance of sound governance and policy frameworks in attracting FDI.

Similarly, Wang et al., (2024) examined the environmental impact of FDI from emerging and developing countries compared to that from developed countries, focusing on a 16-year period (2005–2020). Using a comprehensive dataset of 91 countries, the study employed advanced econometric techniques, including dynamic panel modeling, to analyze the relationship between FDI inflows and environmental outcomes. The findings reveal that FDI from emerging and developing countries tends to have a more detrimental impact on the environment, often leading to increased pollution and resource exploitation. This contrasts with FDI from developed countries, which is generally associated with stricter

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environmental standards and cleaner technologies. The study highlights that weaker institutional frameworks and lower regulatory standards in developing countries exacerbate the environmental degradation caused by FDI. These results underscore the need for host countries to implement robust environmental regulations and adopt sustainability-focused policies to mitigate the adverse effects of FDI from emerging markets.

Some studies highlight the role of economic growth and infrastructure in attracting FDI, others find these factors to be less significant in the presence of high trade costs or inflation volatility (Asiedu, 2006; Blonigen, 2005). The inconsistencies arise due to the dynamic and heterogeneous nature of these regions, where factors such as political risk, institutional quality, and economic conditions vary significantly over time and across countries. This underscores the need for context-specific analyses that account for the unique characteristics and changing dynamics of each region.

CONCEPTUAL FRAMEWORK

The theoretical framework and literature review integrates the interconnections between macroeconomic variables, institutional factors, sustainable environments, and FDI to explain their joint influence on economic growth presented (Figure 1). The framework is rooted in the understanding that FDI acts as a critical channel for economic development, influenced by a combination of economic, institutional, and environmental factors, consistent with prior studies (Willy, 2018; Borensztein et al., 1998; Dunning, 1980).

The independent variables are divided into two key categories: macroeconomic variables and control variables. Macroeconomic variables include economic growth, labor force participation, inflation, and infrastructure. These variables collectively represent a country's internal economic conditions that influence its ability to attract and retain FDI. Economic growth reflects market potential, labor force participation captures the availability of human capital, inflation indicates macroeconomic stability, and infrastructure highlights the readiness of physical resources to support business activities. These variables are widely regarded in the literature as primary determinants of FDI (Asiedu, 2006; Blonigen, 2005; Adejumobi, 2019).

The control variables consist of trade dynamics, institutional factors, and sustainable environment indicators. Trade dynamics, represented by trade costs and market accessibility, impact the ease of doing business and the flow of goods and capital. Institutional factors, such as governance and political stability, are critical in fostering an investor-friendly climate by reducing risks and uncertainties (Kaufmann et al., 2009; North, 1991). Sustainable environment indicators, including sustainable energy consumption, highlight the growing importance of environmental factors in shaping FDI decisions, reflecting an alignment with global sustainability goals (Porter & Linde, 1995).

The framework also emphasizes the interaction between institutions and sustainable environments. Institutional quality (e.g., governance effectiveness) moderates the impact of sustainable environmental practices on FDI inflows. For instance, countries with strong governance are more likely to successfully leverage sustainable energy initiatives to attract environmentally conscious investors, consistent with the resource-based view and institutional theories (Barney, 1991; Peng et al., 2008; Audi et al., 2021; Mohammadi, 2022).

The model hypothesizes that FDI inflows are directly influenced by the above variables. As suggested in the literature, FDI promotes economic growth by facilitating capital formation, transferring technology, and improving productivity (Alfaro et al., 2004; Borensztein et al., 1998). However, this relationship is contingent on complementary factors such as institutional quality and environmental

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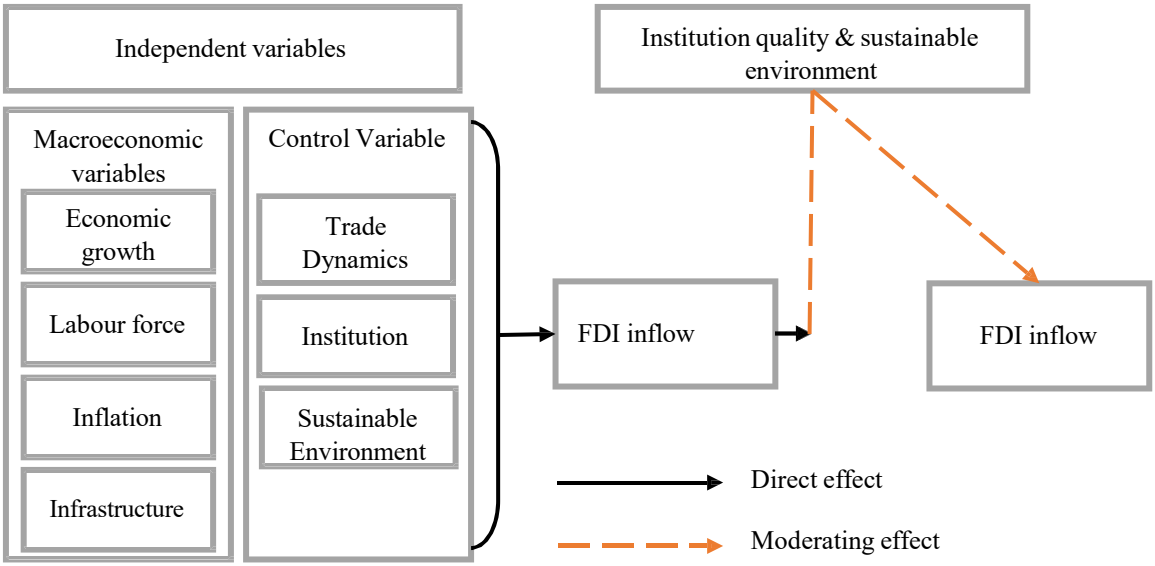
sustainability, as shown in recent studies emphasizing the need for a conducive policy environment to maximize FDI benefits (Acemoglu et al., 2012; Cole et al., 2011).

FIGURE 1: CONCEPTUAL FRAMEWORK



This theoretical framework provides a comprehensive perspective on the drivers of FDI inflows and their role in fostering economic growth, highlighting the importance of macroeconomic stability, institutional strength, and environmental sustainability. It aligns with contemporary research advocating for integrative models that capture the multidimensional nature of FDI and its broader economic implications.

LITERATURE GAP AND SIGNIFICANCE OF THE STUDY

The literature highlights that economic, institutional, political, and environmental factors significantly shape FDI inflows. Economic growth fosters FDI, particularly in ASEAN countries (Tricahyono & Wijaya, 2024), while governance quality plays a crucial moderating role, especially in regions like Africa (Labidi et al., 2024). Macroeconomic drivers such as market size, trade openness, and labor market conditions are important, though institutional factors like transparency show mixed results (Faruq, 2023). Weak environmental regulations exacerbate FDI's negative impacts, such as pollution, particularly in developing nations (Ali & Zulfiqar, 2018; Wang et al., 2024; Xie & Zhang, 2023). ICT advancements enhance FDI through improved trade efficiency (Samir & Mefteh, 2020), and political stability minimizes risks, making governance frameworks essential (Dunning & Lundan, 2008). However, FDI from emerging markets may worsen environmental degradation, necessitating sustainability-focused policies (Wang et al., 2024; Audi et al., 2025). While institutional quality and environmental sustainability are critical determinants of FDI, their impacts vary across contexts, with robust institutions and green policies sometimes overshadowed by economic priorities or lax regulation. This study addresses these complexities by focusing on institutional and environmental factors' moderating roles in Asian FDI, leveraging the region's diversity to explore nuanced dynamics (Zhu et al., 2016). Employing quantile estimation, the study captures heterogeneity across FDI levels and uses fixed-effects and random-effects models for robustness, offering comprehensive insights into FDI dynamics.

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METHODOLOGY

DATA SOURCE

This study analyzes the determinants of FDI inflows in 34 Asian countries (listed in Table A1, Appendix) over the period from 2000 to 2021. The determinants split into three categories: high income, upper middle income and lower middle income group. Using data from secondary sources (WDI, WGI and UNCTAD), the analysis investigates the relationships between FDI inflows and a range of macroeconomic, trade, institutional, and environmental factors. The macroeconomic variables include GDP growth (G_t), labor force participation (F_t), inflation rate (NF_t), and infrastructure (E_t). Trade and market dynamics are represented by trade costs (C_t). Institutional factors are captured through governance (G_t). Environmental considerations are incorporated through sustainable energy consumption ($ENERG_t$). It expresses as a Sustainability and efficiency of power sources (combination of indicators that reflect the availability, accessibility, and use of energy). The detail definition and source of each proxy variable listed in Appendix -Table A2. Additionally, the interaction term ($ENERG \times G_t$) examines the moderating role of governance effectiveness on the relationship between sustainable energy consumption and FDI inflows.

MODEL SPECIFICATION

The study employs a comprehensive econometric model to investigate the determinants of foreign direct investment ( ) inflows in 34 Asian countries over the period 2000 to 2021. The model incorporates key macroeconomic, trade, institutional, and environmental variables, along with an interaction term to explore the moderating role of governance. The functional form of the model is expressed as follows:

$$FD_t = (G_t, F_t, C_t, NF_t, E_t, ENERG_t, G_t, ENERG \times G_t) \quad (1)$$

where

i	number of cross-sections
t	time period
	Foreign Direct Investment
	Gross Domestic Product growth (annual %) is the proxy of economic growth
	Labour force participation
	Fixed Telephone Subscriptions is the proxy of infrastructure
	Sustainable energy consumption
	Political Stability and absence of violence is the proxy of institution quality
$ENERG \times G_t$	Interaction term of $ENERG_t$ and G_t measure the moderating role of institution quality in developing sustainability energy consumption

This study begins by conducting diagnostic tests to ensure the reliability and validity of the model. Tests for cross-sectional dependence, heteroskedasticity, stationarity, and cointegration are performed to address potential econometric issues and align with best practices in panel data analysis. Following the diagnostic phase, panel quantile regression is employed to examine how the effects of various determinants on FDI inflows vary across different levels of FDI (quantiles 0.25 to 0.90). This approach accounts for the heterogeneity among countries with low, medium, and high FDI inflows, providing a nuanced understanding of these relationships.

To ensure robustness, fixed-effects and random-effects models are applied, addressing unobserved heterogeneity across countries. The Hausman (1978) test is used to determine the appropriate model specification, ensuring consistent and efficient estimation. This combination of

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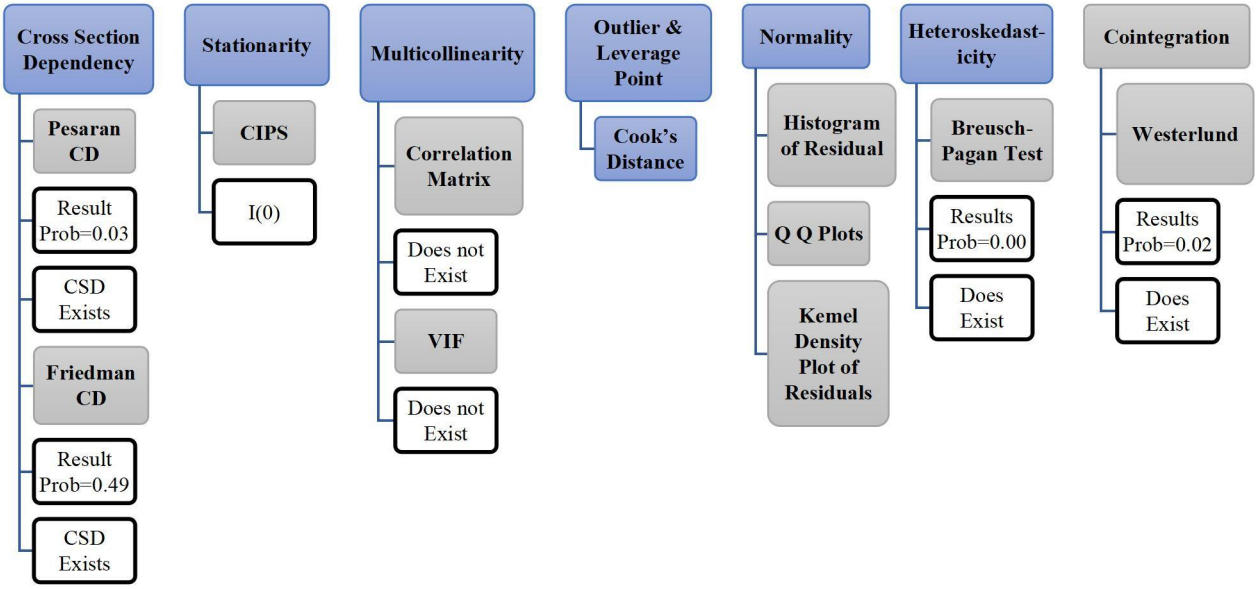
diagnostic tests, quantile regression, and robustness checks provides a comprehensive methodological framework to capture the complex and multifaceted determinants of FDI inflows in Asian economies.

DIAGNOSTICS TEST

Diagnostic tests are crucial in panel data analysis to ensure reliable results by addressing cross-sectional dependence, stationarity, multicollinearity, outliers, normality, heteroskedasticity, and cointegration. Cross-sectional dependence, common in interconnected regional studies, is tested using Pesaran's CD and Friedman's tests, as ignoring it can lead to biased estimates (De Hoyos & Sarafidis, 2006; Pesaran, 2004). Stationarity is checked with the CIPS test to prevent spurious results (Phillips & Perron, 1988). Multicollinearity, which distorts coefficients, is assessed via the Variance Inflation Factor (VIF) and correlation matrices. Outliers, identified using Cook's Distance, and normality, evaluated through Q-Q plots and kernel density analysis, ensure the validity of regression results. Heteroskedasticity, tested with the Breusch-Pagan Test, addresses non-constant variance, while the Westerlund Cointegration Test confirms long-run relationships between variables, accommodating cross-sectional dependence. These comprehensive diagnostics enhance robustness and interpretability in econometric modeling.

FIGURE 2: DIAGNOSTIC TEST



MODEL ESTIMATION STRATEGY

QUANTILE REGRESSION FOR PANEL DATA

Quantile regression, introduced by Koenker and Bassett, (1978), is a robust alternative to mean regression models. It estimates conditional quantiles of the dependent variable, enabling an analysis of how the effects of covariates differ across the distribution of this is particularly relevant when:

1. Relationships between variables vary across different levels of .
2. Data exhibit heteroskedasticity or outliers, which can distort mean-based estimates.
3. Quantile regression mitigates issues with outliers and provides a more comprehensive analysis as our data set uses Asain countries having different income group: high income, upper middle income, and lower middle income.

The quantile regression model for panel data is given as:

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$$(\quad) = |+ \quad + \qquad (2)$$

Where:

$\tau(t \quad t)$ τ-th quantile of t conditional on t

Intercept for quantile τ

Quantile-specific coefficients for the independent variables.

ϵ_t Quantile-specific error term

Quantile regression minimizes the sum of absolute residuals weighted by the quantile

$$e \sum_{,t} \quad (t - - \quad) \qquad (3)$$

Where $() = \quad -[\tau - [I(u < 0 \quad$ is the quantile loss function.

The following Equation 3 broadly explain the structure of our empirical models, which will be estimated, using combinations of macroeconomic and control variables in order to achieve the proposed study objective.

$$(\quad) = + 1 \quad + 2 \quad + 3 \quad + 4 \quad + 5 \quad + \\ {}_6ENERG_t \; {}_7G_t + {}_8ENERG \times G_t + {}_t \qquad (4)$$

where

τ τ-th quantile

Foreign Direct Investment

Gross Domestic Product growth (annual %) is the proxy of economic growth

Labour force participation

Fixed Telephone Subscriptions is the proxy of infrastructure

Sustainable energy consumption

Political Stability and absence of violence is the proxy of institution quality

$ENERG \times G_t$ Interaction term of $ENERG_t$ and G_t measure the moderating role of institution quality in developing sustainability energy consumption

This functional form (Equation 4) enables the study to explore the relative importance of macroeconomic indicators, trade dynamics, institutional factors, environmental variables, and their interactions in shaping FDI inflows.

ESTIMATION AND MODEL JUSTIFICATION

Quantile regression is employed in this study to address several critical aspects of inflows. First, it accounts for the heterogeneity in inflows across countries and over time. Unlike traditional mean-based regression models such as Ordinary Least Squares (OLS), which estimate average relationships, quantile regression captures variations across different points in the distribution (e.g., 0.25, 0.50, 0.75, 0.90). This approach recognizes that low-FDI-receiving countries may face constraints such as inadequate infrastructure, while high-FDI-receiving countries may grapple with governance challenges, providing a more detailed understanding of how explanatory variables influence countries at different levels of inflows. Second, quantile regression is robust to outliers, which are common in data as some countries experience exceptionally high or low inflows. By focusing on conditional quantiles rather than the conditional mean, quantile regression ensures that results are not unduly influenced by extreme values. Third, this approach enables policymakers to derive tailored insights across the distribution. For instance, policy recommendations for countries in the lower quantiles may focus on addressing basic structural issues, while those for higher quantiles might prioritize refining governance and institutional frameworks. Lastly, quantile regression captures the non-uniform impact of explanatory variables, recognizing that factors like infrastructure improvements might have substantial effects on

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in lower quantiles but exhibit diminishing returns in higher quantiles where infrastructure is already well-developed. By addressing these nuances, quantile regression provides a comprehensive and flexible framework for understanding the determinants of inflows. In addition to the quantile regression, both fixed-effects and random-effects models are applied as part of the robustness checks.

EMPIRICAL RESULTS

DESCRIPTIVE STATISTICS

The descriptive analysis provides an overview of the key variables used in the study (Table 1), offering insights into their distribution, central tendencies, and variability. The results indicate that FDI inflows ( ) have a mean value of 5.025 but exhibit significant positive skewness (3.078) and high kurtosis (16.708), suggesting the presence of extreme outliers. GDP growth ( ) has a mean of 4.896, with negative skewness (-0.920) and high kurtosis (24.475), reflecting instances of extreme economic contractions or expansions across countries. Labor force participation ( ) demonstrates a relatively stable mean of 68.052 and moderate variability, while trade costs ( ) and infrastructure ( ) show positive skewness, indicating that a few countries face exceptionally high trade costs and have more developed infrastructure compared to the majority.

TABLE 1: DESCRIPTIVE STATISTICS

Variables	N	Mean	Skewness	Kurtosis	Median	SD	Min.	Max.	IQR
FDI_{it}	748	5.025	3.078	16.708	2.796	7.468	-27.06	58.519	4.735
YG_{it}	748	4.896	-0.92	24.475	5.297	5.904	-54.24	41.745	4.579
LFP_{it}	748	68.052	-0.294	2.497	69.265	10.761	40.13	88.13	15.815
TC_{it}	748	1.495	1.808	8.18	1.211	0.987	0.226	8.435	1.038
INF_{it}	748	5.456	3.091	20.915	4.087	6.111	-5.153	59.74	5.706
TEL_{it}	748	11.831	1.837	5.888	6.637	13.801	0.142	61.153	13.445
$ENERGY_{it}$	748	52.626	0.128	2.15	51.882	19.556	13.383	99.629	31.239
GPS_{it}	748	-0.155	-0.205	2.257	-0.167	0.951	-2.81	1.599	1.514

Source: Authors' calculations

Inflation ( ) and governance effectiveness ( ) also show notable variation, with inflation displaying high positive skewness (3.091) and kurtosis (20.915), driven by outlier events such as hyperinflation or deflation. Sustainable energy consumption ( ), with a mean of 52.626, exhibits a relatively normal distribution, highlighting a balanced adoption of sustainable practices across countries. The descriptive statistics underscore the heterogeneity in the dataset, emphasizing the importance of using robust econometric methods, such as quantile regression, to account for varying impacts across countries and address potential outliers. These insights set the stage for deeper analysis of the determinants of FDI inflows and their relationship with macroeconomic, institutional, and environmental factors.

DIAGNOSTICS TEST RESULTS

The diagnostic tests conducted in this study provide key insights into the characteristics of the dataset, ensuring the reliability and robustness of the econometric analysis. When checking the Cross-sectional dependence, it is find that Pesaran CD test yielded a p-value of 0.03, while the Friedman CD test reported a p-value of 0.49, both indicating the presence of cross-sectional dependency among the panel countries. The existence of cross-sectional dependence suggests that the countries in the dataset are interconnected, likely due to shared global or regional factors such as trade, economic policies, or

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environmental regulations. Ignoring CSD may lead to biased estimates. Quantile regression is not inherently sensitive to cross-sectional dependency since it focuses on the conditional quantiles of the dependent variable. However, acknowledging CSD ensures that results are interpreted considering the interconnectedness among entities.

CIPS (Cross-Sectionally Augmented IPS) revealed that the variables are found to be a stationary at I(0) (Table 2) indicating that variables exhibit time-invariant properties.

TABLE 2: CROSS-SECTIONALLY AUGMENTED IPS TEST

Variable	level I(0)	level I(1)
$FDIW_{it}$	-3.085***	-5.416***
YG_{it}	-2.988***	-5.086***
LFP_{it}	-1.888***	-2.793***
TC_{it}	-1.329***	-3.542***
INF_{it}	-2.996***	-4.753***
TEL_{it}	-2.117***	-3.654***
$ENERGY_{it}$	-2.645***	-5.129***
GPS_{it}	-2.546***	-4.186 ***

Source: Authors' Estimates

Quantile regression does not require strict assumptions about stationarity, unlike traditional time-series methods. This makes it suitable for exploring relationships in heterogeneous panel data. Correlation Matrix and Variance Inflation Factor (VIF) both tests indicate that multicollinearity does not exist among the independent. The absence of multicollinearity ensures that the independent variables are not highly correlated, providing more reliable coefficient estimates and enhancing model interpretability.

Cook's Distance observations with significant leverage were identified but did not heavily distort the model results. The identification of outliers allows for a better understanding of influential data points, ensuring that these do not disproportionately impact model outcomes. In our data set since there is three categories of income group, the outlier in our data set are: Azerbaijan, Fiji, Hong Kong SAR, China, Macao SAR, China, Maldives, Myanmar, Singapore, Solomon Islands and Turkmenistan. Quantile is an ideal method for handling datasets with leverage points while ensuring reliable parameter estimates. Moreover, quantile with .25, .50 and .75 help us to estimate the equation along with these outlier.

Histogram, Q-Q Plot, and Kernel Density Plot used to check the normality presented in Figure 3. The residuals deviate slightly from a perfect normal distribution, as shown by slight deviations in the Q-Q plot and Kernel Density plot (Figure 3). Mild deviations from normality are typical in large datasets, especially those involving economic variables, and do not critically impact regression outcomes. Quantile regression does not rely on the assumption of normality for residuals, making it a robust method for analyzing data with non-normal distributions.

Breusch-Pagan Test p-value is 0.00, indicating the presence of heteroskedasticity in the dataset. Quantile regression is inherently robust to heteroskedasticity as it estimates conditional quantiles rather than assuming constant variance across all observations.

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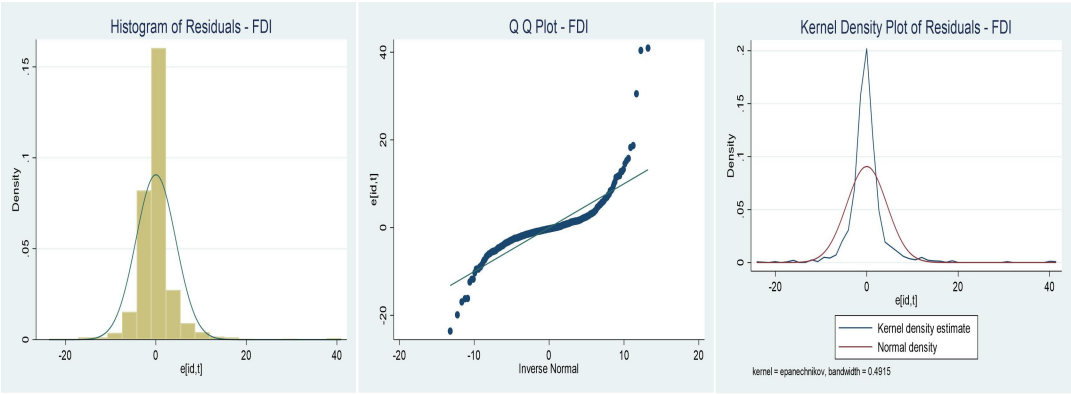
FIGURE 3: NORMALITY TEST



The p-value of 0.02 of Westerlund test indicates the presence of cointegration among variables. It confirms a long-term equilibrium relationship between the dependent and independent variables, even if the variables are non-stationary. The presence of cointegration ensures that quantile regression captures meaningful and stable relationships across different levels of the dependent variable, making it suitable for analyzing long-term economic relationships.

ESTIMATION RESULTS AND ROBUSTNESS CHECK

The estimation results, presented in Table 3, provide a detailed analysis of the determinants of foreign direct investment ( ) inflows using quantile regression across the 25th, 50th, 75th, and 90th quantiles. The results highlight how the effects of explanatory variables vary across different levels of FDI inflows. Additionally, fixed and random effects models are applied as robustness checks, with the Hausman test guiding model selection to validate the consistency of the results.

The quantile regression results reveal substantial heterogeneity in the determinants of across different quantiles of the FDI distribution:

GDP GROWTH ( )

has a consistently positive and significant effect on FDI inflows across all quantiles, but its impact diminishes as we move from the lower to higher quantiles. For example, the coefficient decreases from 0.195 at the 50th quantile to 0.098 at the 90th quantile. This suggests that while economic growth is a strong determinant for low- and medium-FDI-receiving countries, its importance decreases for high-FDI-receiving nations where other factors may dominate (Dunning, 1980).

LABOR FORCE PARTICIPATION ( )

shows an increasing positive impact on FDI as we move to higher quantiles, indicating that countries with higher FDI inflows benefit more from an active labor force. The coefficient rises from 0.0249 at the 25th quantile to 0.189 at the 90th quantile, consistent with the argument that skilled and available labor pools are essential for attracting FDI (Borensztein et al., 1998) .

TRADE COSTS ( )

has a consistently negative and significant impact across all quantiles, with its effect becoming more pronounced at higher quantiles. The coefficient ranges from -0.850 at the 25th quantile to -1.788 at the 90th quantile. This reflects that trade cost reduction is especially critical for high-FDI-receiving countries to maintain their competitive advantage.

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TABLE 3: QUANTILE REGRESSION ESTIMATION

	Quantile Estimation				Fixed and Random Effect	
	0.25q	0.50q	0.75q	0.90q	FE	RE
YG_{it}	0.141***	0.195***	0.159***	0.0982	0.225***	0.224***
	(0.0171)	(0.0364)	(0.0461)	(0.0871)	(0.0307)	(0.0308)
LFP_{it}	0.0249**	0.0259	0.0634**	0.189***	0.277***	0.178***
	(0.00968)	(0.0206)	(0.0261)	(0.0493)	(0.0638)	(0.0440)
TC_{it}	-0.850***	-1.219***	-1.436***	-1.788***	-1.025***	-1.286***
	(0.112)	(0.239)	(0.302)	(0.571)	(0.348)	(0.317)
INF_{it}	0.0111	0.0478	0.00597	-0.0140	-0.00238	0.00311
	(0.0175)	(0.0372)	(0.0471)	(0.0890)	(0.0341)	(0.0339)
TEL_{it}	0.0132	0.0390	0.240***	0.445***	0.0677	0.108***
	(0.0126)	(0.0268)	(0.0339)	(0.0641)	(0.0500)	(0.0376)
$ENERGY_{it}$	0.0337***	0.0267	0.0203	-0.0307	0.0784**	0.0779***
	(0.00870)	(0.0185)	(0.0234)	(0.0442)	(0.0333)	(0.0268)
GPS_{it}	-0.202	-1.067	-3.430***	-2.500	-0.426	-1.206
	(0.332)	(0.706)	(0.894)	(1.690)	(1.141)	(0.995)
$ENERGY_{it} \times GPS_{it}$	-0.000848	0.0243*	0.0861***	0.0526*	0.00254	0.0184
	(0.00621)	(0.0132)	(0.0167)	(0.0316)	(0.0211)	(0.0183)
Constant	-1.522*	0.0146	-0.460	-3.424	-18.37***	-11.86***
	(0.891)	(1.895)	(2.398)	(4.533)	(5.161)	(3.568)
Observations	748	748	748	748	748	748
Number of id	34	34	34	34	34	34
Pseudo R^2 / R-squared	0.1003	0.1362	0.2610	0.3890	0.112	0.105

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

INFRASTRUCTURE ( )

Infrastructure ( ) is insignificant at lower quantiles but becomes a significant and strong determinant at higher quantiles, with the coefficient increasing from 0.013 at the 25th quantile to 0.445 at the 90th quantile. This suggests that advanced infrastructure plays a vital role in attracting higher levels of FDI.

SUSTAINABLE ENERGY ( )

The analysis reveals that sustainable energy consumption has a positive and significant impact on foreign direct investment ( ) inflows across most quantiles. This underscores the increasing importance of sustainable energy policies in attracting environmentally conscious investors. Countries that prioritize renewable energy sources and demonstrate a commitment to environmental sustainability are more likely to appeal to investors seeking to align their portfolios with global sustainability goals. This trend

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reflects a broader shift in investment strategies, where environmental considerations are becoming integral to decision-making processes.

GOVERNANCE ( )

Governance effectiveness exhibits a negative and significant effect on FDI inflows at higher quantiles, particularly at the 75th and 90th percentiles. This suggests that in countries receiving substantial , governance factors may influence investment through more indirect or nuanced channels. It is possible that in these contexts, investors prioritize other factors such as market size, economic growth, or sector-specific opportunities over governance metrics. Alternatively, high levels of might lead to complacency in governance reforms, as the immediate economic benefits overshadow the perceived need for institutional improvements.

INTERACTION TERM ($ENERG \times G_t$)

The interaction between sustainable energy consumption and governance effectiveness use as moderating role of effective governance in developing sustainable energy consumption to check whether it helps in FD_t inflow in Asain economies or not. The study found that $ENERG \times G_t$ significant and positive across most quantiles, with its effect becoming more pronounced in the middle and upper quantiles. This indicates that effective governance enhances the positive impact of sustainable energy policies on FDI inflows. In other words, the combination of strong institutional frameworks and a commitment to renewable energy creates a conducive environment for attracting foreign investment. This finding aligns with the Porter Hypothesis, which posits that stringent environmental regulations, when coupled with effective governance, can stimulate innovation and attract investment by creating a stable and predictable business environment.

A study by Abbas et al., (2021) examines the role of foreign direct investment interaction with energy consumption and institutional governance in sustainable greenhouse gas emission reduction. The findings suggest that the interplay between FDI, energy consumption, and governance quality significantly influences environmental outcomes, highlighting the importance of integrated policy approaches (Abbas et al., 2021). These studies reinforce the notion that sustainable energy policies, when supported by effective governance, play a pivotal role in attracting FDI and promoting sustainable development.

VISUALIZATION OF QUANTILE EFFECTS

Figure 4 provides a visual representation of the quantile regression results which shows varying impacts of each determinant across different quantiles of inflows. The plots for , , and show upward trends. It reveals increasing importance at higher quantiles. exhibits a downward trend which reflects stronger negative impact as inflows increase. The moderating role of institutional quality and sustainable energy consumption also demonstrate their increasing significance at higher quantiles, reinforcing the importance of sustainable energy policies combined with effective governance in attracting substantial inflows.

ROBUSTNESS CHECK

The results of fixed and random effects models (Appendix - Table A3) confirm the validity of the quantile regression results. The fixed-effects model reveals consistent relationships between the key variables and FDI inflows. The random-effects model provides similar results that are robust to alternative estimation techniques. and significantly and positively influence FDI inflows across both models. The trade cost ( ) negatively impacts FDI, highlighting the deterrent effect of high trade barriers. is significant only in the random-effects model, and positively affects FDI in

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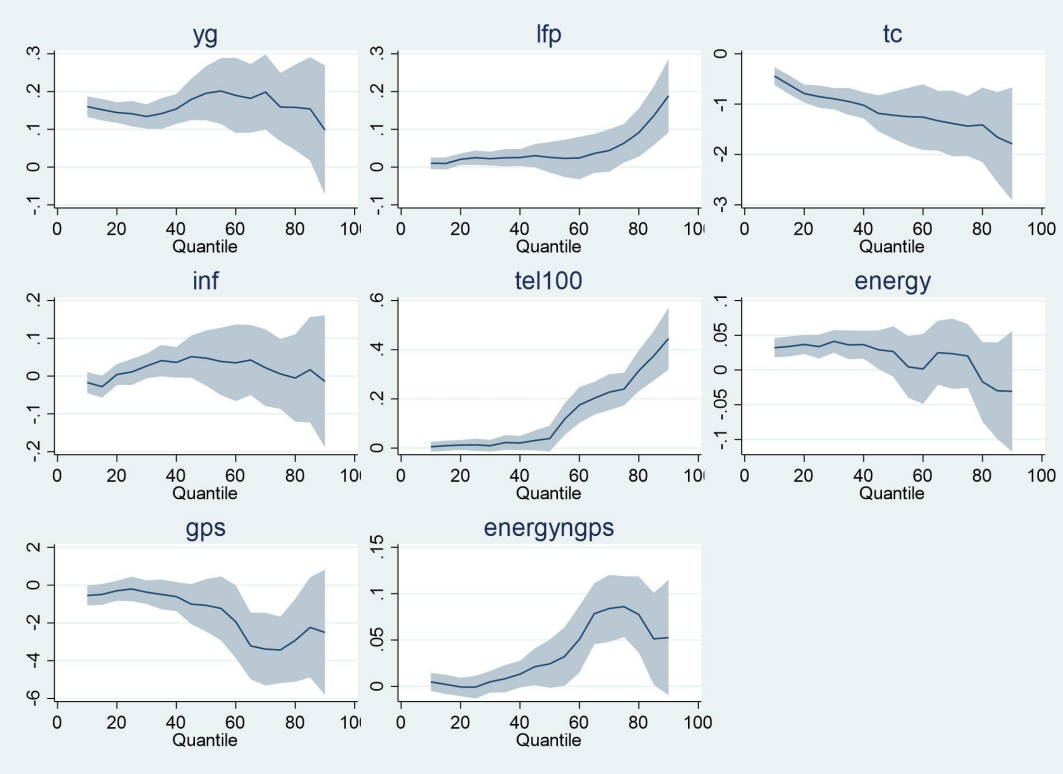
both models. remains insignificant, aligning with quantile results that macroeconomic stability may not heavily influence FDI decisions.

FIGURE 4: QUANTILE PLOTS



Governance effectiveness (G_t) and its interaction with energy ($ENERG \times G_t$) are insignificant in both models, reflecting mixed results in the quantile analysis regarding institutional quality's role in attracting FDI. These results corroborate the quantile regression analysis, underscoring the importance of economic growth, labor force, trade openness, and sustainability in influencing FDI inflows.

CONCLUSIONS

The paper provides a holistic analysis of the drivers of FDI inflows within a panel of 34 Asian countries for the period covering 2000-2021. Economic growth, labor force participation, trade costs, sustainable energy consumption, and infrastructure emerged as key determinants of FDI inflows. GDP growth and labor force participation positively and consistently contribute to making conditions favorable for foreign investment. Similarly, trade cost becomes a significant barrier and introduces the aspect of facilitation in trade and openness of market. The use of sustainable energy becomes crucial for the countries to attract more green investors into the country. In the aspect of governance effectiveness and its interactions with sustainable energy, on the other hand, produces mixed results and indicates that the quality of institutions influence FDI dynamics a lot more complexly. Additionally, it points to significant heterogeneity of FDI determinants across quantiles, or heterogeneous effects for the low, median, and high FDI-receiving countries.

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In this respect, Asian policymakers should adopt multi-faceted approaches to attract and retain FDI. First, sound fiscal and monetary policies that promote economic growth are essential in creating an investor-friendly environment. Second, labor market reforms to improve workforce participation and skills development are necessary to enhance human capital attractiveness. Third, easier customs procedures and enhancement of regional trade agreements may effectively cut the cost of trade and facilitate market access for foreign investors. Fourth, governments should give priority to investments in infrastructure and sustainable energy projects that meet global standards for sustainability in order to attract green FDI. Finally, reforms to the institution that will improve the quality of governance, transparency, and political stability are needed. These reforms not only reduce risks for investors but also enhance the moderating effect of governance on sustainable energy policies, thus creating an enabling environment for FDI inflows that also accords with long-term economic and environmental goals.

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APPENDIX I

TABLE A1 ASIAN COUNTRY LIST

Lower Middle Income		Upper Middle Income	High Income
Bangladesh	Papua New Guinea	Azerbaijan	Brunei Darussalam
Bhutan	Philippines	China	Hong Kong SAR, China
Cambodia	Samoa	Fiji	Japan
India	Solomon Islands	Kazakhstan	Macao SAR, China
Indonesia	Sri Lanka	Malaysia	
Kyrgyz Republic	Tajikistan	Maldives	
Lao PDR	Timor-Leste	Thailand	
Myanmar	Uzbekistan	Tonga	
Nepal	Vanuatu	Turkmenistan	
Pakistan	Vietnam		

TABLE A2: VARIABLES SUMMARY AND DEFINITION

Factors	Abbreviation	Proxy / Variable Description	Source
Foreign Investment	FDIW	Foreign direct investment, net inflows (% of GDP), (World Bank - WDI, 2022)	WDI
Economic growth	YG	GDP growth (annual percentage)	WDI
labour force	LFP	Labor force participation rate, total (% of total population ages 15+) (modeled ILO estimate)	WDI
Trade & Market Dynamics	TC	Inverse of (exports + imports)/GDP. Data are in constant 2015 US$ (World Bank—WDI, 2022)	WDI
Inflation	INF	Inflation, consumer prices (annual %), (World Bank - WDI, 2022)	WDI
Infrastructure	TEL	Fixed Telephone Subscriptions (per 100 people)	WDI
Sustainable Energy Consumption	ENERGY	Sustainability and efficiency of power sources (combination of indicators that reflect the availability, accessibility, and use of energy) i. Access to Electricity (percentage of population) ii. Renewable Energy Consumption (percentage of total final energy consumption) iii. Electricity Production from Renewable Sources (excluding hydro, percentage of total) iv. Energy Intensity (megajoules per GDP constant 2017 US$) v. CO_2 Emissions from Electricity and Heat Production (kg per 2017 PPP $ of GDP) vi. Electricity Transmission and Distribution Losses (percentage of output)	UNCTAD

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Institution Quality	GPS	Political Violence/Terrorism: Estimate	Stability	and	Absence	of	WGI

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Table A3: Robust check – FIXED and Random Effect

Variables	Fixed	Random
YG_{it}	0.225***	0.224***
	(0.0307)	(0.0308)
LFP_{it}	0.277***	0.178***
	(0.0638)	(0.0440)
TC_{it}	-1.025***	-1.286***
	(0.348)	(0.317)
INF_{it}	-0.00238	0.00311
	(0.0341)	(0.0339)
TEL_{it}	0.0677	0.108***
	(0.0500)	(0.0376)
$ENERGY_{it}$	0.0784**	0.0779***
	(0.0333)	(0.0268)
GPS_{it}	-0.426	-1.206
	(1.141)	(0.995)
$ENERGY_{it} \times GPS_{it}$	0.00254	0.0184
	(0.0211)	(0.0183)
Constant	-18.37***	-11.86***
	(5.161)	(3.568)
Observations	748	748
R-squared	0.112	0.105
Number of id	34	34