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The Relationship Between Foreign Direct Investment, Human Development, and Economic Growth in Vietnam: A Quantile-on-Quantile Regression Approach

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ABSTRACT

This study examines the dynamic interactions between Foreign Direct Investment (FDI), human development, and economic growth in Vietnam from 1990 to 2022. Employing Quantile-on-Quantile Regression (QQR) and Granger causality analysis in quantiles, the research explores the reciprocal links among FDI, the Human Development Index (HDI), and GDP, aiming to understand their interdependent effects across different economic contexts. The results reveal that FDI has a significantly positive impact on GDP growth across the 0.55–0.7 quantiles and enhances HDI within the low to middle range (0.05–0.5), underscoring the role of foreign investment in promoting economic and social development in Vietnam. In turn, HDI positively influences both FDI and GDP, particularly within the 0.05–0.7 interval, highlighting the importance of human capital in attracting investment and sustaining growth. Moreover, GDP growth positively affects FDI and HDI at early to intermediate distribution levels (0.3–0.6 and 0.05–0.65, respectively), but the effect turns negative at higher quantiles, indicating diminishing developmental returns in Vietnam's later stages of economic transition. These findings suggest that policymakers should adopt targeted strategies to strengthen human capital, attract high-quality FDI aligned with development goals, and ensure that economic growth leads to broad-based improvements in human development, fostering balanced and sustainable progress.

1. INTRODUCTION

In globalization and comprehensive societal development, FDI, human development, and economic growth have become focal keywords, attracting special attention from researchers, policymakers, and national governments. The relationship between these macroeconomic factors is not only a significant question for researchers but also poses challenges for policymakers in seeking pathways for sustainable development, both economically and socially, two crucial elements playing pivotal roles in driving national breakthroughs in the modern era.

Most studies across various countries have demonstrated a positive relationship between FDI and economic growth, along with improvements in human development due to enhancements in education, health, and living standards. Analyses from different countries, including studies by Ozturk and Suluk [1] in Norway and Taqi et al. [2] in Pakistan, have shown that FDI contributes to GDP growth and elevating social standards and human development. While studies like Srivastava and Talwar [3] indicate a positive relationship between HDI, FDI, and GDP across a group of 30 countries from 1990 to 2016, other studies such as Hamdi and Hakimi [4] in the Middle East and North Africa region suggest that both foreign and domestic investments significantly influence human development in the short and long term. However, the relationship between these factors is not always straightforward or unidirectional. In the ASEAN context, the study by Kaukab and Surwandono [5] also highlights that while GDP might negatively impact HDI, FDI helps improve HDI. Similarly, Triatmanto et al. [6] point out that while FDI has a significantly positive relationship with GDP in ASEAN countries, GDP has a negative relationship with variables related to education and health.

Within globalization, Vietnam has witnessed significant growth in FDI and continuous socio-economic development. From 1990 to 2022, the FDI-to-GDP ratio increased from 5.1% to 8.12%, indicating strong and stable growth over nearly three decades [7]. Simultaneously, the HDI increased from 0.492 to 0.726, reflecting significant improvements in education, health, and living conditions for the people of Vietnam [8]. The GDP also saw positive changes, with an average annual growth rate of about 4 to 5%, peaking at 11.94% in 1994 [7]. However, with economic, political, social, and pandemic fluctuations affecting global and Vietnamese economic growth, the subsequent period stabilized Vietnam's economic growth at over 4% in recent years. The significant increase in FDI has been demonstrated not only to promote economic growth but also to have the potential to significantly improve the HDI through enhancing the quality of education, health, and living conditions. However, alongside the apparent benefits, over-reliance on FDI can also bring challenges, such

as instability due to fluctuations in foreign capital flows and uneven distribution of economic and social benefits across regions and social strata.

Although the relationships between FDI, HDI, and GDP have been explored in prior studies, existing literature examines these variables either in isolation or through pairwise associations, often relying on linear estimation techniques. Moreover, limited attention has been given to the complex and potentially nonlinear interactions among FDI, HDI, and GDP within the specific context of Vietnam, a rapidly developing economy undergoing significant structural and institutional transformation. This lack of comprehensive, multidimensional, and context-specific analysis represents a notable gap in the literature. This study investigates the dynamic interrelationships among FDI, HDI, and GDP in Vietnam to address this gap by employing QQR and Granger causality testing across quantiles. This methodological approach allows for a more nuanced understanding of how these variables influence each other across the entire conditional distribution, capturing heterogeneous effects that conventional models may overlook.

The contributions of this research are threefold. First, it fills a substantial gap in the literature by examining the tri-variate nexus of FDI, HDI, and GDP in a developing country context using appropriate and rigorous econometric techniques. Second, it introduces a novel analytical framework that accounts for distributional asymmetries, offering deeper empirical insights. Third, the empirical findings provide policy-relevant insights that can support the formulation of more effective development strategies in Vietnam and other emerging economies sharing comparable structural and economic characteristics.

2. THEORETICAL FRAMEWORK AND EMPIRICAL RESEARCH

2.1 Theoretical framework

FDI involves investing from a company or individual in one country into business interests in another, typically through acquiring a lasting interest and control over a foreign enterprise [9]. FDI significantly impacts human development and economic growth, serving as a conduit for financial resources, technology transfer, and managerial skills enhancement. Foreign investors influence management practices and strategic directions by investing in businesses across borders, often with a controlling stake. This investment typically transfers monetary capital, technology, and expertise [10]. This dynamic fosters better education through training programs, improves healthcare through advanced medical technology, and enhances working conditions by introducing international labor standards [11], ultimately promoting economic and social development in the host countries.

Building on this, the improvements catalyzed by FDI are crucial in enhancing the HDI, which assesses essential aspects of human development, such as life expectancy, education levels, and quality of life [12]. Developed by the UNDP, HDI is a comprehensive tool that evaluates national income and focuses on three fundamental dimensions: health/life expectancy, educational level, and standard of living. Designed to broaden individual choices, HDI reflects a more holistic view of a country's development beyond mere economic growth [13]. The index is derived from indicators including average life expectancy at birth, expected years of schooling for children, and per capita income adjusted for purchasing power parity. It ranges from 0 to 1, where higher values indicate better human development. Based on their HDI, countries are categorized into four levels: very high, high, medium, and low. This metric is valuable for policymakers and researchers to evaluate human potential and develop policies that promote sustainable socio-economic development, ensuring a balanced economic, social, and health progression.

Continuing the exploration of the interconnected roles of FDI and HDI, it is imperative to focus on economic growth, a fundamental measure of a nation's economic health, with various scholars defining it as an increase in per capita income or total social product over time. The World Bank [14] views it as the augmentation of the total social product relative to the population, while Nafziger [15] describes it as an increase in per capita income. This growth is crucial for evaluating improvements in living standards and overall economic prosperity.

The theoretical frameworks explaining economic growth have evolved from classical to modern models. Classical economists like Smith [16] and Ricardo [17] focused on accumulating capital, land, and labor as primary growth drivers. In contrast, modern growth theories introduced by Romer [18] and Lucas [19] highlight the significance of knowledge, innovation, and human capital. Lucas's endogenous growth models, particularly investments in education and training, crucially enhance labor quality and productivity, propelling sustainable economic development.

In the context of globalization, FDI has emerged as a pivotal element in this growth narrative. FDI facilitates economic expansion by enabling capital accumulation and technology transfer, as De Mello [20] and Herzer and Klasen [21] noted. Additionally, the HDI, integrating health, education, and income indicators, offers a broader perspective on development than GDP alone. Studies suggest that improvements in HDI, which signal better health and education outcomes, enhance labor productivity and facilitation, thereby driving economic growth. Simultaneously, FDI enhances HDI by improving services in health and education, health and education services, and development through a more skilled and healthier workforce. This interaction underscores the complex relationship between FDI, human development, and economic growth, necessitating further exploration to fully understand these dynamics and their implications.

2.2 Empirical research

In recent decades, the relationship between capital, human development, and economic growth has garnered global attention from researchers. Studying these factors, not only individually but also in conjunction with other economic and social elements, has opened up deep insights into how nations can optimize resources to promote economic development. Attention has mainly been focused on exploring the impacts of FDI and human development on macroeconomic indicators, such as economic growth (often represented by GDP variables).

a) Foreign direct investment and human development

Several studies have consistently demonstrated a positive relationship between FDI and human development. Kaukab and Surwandono [5] found that FDI significantly enhanced the

HDI in ASEAN countries, with average HDI levels from 2013 to 2017. Similarly, Hamdi and Hakimi [4], using VECM analysis for the MENA region from 2002 to 2015, confirmed that foreign and domestic investments significantly impacted human development in the short and long term. Supporting this general trend, Djokoto and Wongnaa [22] revealed that FDI contributed positively to human development across developing economies between 1990 and 2019.

Contrary to the prevailing evidence supporting a positive relationship between FDI and human development, several studies have reported insignificant or context-specific effects. Nam and Ryu [23], in their analysis of ten ASEAN countries from 2001 to 2020, found that FDI did not significantly enhance human development, as measured through key indicators such as healthcare, education, and income. Meanwhile, Abdouli and Omri [24] identified bidirectional causality in most cases in Mediterranean countries; the direction of influence varied by region, with some subgroups exhibiting only unidirectional effects. Similarly, Srivastava and Talwar [3] reported no statistically significant impact of FDI on HDI, nor vice versa, across 30 countries with notable HDI improvements between 2012 and 2017. These contrasting findings underscore the heterogeneity of the FDI–HDI nexus and suggest that the impact of FDI on human development may depend heavily on country-specific institutional, structural, and policy conditions.

Based on the above discussion, the authors develop the following hypothesis:

H1: There is a mutual positive relationship between FDI and HDI.

b) Foreign direct investment and Economic growth

Numerous empirical studies have documented a robust and positive relationship between FDI and economic growth, particularly in developing and emerging economies. This positive effect has been consistently evidenced across a range of national contexts, including China, India, and several ASEAN countries, through the studies of Agrawal andKhan [25], Har et al. [26], Nam and Ryu [23], Srivastava and Talwar [3], and Triatmanto et al. [6]. However, not all studies support a uniformly positive impact of FDI on economic growth. Some have reported adverse or insignificant effects. Rehman [27] and Nguyen et al. [28] found that FDI negatively influenced long-term growth in Pakistan and Vietnam, respectively, though the latter noted positive short-term effects. Other studies, such as those by Anetor [29] and Rajab and Zouheir [30], found no statistically significant relationship between FDI and GDP in sub-Saharan Africa and the least-developed African countries. These findings suggest that the effectiveness of FDI in promoting growth may vary across contexts, depending on a country's absorptive capacity.

Several studies have examined the impact of economic growth on FDI, resulting in inconsistent empirical evidence. Moudatsou and Kyrkilis [31], using VECM analysis, confirmed that economic growth in both the European Union and ASEAN countries stimulated inward FDI from 1970 to 2003. Similarly, Sabir et al. [32] found that GDP per capita positively affected FDI in developing countries. However, a negative relationship was observed in developed economies, suggesting that the effect of GDP may vary with income levels. In contrast, Srivastava and Talwar [3] reported no statistically significant evidence of a causal relationship from GDP to FDI, indicating that economic growth alone may not be sufficient to attract foreign investment in all contexts.

Beyond these findings, some studies point to a bidirectional relationship between FDI and economic growth, suggesting mutual reinforcement between the two variables. Liang et al. [33] discovered a strong positive correlation between FDI and GDP in developing and transitioning economies, while Dankyi et al. [34], using causality analysis in the ECOWAS region, identified two-way causality, indicating that FDI and GDP not only influence each other but may also evolve together over time. These results underscore the dynamic and interdependent nature of the FDI–growth nexus, particularly in emerging markets.

In light of the above, the authors examine the following hypothesis:

H2: There exists a reciprocal positive correlation between GDP and FDI.

c) Human development and Economic growth

Several studies have highlighted the positive impact of human development on economic growth, emphasizing that improvements in education, health, and income can enhance labor productivity and long-term economic performance. Empirical evidence from Gulcemal [35], Srivastava and Talwar [3], and Nguyen et al. [28] supports this view, showing that higher levels of human capital significantly contribute to GDP growth in developing countries. However, other studies, such as those by Anetor [29] and Rajab and Zouheir [30], found no statistically significant effect of human capital on economic growth in sub-Saharan and developed African economies.

The impact of economic growth on human development has been widely examined, with studies reporting divergent empirical findings. Higher GDP levels have contributed to improvements in education, healthcare, and living standards in some contexts, enhancing overall human development. Taqi et al. [2] found that economic growth in Pakistan played a key role in advancing human development outcomes. In contrast, other research suggests that GDP growth does not always lead to better human development. Kaukab and Surwandono [5] and Triatmanto et al. [6] showed that in several ASEAN countries, rising GDP had a negative effect on components of human development, particularly in education and health. Meanwhile, Srivastava and Talwar [3] found no statistically significant evidence that GDP had any measurable impact on human development.

Following the evidence on the directional impacts between HDI and GDP, several studies have examined their causal relationship, revealing varied patterns across contexts. Unidirectional causality from HDI to GDP was identified in Norway by Ozturk and Suluk [1], while Dankyi et al. [34] and Nguyen [36] confirmed that human capital drives economic growth in the ECOWAS region and Vietnam. In contrast, Abdouli and Omri [24] identified causality from GDP to human capital in the Mediterranean region. Moreover, Ngo et al. [37] revealed positive and negative causal effects between HDI and GDP over the medium and long term, highlighting the dynamic and context-specific nature of the relationship.

Based on the above, the authors propose the following hypothesis:

H3: There is a positive bidirectional impact between HDI and GDP.

In summary, the studies mentioned above collectively illustrate that the relationships between FDI, HDI, and GDP are complex and varied. These relationships can be positive, negative, or neutral, depending on the specific circumstances of each country studied. This diversity highlights the intricate and context-dependent interactions between FDI, human

development, and economic growth across different geopolitical and economic settings. Based on these findings, the authors have highlighted several notable gaps, as outlined below.

Firstly, in terms of empirical research, previous studies have explored the relationship between FDI and economic development or human development and economic growth. To the authors' knowledge, there has yet to be a study that simultaneously evaluates the multidimensional relationship among FDI, HDI, and GDP at each level or each quantile in an integrated model in a developing country like Vietnam. This research gap exists because the multidimensional relationship among these three factors could provide deeper insights into how FDI affects economic growth directly and indirectly by improving the quality of human resources.

Secondly, previous studies have predominantly employed linear analytical methods such as OLS, VECM, and PVAR to explore the relationships between FDI, HDI, and economic growth. However, there appears to be a lack of research utilizing the QQR method to investigate the multidimensional interactions among these variables in Vietnam. This method could provide more detailed information about the relationships between variables at different quantiles or levels of distribution, thereby allowing for a more accurate assessment of the variability of these relationships under various economic conditions and levels. Furthermore, Granger causality testing by quantiles will determine the causal relationships between the three pairs of variables: HDI and GDP, FDI and HDI, and FDI and GDP.

Therefore, the authors study the relationship between FDI, human development, and economic growth in Vietnam across quantiles from 1990 to 2022. By applying the QQR method and Granger causality testing by quantile, this research will explore the relationships between FDI, HDI, and economic growth in a manner different from previous research.

3. RESEARCH DATA AND METHODOLOGY

3.1 Research data

This study analyzes secondary data from Vietnam from 1990 to 2022, collected annually from the United Nations Development Programme [8] and the World Bank's World Development Indicators [7]. Due to the availability of complete data on the variables discussed only within this timeframe, the research is constrained to the period from 1990 to 2022. The sources and description of the data and research variables are detailed in Table 1 below.

Table 1. Description of research variables

Symbol	Variables	Description and Measurement Unit	Data Source
FDI	Foreign Direct Investment	The ratio of FDI inflows to the total GDP expressed as a percentage (%)	WDI (2024)
HDI	Human Development Index	The index measures income, knowledge, and human health	UNDP (2024)
GDP	Economic Growth	GDP per capita (constant 2015 US$)	WDI (2024)

Source: Compiled by Authors

The research variables include:

The foreign direct investment (FDI) variable is the ratio of FDI inflows to the total GDP, expressed as a percentage (%). The role of FDI in economic growth has been extensively studied, showing significant impacts on technology and knowledge diffusion. Research by Srivastava and Talwar [3], Gulcemal [35], Kaukab and Surwandono [5], Triatmanto et al. [6], Nam and Ryu [23], and Nguyen et al. [28] has utilized this variable.

The Human Development Index (HDI) measures income, knowledge, and human health indices. The United Nations Development Programme proposed this index [13], which has been used in the studies of Ozturk and Suluk [1], Taqi et al. [2], Srivastava and Talwar [3], Kaukab and Surwandono [5], and Ngo et al. [37].

The Economic Growth variable is measured by the annual growth rate of the Gross Domestic Product (GDP) at constant 2015 prices (US$), based on studies by Ozturk and Suluk [1], Taqi et al. [2], Srivastava and Talwar [3], Gulcemal [35], Kaukab and Surwandono [5], and Triatmanto et al. [6].

3.2 Research methodology

The research process is summarized in Figure 1 below.

Quantile-on-Quantile Regression (QQR) Method:

In this study, the authors utilize the QQR method to investigate the impacts of FDI on HDI, FDI on GDP, and HDI on GDP across different quantiles. Introduced by Sim and Zhou [38], the QQR method allows for the correlation analysis between the quantiles of two variables, offering more profound insights into the dynamic relationship between them under varying economic conditions. Studies by Mensi et al. [39], Troster et al. [40], and Ngo et al. [41] have also applied the QQR approach to explore relationships in different economic contexts, further affirming its utility in the fields of finance and economic growth.

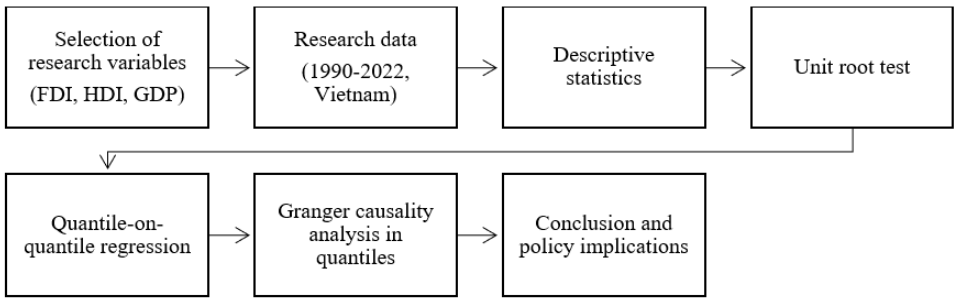

Figure 1. Research process
Source: Illustrated by Authors

The research model, according to the QQR method, is as follows:

$$Y_t = \beta_0(\theta,\tau) + \beta_1(\theta,\tau)(X_t - X_t^\tau) + u_t^\theta$$

This function estimates the relationship between X and Y, where $\beta_0(\theta,\tau)$ represents the quantile-specific intercept, and $\beta_1(\theta,\tau)$ reflects how the deviation of X at quantile τ compared to its value at quantile θ impacts Y, with u_t^θ being the error term.

This function analyzes the impact of FDI on HDI, FDI on GDP, and HDI on GDP across different quantiles.

$$HDI_t = \beta_0(\theta,\tau) + \beta_1(\theta,\tau)(FDI_t - FDI_t^\tau) + u_t^\theta \quad (1)$$

$$FDI_t = \beta_0(\theta,\tau) + \beta_1(\theta,\tau)(HDI_t - HDI_t^\tau) + u_t^\theta \quad (2)$$

The Eq. (1) estimates the relationship between HDI and FDI, where $\beta_0(\theta,\tau)$ is the quantile-specific intercept, and $\beta_1(\theta,\tau)$ reflects how the deviation of FDI at quantile τ from its value at quantile θ impacts HDI. The Eq. (2) estimates the relationship between FDI and HDI, where $\beta_0(\theta,\tau)$ is the quantile-specific intercept, and $\beta_1(\theta,\tau)$ reflects how the deviation of HDI at quantile τ from its value at quantile θ impacts FDI.

$$GDP_t = \beta_0(\theta,\tau) + \beta_1(\theta,\tau)(FDI_t - FDI_t^\tau) + u_t^\theta \quad (3)$$

$$FDI_t = \beta_0(\theta,\tau) + \beta_1(\theta,\tau)(GDP_t - GDP_t^\tau) + u_t^\theta \quad (4)$$

The Eq. (3) estimates the relationship between GDP and FDI, where $\beta_0(\theta,\tau)$ is the quantile-specific intercept, and $\beta_1(\theta,\tau)$ reflects how the deviation of FDI at quantile τ from its value at quantile θ impacts GDP. The Eq. (4) estimates the relationship between FDI and GDP, where $\beta_0(\theta,\tau)$ is the quantile-specific intercept, and $\beta_1(\theta,\tau)$ reflects how the deviation of GDP at quantile τ from its value at quantile θ impacts FDI.

$$GDP_t = \beta_0(\theta,\tau) + \beta_1(\theta,\tau)(HDI_t - HDI_t^\tau) + u_t^\theta \quad (5)$$

$$HDI_t = \beta_0(\theta,\tau) + \beta_1(\theta,\tau)(GDP_t - GDP_t^\tau) + u_t^\theta \quad (6)$$

The Eq. (5) estimates the relationship between HDI and GDP, where $\beta_0(\theta,\tau)$ is the quantile-specific intercept, and $\beta_1(\theta,\tau)$ reflects how the deviation of HDI at quantile τ from its value at quantile θ impacts GDP. The Eq. (6) estimates the relationship between GDP and HDI, where $\beta_0(\theta,\tau)$ is the quantile-specific intercept, and $\beta_1(\theta,\tau)$ reflects how the deviation of GDP at quantile τ from its value at quantile θ impacts HDI.

Quantile Granger Causality Test

The Quantile Granger Causality Test, developed from Granger's theory [42], was extended by Koenker and Xiao [43] to analyze causal relationships at the mean level and across different distribution quantiles. This approach allows for a more comprehensive understanding of how causality varies at various points in the distribution, providing insights into the dynamics that may not be visible through average effects alone.

An extended quantile regression model is used to test for Granger causality across quantiles, where the relationship between the dependent variable Y_t and the independent variables X_t is modeled at specific quantiles of Y_t. Specifically, the model can be written as follows:

$$Q_\tau(Y_t|X_t) = \beta_0(\tau) + \beta_1(\tau)X_t + \ldots + \beta_k(\tau)X_{t-k} + \epsilon_t(\tau)$$

in which:

- $Q_\tau(Y_t|X_t)$ Represents the conditional quantile of Y_t at quantile τ given X_t.
- $\beta_i(\tau)$ are the quantile-specific coefficients that indicate how past values of X_{t-i} Influence the quantile τ of Y_t.
- $\epsilon_t(\tau)$ is the error term at quantile τ.

The Quantile Granger Causality Test is employed to determine the causal relationships among three variable pairs: HDI and GDP, FDI and HDI, and FDI and GDP. This approach identifies causality at different points of the conditional distribution, providing a more nuanced understanding of the dynamic interactions between these economic indicators.

4. RESULTS AND DISCUSSION

4.1 Descriptive statistics of variables

From 1990 to 2022, Vietnam exhibited significant economic and developmental indicator trends, as presented in Table 2 below. The average FDI was 6.66% of GDP, peaking at 9.54% and dipping to a minimum of 2.55%, with a standard deviation of 1.56%. The HDI averaged 0.6343, with a recorded high of 0.7260 and a low of 0.4920, demonstrating variability with a standard deviation of 0.0715. GDP per capita showed an average of USD 1,831.8290, reaching a maximum of USD 3,658.6930 and a minimum of USD 673.3855, with a standard deviation of USD 900.6803.

4.2 Unit root test

The authors utilized the Augmented Dickey-Fuller (ADF) Unit Root Tests to examine the variables FDI, HDI, and GDP stationarity. According to the test outcomes in Table 3, the FDI series is confirmed as stationary at level I(0) with a t-statistic of -4.816567 and a probability value of 0.0001. Similarly, the HDI series shows stationarity at level I(0), evidenced by a t-statistic of -3.423581 and a probability value of 0.012. In contrast, the GDP series is not stationary at I(0) with a t-statistic of -1.161849 and a probability value of 0.6893; however, it becomes stationary upon first differencing I(1), where the t-statistic improves to -3.394122 with a probability value of 0.013. The analysis will, therefore, proceed with the first differences of GDP in subsequent stages.

Table 2. Descriptive statistics results for FDI, HDI, and GDP

	Mean	Median	Maximum	Minimum	Std. Dev.	Jarque-Bera
FDI	0.0666	0.0679	0.0954	0.0255	0.0156	2.648381
HDI	0.6343	0.6530	0.7260	0.4920	0.0715	2.763931
GDP	1831.8290	1663.5600	3658.6930	673.3855	900.6803	2.632687

Source: Calculated by Authors

Table 3. ADF unit root test results

ADF		
I (0)		
Variables	**t-Statistic**	**Prob.***
FDI	-4.816567	0.0001
HDI	-3.423581	0.0120
GDP	-1.161849	0.6893
	I (1)	
	t-Statistic	Prob.*
GDP	-3.394122	0.0130

Source: Calculated by Authors

4.3 Quantile-on-Quantile Regression

Table 4. Summary of QQR results for FDI, HDI, and GDP relationships

Relationship	Quantile	Direction of Impact
FDI → HDI	low	Strongly positive
	middle	Positive but fluctuating
	high	Clearly negative
HDI → FDI	low	Stable and positive
	middle	Moderately positive
	high	Negative
FDI → GDP	low	Initially negative
	middle	Strong and increasingly positive
	high	Significantly adverse
GDP → FDI	low	Stable, low responsiveness
	middle	Strongly positive
	high	Turning negative
HDI → GDP	low	Strongly positive
	middle	Positive but less consistent
	high	Mixed, potentially negative
GDP → HDI	low	Strong and consistent positive
	middle	Positive but less stable
	high	Clearly negative

Source: calculated by Authors

In this section, we present the empirical results of the QQR analysis, which investigates the intricate relationships among FDI, HDI, and GDP in Vietnam from 1990 to 2022. The key findings are summarized in the simplified overview presented in Table 4, which categorizes the direction of effects across low, middle, and high quantiles for each pairwise relationship. To complement the tabular summary, Figures 2 to 7 provide three-dimensional visualizations that illustrate the quantile-specific dynamics between the variables. The color gradients across these plots indicate the intensity and direction of the effects, where transitions from one shade to another reflect shifts in the strength and sign of the relationships.

The impact of FDI on HDI across different quantiles, as illustrated in Figure 2, reveals a nuanced relationship in the context of Vietnam, where FDI contributes positively to human development at lower levels, but its effects become less predictable—and occasionally adverse—as the country advances to higher stages of development. For the low quantiles (0.05 – 0.25), the color transition from deep blue to bright yellow illustrates an evident positive trend, representing higher impacts. This result shows that increases in FDI are associated with higher values of HDI, suggesting that FDI contributes significantly to human development when HDI is initially at lower levels. Conversely, the relationship remains positive but becomes more variable around quantiles 0.3 to 0.5. This variability suggests that other mediating factors, such as the sectoral distribution of FDI or the specific developmental needs of the population at these HDI levels, may influence the impact of FDI on HDI. This variability is visible in the plot through a mix of cyan and green colors, suggesting a more moderate and fluctuating impact. These results align with the outcomes of previous research by Kaukab and Surwandono [5] and Djokoto and Wongnaa [22]. Quantiles 0.5 and above show a significant and complex negative impact, where higher FDI correlates with a decrease in HDI. The plot transitions to darker shades of green and blue, where these darker colors represent the increasing negative impacts. These findings align with the results of previous research by Rehman [27] and Nam and Ryu [23], where FDI negatively affects human development. This negative trend observed in the higher quantiles may reflect Vietnam's growing challenges associated with over-reliance on foreign capital, including negative externalities such as environmental degradation, labor exploitation, or widening income inequality, which can offset the gains typically linked to higher levels of human development. This pattern suggests that while FDI has catalyzed improving human development at earlier stages, its benefits are increasingly uneven across the development spectrum in Vietnam.

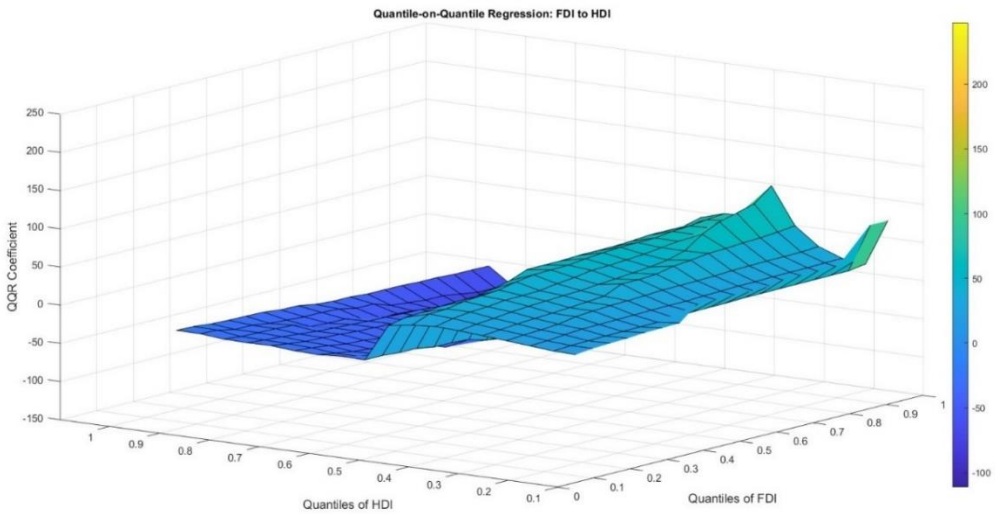

Figure 2. The impact of FDI on HDI
Source: Illustrated by Authors

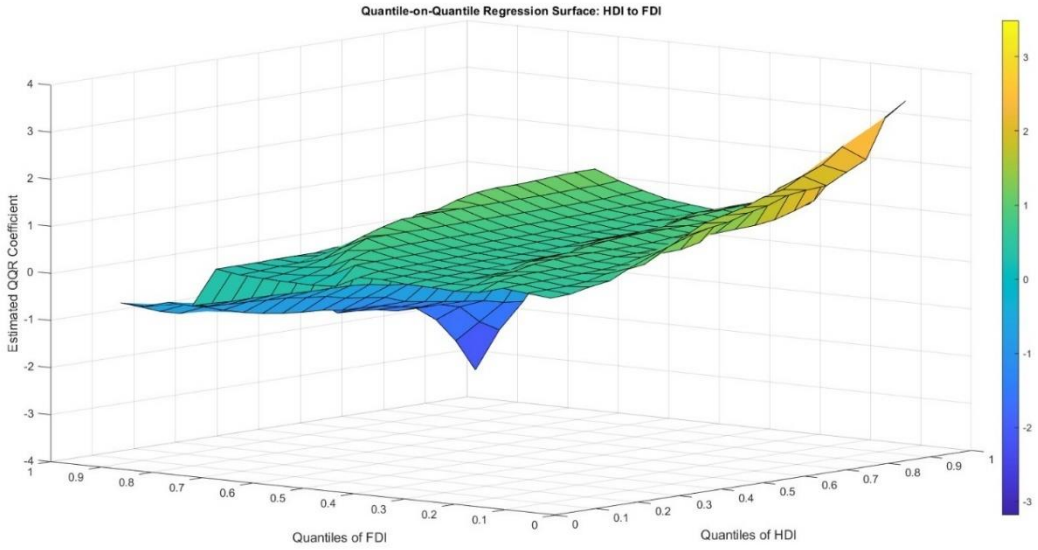

Figure 3. The impact of HDI on FDI
Source: Illustrated by Authors

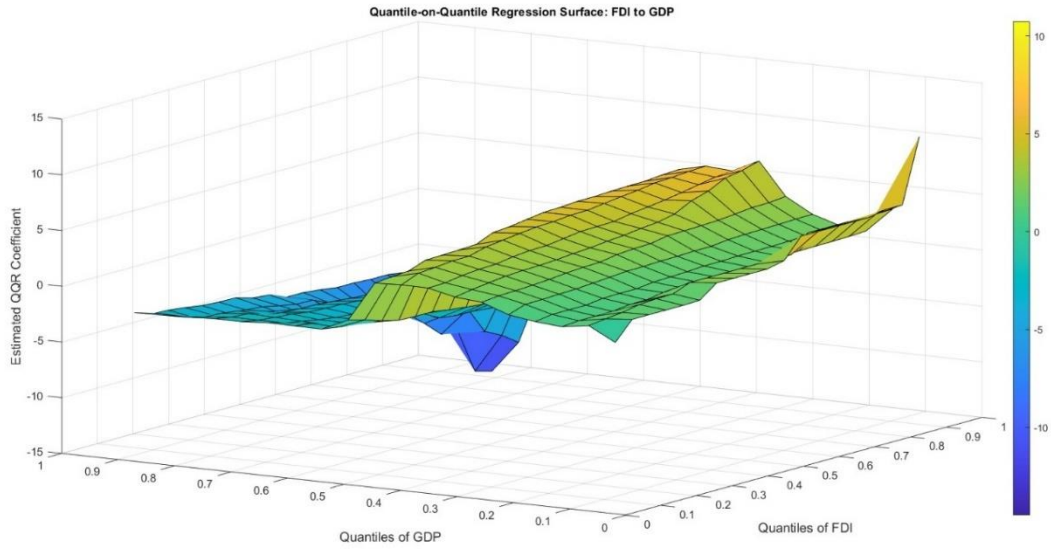

Figure 4. The impact of FDI on GDP
Source: Illustrated by Authors

Figure 3 indicates that across quantiles 0.05 to 0.65, improvements in human development are positively associated with increased FDI inflows, highlighting the role of HDI in attracting foreign investment at these stages of development. This positive association is further illustrated by the color transition from light blue to green in the lower quantiles, signaling that enhancements in HDI correspond with rising levels of FDI. The upward trajectory—particularly evident in the case of Vietnam—indicates that as the country advances in education, healthcare, and living standards, it becomes increasingly attractive to foreign investors, with the positive relationship persisting across the middle quantiles despite some fluctuations, likely influenced by additional economic or institutional factors such as market size or macroeconomic stability. Interestingly, in the upper quantiles 0.8 and above, the relationship between HDI and FDI turns negative, as indicated by the transition from green to yellow to deep blue, showing a diminishing or even adverse effect of higher HDI on FDI. This could be due to higher labor costs associated with more developed regions or a shift in the type of FDI attracted, from labor-intensive to technology or capital-intensive investments, which might not scale linearly with HDI improvements in Vietnam.

The impact of FDI on GDP shows these variations across different quantiles, as visually represented in Figure 4 through the changing colors from blue to yellow and back to blue, demonstrating the complex and nuanced relationship, suggesting that the effectiveness of FDI depends significantly on the economic context and the specific quantile of GDP being considered. In the lower quantiles, the plot begins with a negative impact of FDI on GDP—indicated by the initial deep blue color—suggesting a period of initial inefficiency or structural adjustment in Vietnam, during which foreign investment may not immediately translate into economic

growth due to factors such as underdeveloped infrastructure, limited absorptive capacity, or institutional constraints. As the figure transitions from cyan to green and peaks in yellow, it illustrates that FDI, when effectively integrated, can significantly enhance economic output. From quantile 0.55 onward, the consistent green to yellow shading reflects a substantial positive impact of FDI on GDP, suggesting that in this development range, foreign investment is increasingly channeled into productive sectors, such as manufacturing and services, which align well with domestic economic structures and development priorities. This positive effect is consistent with the findings of Har et al. [26], Agrawal and Khan [25], Liang et al. [33], Nam and Ryu [23], and Triatmanto et al. [6].

Conversely, at the highest quantiles, the impact of FDI turns negative, with coefficients declining markedly. The plot shifting from green to deep blue, potentially reflecting Vietnam's growing challenges such as the saturation of FDI in certain sectors (e.g., low value-added manufacturing), inefficiencies in resource allocation, or limited technological spillovers, where additional foreign investment no longer yields proportional gains and may even crowd out domestic enterprises or exacerbate regional and sectoral disparities. The results regarding the negative impact of FDI on GDP are also consistent with the findings of Moudatsou and Kyrkilis [31], Rehman [27], and Nguyen et al. [28].

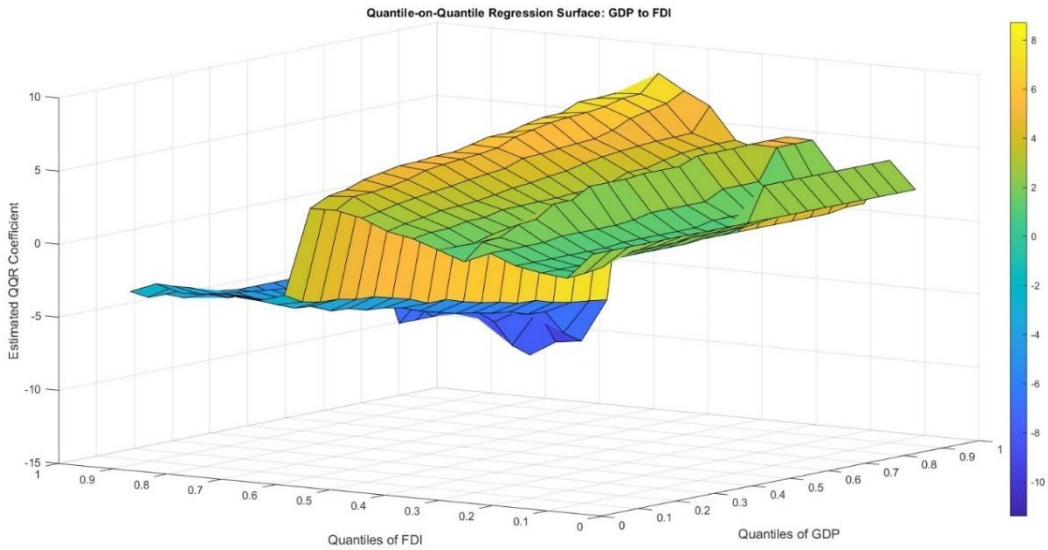

Figure 5. The impact of GDP on FDI
Source: Illustrated by Authors

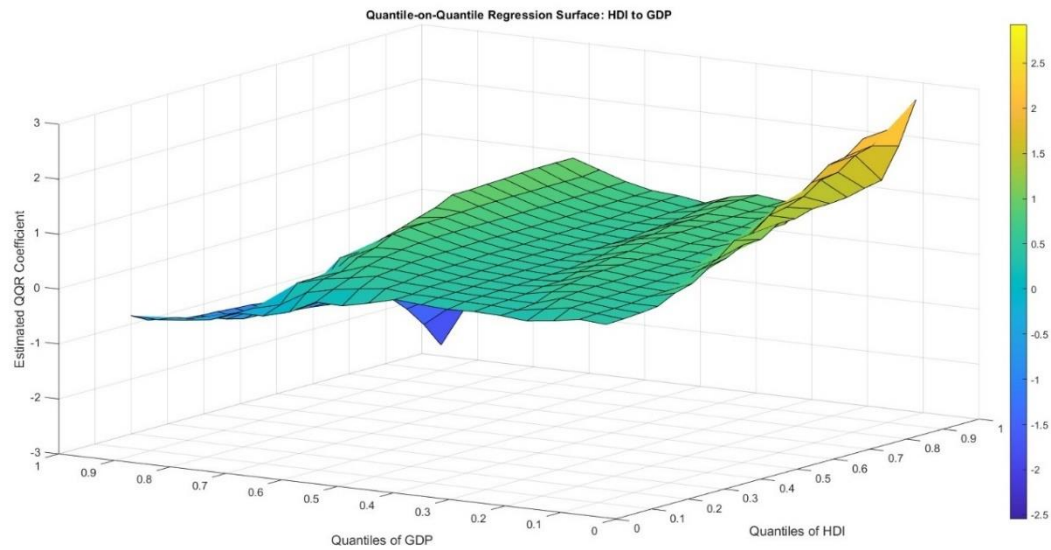

Figure 6. The impact of HDI on GDP
Source: Illustrated by Authors

At low quantiles in Figure 5, the effect of GDP on FDI remains relatively stable, indicated by the deep blue color, implying that even at modest income levels, Vietnam retains a baseline appeal to foreign investors, likely due to labor availability and market potential. As GDP increases, the relationship strengthens markedly, reflected in the color shift

to green and yellow, suggesting a threshold effect where modest economic improvements substantially enhance FDI inflows. This pattern highlights that as Vietnam progresses beyond low-income status, it creates more favorable conditions for foreign investment, driven by improved infrastructure, market expansion, and greater economic stability. The beneficial impact of GDP on FDI has also been demonstrated in the study by Moudatsou and Kyrkilis [31]. However, a reversal in the trend emerges from quantile 0.65 onward, with coefficients turning negative, consistent with findings by Sabir et al. [32], indicating that further GDP growth may no longer correspond to increased FDI inflows. In the context of Vietnam, this may signal a saturation point where rising economic output does not proportionally attract additional foreign capital, potentially due to diminishing returns, heightened competition, or structural inefficiencies that limit the absorptive capacity of the economy at more advanced stages of development.

Figure 6 indicates that although HDI is a key driver of economic growth in lower economic brackets, its impact becomes more nuanced and potentially less predictable at higher GDP levels, a pattern illustrated by the color transition from blue to yellow and back to blue. From quantiles 0.05 to 0.35, a generally positive impact of HDI on GDP can be observed. This trend is visually represented by the color transition from light blue to green and then yellow, suggesting that improvements in human development significantly enhance economic output. The plot exhibits a positive trend at intermediate distribution levels, approximately from 0.35 to 0.65, with coefficient magnitudes fluctuating within shades of green. This pattern suggests that in developing economies like Vietnam, as the country advances to more moderate levels of income and human development, the positive impact of HDI on GDP persists but becomes less intense than at earlier stages. Such a trajectory may reflect the transition from basic human development gains (e.g., literacy, primary healthcare) to more complex challenges like enhancing workforce productivity and institutional quality, where the marginal returns to HDI improvements are less immediate but remain essential for sustaining growth. The results showing that HDI positively impacts GDP are consistent with the findings of Dankyi et al. [34], Gulcemal [35], Taqi et al. [2], and Nguyen et al. [28]. Notably, the trend becomes mixed in the higher quantiles 0.7 and above, with some coefficients turning negative, indicating that further improvements in HDI may not directly lead to higher economic growth. In the case of a developing economy like Vietnam, this pattern may reflect structural challenges at more advanced development stages, such as diminishing marginal returns on social investments, inadequate technological absorption, or institutional bottlenecks that limit the effective translation of human development into sustained economic performance.

In the lower quantiles (0.05 – 0.35), the coefficients are exceptionally high and stable, indicated by the transition from deep blue to green in Figure 7. This suggests a robust and consistent positive impact of GDP on HDI, implying that in contexts where GDP levels are lower, even slight improvements in economic output can lead to substantial gains in human development metrics such as education, health, and living standards. Moving to the middle quantiles, the coefficients demonstrate positive effects but with more significant variability. This pattern suggests that as GDP reaches higher levels in Vietnam, the link between economic growth and HDI becomes increasingly influenced by how resources are allocated and invested, such as in education, healthcare, and social equity. At upper quantiles, the relationship appears less linear, possibly due to diminishing returns or structural issues that limit the translation of growth into broader human development gains. However, a significant negative trend emerges from upper quantiles (0.65 and above), with coefficients plunging deeply into negative territory, transitioning back to blue. This trend implies that the impact of GDP on HDI becomes increasingly negative at higher income levels in Vietnam, potentially reflecting rising inequality, environmental degradation, or insufficient investment in social services, factors that can offset the benefits of economic growth and hinder broader human development outcomes. The findings that GDP negatively influences HDI align with the research outcomes of Kaukab and Surwandono [5] and Triatmanto et al. [6].

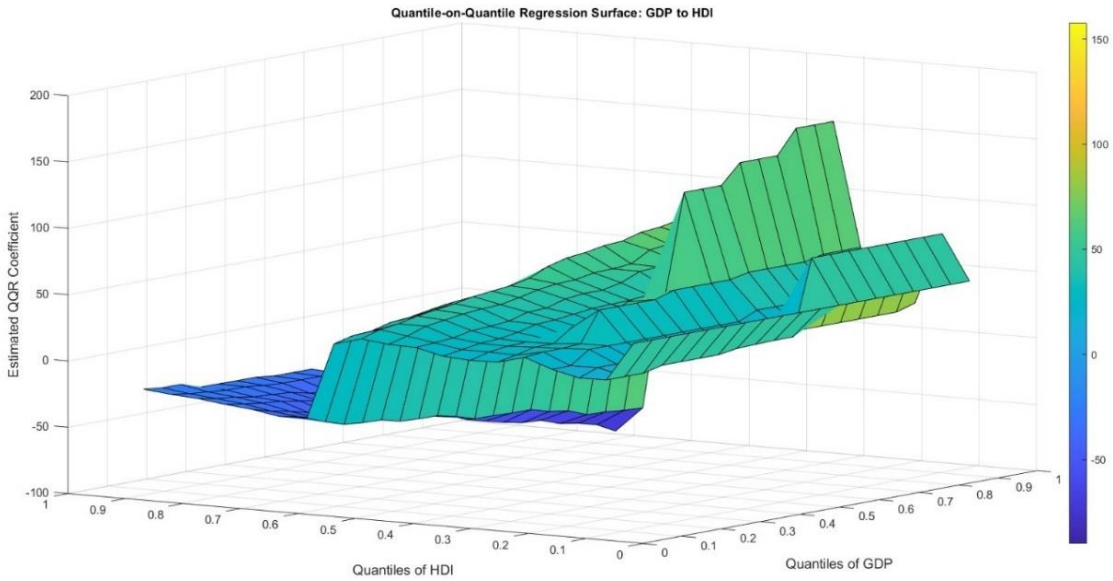

Figure 7. The impact of GDP on HDI
Source: Illustrated by Authors

Table 5. Granger causality analysis of FDI, HDI, and GDP across quantiles

Quantile	FDI → HDI	HDI → FDI	FDI → GDP	GDP → FDI	HDI → GDP	GDP → HDI
0.05	0.07824*	0.13953	0.04784	0.11099	0.04287**	0.00092***
0.1	0.23005	0.35714	0.38878	0.38933	0.79452	0.40581
0.15	0.47450	0.00030***	0.63926	0.25086	0.51256	0.22199
0.2	0.19107	0.42829	0.10268	0.10978	0.01946**	0.27477
0.25	0.81656	0.12943	0.50623	0.44250	0.39599	0.95344
0.3	0.54143	0.34520	0.62950	0.93165	0.33500	0.73746
0.35	0.51318	0.40014	0.69402	0.04553	0.12950	0.48721
0.4	0.68663	0.43137	0.07300*	0.34924	0.69365	0.68945
0.45	0.37486	0.13334	0.52510	0.83541	0.02756**	0.11796
0.5	0.00499**	0.08217*	0.91152	0.95093	0.12150	0.61638
0.55	0.61542	0.00312**	0.45405	0.84996	0.69783	0.81382
0.6	0.23754	0.36642	0.29138	0.46113	0.78336	0.43514
0.65	0.16386	0.72828	0.95284	0.06315*	0.98585	0.20062
0.7	0.87451	0.09534*	0.11869	0.04917**	0.04124**	0.11779
0.75	0.17039	0.09553*	0.52120	0.42223	0.01652**	0.85367
0.8	0.17305	0.01673**	0.18432	0.76130	0.22238	0.93272
0.85	0.31658	0.14462	0.91484	0.46767	0.30822	0.24871
0.9	0.17955	0.13467	0.98522	0.96518	0.16276	0.87516
0.95	0.70632	0.14797	0.86026	0.07120*	0.57286	0.90457

The symbols *, **, *** correspond to significance levels of 10%, 5%, and 1%, respectively.
Source: calculated by Authors

4.4 Granger causality analysis in quantiles

The Granger Causality Analysis delineates the interactions among FDI, HDI, and GDP across different quantiles, as shown in Table 5. In Vietnam, FDI clearly impacts human development at early and intermediate stages, contributing to improvements in education, healthcare, and overall living standards. HDI, in turn, exerts a notable influence on FDI across different stages of Vietnam's development, with effects evident from early to more advanced levels of progress. This pattern suggests that as the country enhances its human capital through better education, healthcare, and living conditions, it becomes more capable of attracting and retaining foreign investment, particularly as the socioeconomic environment grows more stable and sophisticated. The bidirectional causal relationship between FDI and HDI mirrors the findings of Abdouli and Omri [24].

At the early stages of development (0.05–0.35), there is no clear causal relationship between FDI and GDP. However, a significant effect emerges at more moderate levels, where FDI contributes meaningfully to Vietnam's economic growth, reflecting the increasing absorption capacity of the economy. Conversely, GDP substantially influences FDI in both middle and high quantiles, suggesting that as the Vietnamese economy grows, it becomes increasingly capable of attracting foreign capital. The reciprocal interaction between FDI and GDP is also confirmed in the study by Dankyi et al. [34].

Furthermore, HDI begins to influence GDP from the early stages of development, remains impactful at intermediate levels, and continues to play a significant role as the economy becomes more advanced (e.g., around the 0.7 to 0.75 quantiles). These findings highlight human capital as a consistent and essential driver of economic growth across different phases of Vietnam's development. Conversely, GDP has a significant impact on HDI during the early stages of development, indicating that economic growth in Vietnam's initial phases contributes meaningfully to improvements in education, healthcare, and living conditions. However, this effect diminishes as the country reaches more advanced levels of development, where no clear evidence supports a continued influence of GDP on HDI.

These findings from the Granger causality analysis underscore the complex and evolving interactions among economic output, human development, and foreign investment across varying stages of Vietnam's economic development. Each relationship demonstrates a distinct pattern of influence, reflecting the nuanced dynamics that emerge as the country progresses, from foundational phases where economic growth and FDI are critical drivers of HDI, to more advanced stages where the effectiveness of these factors depends increasingly on structural reforms, equitable distribution, and the quality of social investment.

5. CONCLUSION AND POLICY IMPLICATIONS

5.1 Conclusion

Based on the QQR and Granger Causality Analysis results, the relationship between FDI, HDI, and GDP growth in Vietnam can be complex and varies depending on different quantile levels. The analyses show the mutual influences among these three variables and reflect the varying degrees of impact at various points in the distribution. From the QQR analysis, it is evident that FDI positively impacts GDP growth at specific quantiles, particularly at low and middle levels of the distribution. This suggests that FDI can promote economic growth at particular stages of economic development. On the other hand, the impact of HDI on GDP is also significant, especially at lower and higher quantiles, indicating that improvements in human development can lead to economic growth. The results from the Granger Causality Analysis further substantiate the causal relationships between these three variables, albeit with distinct differences across quantile levels. The causality between FDI and GDP growth is evident at specific quantiles, while HDI appears to be an essential driving factor for FDI at higher quantiles. This indicates the importance of human development in attracting foreign investment, especially in Vietnam's economy, which is increasingly integrating into the global economy.

5.2 Policy implications

The interconnections revealed between FDI, HDI, and GDP growth in Vietnam highlight the complex dynamics that policymakers must navigate to harness the full potential of economic and developmental policies. The nuanced impact of these factors across different quantiles necessitates a tailored approach, ensuring that policy interventions are responsive to the country's diverse economic landscapes. Understanding these relationships helps formulate strategies for economic growth, sustainable human development, and effective utilization of foreign investments.

For FDI, the policy implications are clear: Vietnam should continue refining its strategies to attract high-quality FDI that aligns with national development goals. This involves promoting investments that bring advanced technologies, enhancing the skill set of the local workforce, and contributing to sustainable practices. Establishing clear criteria for FDI that prioritize sectors crucial for long-term growth, such as green energy, technology, and healthcare, can ensure that foreign investments contribute substantially to Vietnam's broader economic objectives. Creating a conducive and transparent business environment that simplifies procedures and strengthens legal frameworks will also be crucial in attracting and retaining quality FDI.

Regarding HDI, the focus should be on policies that directly enhance human development outcomes. This means increased investment in education, healthcare, and social services that elevate the population's overall well-being. Prioritizing human capital development not only improves HDI but also supports a resilient and adaptive economy capable of sustaining high levels of growth. Programs aimed at reducing disparities in education and health services across different regions can ensure a more equitable distribution of the developmental gains from economic growth.

Lastly, regarding GDP, policies should be crafted to ensure that economic growth translates into tangible improvements in the quality of life for all citizens. This includes fostering an environment where domestic and foreign investments drive growth into labor-intensive sectors with broad benefits, such as agriculture and manufacturing. Enhancing physical and digital infrastructure to support business activities and improve efficiencies is also crucial. Furthermore, integrating technological advancements across economic sectors can boost productivity, sustaining long-term GDP growth.

By addressing these policy implications with targeted and informed strategies, Vietnam can ensure that the interplay between FDI, HDI, and GDP leads to a harmonious growth and development cycle, benefiting the nation.

5.3 Limitations and future research directions

Despite providing valuable insights into the interplay between FDI, HDI, and GDP in Vietnam, this study has limitations that suggest directions for future research. Firstly, the study's reliance on quantile regression and Granger causality tests may not fully capture the non-linear and dynamic relationships between these variables over time. Future studies could employ more sophisticated econometric models, such as dynamic panel data models, to better understand these dynamics across different periods and economic conditions. Secondly, this analysis is constrained by the scope of available data, which may not account for all factors influencing relationships, such as political stability, policy changes, or international economic conditions. Future research could integrate these variables into the analysis to provide a more comprehensive view of how they interact with FDI, HDI, and GDP. Additionally, comparative studies involving other countries in the Southeast Asian region could offer valuable benchmarks and broader insights, helping to contextualize Vietnam's experience within regional development trends. Lastly, qualitative research methods, including case studies or expert interviews, could enrich the quantitative findings and offer deeper insights into the causal mechanisms and policy impacts of FDI, HDI, and GDP interactions.

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REFERENCES

[1] Ozturk, S., Suluk, S. (2020). The granger causality relationship between human development and economic growth: The case of Norway. International Journal of Research in Business and Social Science, 9(6): 143-153. https://doi.org/10.20525/ijrbs.v9i6.902

[2] Taqi, M., e Ali, M.S., Parveen, S., Babar, M., Khan, I.M. (2021). An analysis of human development index and economic growth. A case study of Pakistan. Irasd Journal of Economics, 3(3): 261-271. https://doi.org/10.52131/joe.2021.0303.0042

[3] Srivastava, S., Talwar, S. (2020). Decrypting the dependency relationship between the triad of foreign direct investment, economic growth and human development. The Journal of Developing Areas, 54(2). https://doi.org/10.1353/jda.2020.0012

[4] Hamdi, H., Hakimi, A. (2021). Trade openness, foreign direct investment, and human development: A panel cointegration analysis for MENA countries. The International Trade Journal, 36(3): 219-238. https://doi.org/10.1080/08853908.2021.1905115

[5] Kaukab, M.E., Surwandono, S. (2021). Convergence of Human Development Index: Case study of foreign direct investment in ASEAN. Business: Theory and Practice, 22(1): 12-17. https://doi.org/10.3846/btp.2021.12153

[6] Triatmanto, B., Bawono, S., Wahyuni, N. (2023). The contribution and influence of total external debt, FDI, and HCI on economic growth in Indonesia, Thailand, Vietnam, and the Philippines. Research in Globalization, 7: 100163. https://doi.org/10.1016/j.resglo.2023.100163

[7] World Bank. (2024). World Development Indicators (WDI). The World Bank. https://databank.worldbank.org/source/world-development-indicators.

[8] United Nations Development Programme (UNDP). (2024). Annual Report. https://hdr.undp.org/data-center/specific-country-data#/countries/VNM.

[9] International Monetary Fund (IMF). International Monetary Fund annual report 1993. Washington, DC: International Monetary Fund. https://www.imf.org/external/pubs/ft/ar/archive/pdf/ar1993.pdf.

[10] United Nations Conference on Trade and Development

(UNCTAD). (2018). World Investment Report. https://unctad.org/system/files/official-document/wir2018_en.pdf.
[11] International Labour Organization (ILO). (2022). International Labour Standards and Best Practices. https://www.ilo.org/international-labour-standards.
[12] United Nations Development Programme (UNDP). (2022). Human Development Report. https://hdr.undp.org/content/human-development-report-2021-22.
[13] United Nations Development Programme (UNDP). (1990). Human Development Report. United Nations Development Programme. https://hdr.undp.org/system/files/documents/hdr1990encompletenostats.pdf.
[14] World Bank. (1991). World Development Report. The World Bank. https://documents1.worldbank.org/curated/en/888891468322730000/pdf/96960REPLACEMENT0WDR01991.pdf.
[15] Nafziger, E.W. (2012). Economic Development. Cambridge University Press. https://assets.cambridge.org/97805217/65480/frontmatter/9780521765480_frontmatter.pdf.
[16] Smith, A. (1776). An inquiry into the nature and causes of the wealth of nations. London: W. Strahan and T. Cadell. https://www.rrojasdatabank.info/Wealth-Nations.pdf.
[17] Ricardo, D. (1817). On the principles of political economy and taxation. London: John Murray. https://www.econlib.org/library/Ricardo/ricP.html?chapter_num=1#book-reader.
[18] Romer, P.M. (1986). Increasing returns and long-run growth. The Journal of Political Economy, 94(5): 1002-1037. https://doi.org/10.1086/261420
[19] Lucas, R.E. (1988). On the mechanics of economic development. Journal of Monetary Economics, 22(1): 3-42. https://doi.org/10.1016/0304-3932(88)90168-7
[20] De Mello, L.R. (1997). Foreign direct investment in developing countries and growth: A selective survey. The Journal of Development Studies, 34(1): 1-34. https://doi.org/10.1080/00220389708422501
[21] Herzer, D., Klasen, S. (2008). In search of FDI-led growth in developing countries: The way forward. Economic Modelling, 25(5): 793-810. https://doi.org/10.1016/j.econmod.2007.11.005
[22] Djokoto, J.G., Wongnaa, C.A. (2023). Does the level of development distinguish the impacts of foreign direct investment on the stages of human development? Sustainable Futures, 5: 100111. https://doi.org/10.1016/j.sftr.2023.100111
[23] Nam, H.J., Ryu, D. (2023). FDI and human development: The role of governance, ODA, and national competitiveness. Journal of International Financial Markets, Institutions and Money, 85: 101769. https://doi.org/10.1016/j.intfin.2023.101769
[24] Abdouli, M., Omri, A. (2021). Exploring the nexus among FDI inflows, environmental quality, human capital, and economic growth in the Mediterranean region. Journal of the Knowledge Economy, 12: 788-810. https://doi.org/10.1007/s13132-020-00641-5
[25] Agrawal, G., Khan, M.A. (2011). Impact of FDI on GDP: A comparative study of China and India. International Journal of Business and Management, 6(10): 71. http://doi.org/10.5539/ijbm.v6n10p71
[26] Har, W., Teo, K., Yee, K. (2008). FDI and economic growth relationship: An empirical study on Malaysia. International Business Research, 1(2): 11-18.
[27] Rehman, N.U. (2016). FDI and economic growth: Empirical evidence from Pakistan. Journal of Economic and Administrative Sciences, 32(1): 63-76. https://doi.org/10.1108/JEAS-12-2014-0035
[28] Nguyen, H.Y., Nguyen, N.C., Phan, X.H., Dang, T.T. (2022). The impact of foreign capital flows, trade openness, and human capital on economic growth in Vietnam. Hue University Journal of Science: Economics and Development, 131(5A): 39-56. https://doi.org/10.26459/hueunijed.v131i5A.6600
[29] Anetor, F.O. (2020). Human capital threshold, foreign direct investment and economic growth: Evidence from sub-Saharan Africa. International Journal of Development Issues, 19(3): 323-337. https://doi.org/10.1108/IJDI-01-2020-0014
[30] Rajab, B., Zouheir, A. (2024). Complementarity relationship between foreign direct investment, human capital threshold and economic growth: State of the 15 least developed African countries. Journal of the Knowledge Economy, 15(2): 7216-7236. https://doi.org/10.1007/s13132-023-01314-9
[31] Moudatsou, A., Kyrkilis, D. (2011). FDI and economic growth: Causality for the EU and ASEAN. Journal of Economic Integration, 554-577. http://www.jstor.org/stable/41348800.
[32] Sabir, S., Rafique, A., Abbas, K. (2019). Institutions and FDI: Evidence from developed and developing countries. Financial Innovation, 5(1): 1-20. https://doi.org/10.1186/s40854-019-0123-7
[33] Liang, C., Shah, S.A., Bifei, T. (2021). The role of FDI inflow in economic growth: Evidence from developing countries. Journal of Advanced Research in Economics and Administrative Sciences, 2(1): 68-80. https://doi.org/10.47631/jareas.v2i1.212
[34] Dankyi, A.B., Abban, O.J., Yusheng, K., Coulibaly, T.P. (2022). Human capital, foreign direct investment, and economic growth: Evidence from ECOWAS in a decomposed income level panel. Environmental Challenges, 9: 100602. https://doi.org/10.1016/j.envc.2022.100602
[35] Gulcemal, T. (2020). Effect of human development index on GDP for developing countries: A panel data analysis. Journal of Economics Finance and Accounting, 7(4), 338-345. https://doi.org/10.17261/Pressacademia.2020.1307
[36] Nguyen, D.H. (2022). The relationship between human capital, energy consumption, CO_2 emissions, and economic growth in Vietnam. Ho Chi Minh City Open University Journal of Science, 17(1): 59-71. https://doi.org/10.46223/HCMCOUJS.proc.vi.17.1.2453.2022
[37] Ngo, T.H., Bui, M.B., Ho, L.D. (2023). The relationship between the human development index, technological infrastructure, renewable energy, and economic growth in Vietnam. Journal of Economics and Development, 315: 13-25.
[38] Sim, N., Zhou, H. (2015). Oil prices, US stock return, and the dependence between their quantiles. Journal of Banking & Finance, 55: 1-8. https://doi.org/10.1016/j.jbankfin.2015.01.013

[39] Mensi, W., Hammoudeh, S., Yoon, S.M. (2016). How do OPEC news and structural breaks impact returns and volatility in crude oil markets? Further evidence from a Quantile-on-Quantile Regression approach. Energy Economics, 57: 240-252. https://doi.org/10.1016/j.eneco.2013.11.005
[40] Troster, V., Shahbaz, M., Uddin, G.S. (2018). Renewable energy, oil prices, and economic activity: A Granger-causality in quantiles analysis. Energy Economics, 70: 440-452. https://doi.org/10.1016/j.eneco.2018.01.029
[41] Ngo, T.H., Nguyen, Y.N., Bui, N.B.C., Pham, T.K.X., Nguyen, H.T.A. (2023). The role of FDI in the relationship between economic growth and tourism in the Vietnamese market. Journal of Science Ho Chi Minh City Open University-Economics and Business Administration, 18(4): 63-76. https://doi.org/10.46223/HCMCOUJS.econ.vi.18.4.2232.2023
[42] Granger, C.W.J. (1969). Investigating causal relations by econometric models and cross-spectral methods. Econometrica, 37(3): 424-438. https://doi.org/10.2307/1912791
[43] Koenker, R., Xiao, Z. (2004). Unit root quantile autoregression inference. Journal of the American Statistical Association, 99(467): 775-787. https://doi.org/10.1198/016214504000001114

NOMENCLATURE

ARDL	AutoRegressive Distributed Lag
ASEAN	Association of Southeast Asian Nations
ECOWAS	Economic Community of West African States
FDI	Foreign Direct Investment
GDP	Gross domestic product
GMM	Generalized method of moments
HDI	Human Development Index
PVAR	Panel Vector Autoregression
QQR	Quantile-on-Quantile Regression
UNDP	United Nations Development Programme
VECM	Vector Error Correction Model
WDI	World Development Indicators