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Assessing the Impact of Foreign Direct Investment and Labor Force on Vietnam's Economic Growth: A Vector Error Correction Model Approach

This study investigates the impact of foreign direct investment (FDI) and the labor force on Vietnam's economic growth using the Vector Error Correction Model (VECM) with data spanning 2000 to 2023. The findings reveal that, in the long run, gross fixed capital formation (GFCF) and the labor force significantly and positively influence GDP per worker, while FDI shows no notable impact, and trade exhibits a negative relationship. In the short term, shocks from trade, FDI, and GFCF strongly affect economic growth, though these effects diminish over time, underscoring the sustained role of GFCF and labor. The study highlights the limited long-term contribution of FDI, indicating its effectiveness hinges on the economy's capacity to absorb foreign capital. Policy implications include prioritizing infrastructure development, reforming trade policies, attracting high-tech FDI, and enhancing labor skills to ensure sustainable economic growth in Vietnam amidst globalization.

1. Introduction

The relationship between Foreign Direct Investment (FDI) and economic growth has been the subject of extensive academic research, producing mixed results. FDI is a crucial capital source integrated into domestic investment, often associated with job creation and mutual benefits for both host countries and multinational corporations (MNCs). According to endogenous growth theories, FDI fosters economic growth by facilitating technology transfer to recipient countries. Specifically, FDI helps bridge the capital and technological gaps between developed and developing nations, thereby enhancing global efficiency in the utilization of production factors.

Globalization, driven notably by advancements in information and communication technology, has significantly boosted the international flow of capital, technology, and labor. These developments benefit all participating parties, provided national borders remain open, as they enable more efficient resource allocation. Multinational corporations, equipped with superior information, are better positioned to make informed investment decisions regarding optimal host countries. Notably, international investment flows are not unidirectional from developed to developing nations. Emerging economic sectors in developed economies also offer lucrative opportunities for MNCs, particularly those leading in Research and Development (R&D). Many MNCs explore significant market potential and profit opportunities in relatively underdeveloped industries within advanced economies. This dynamic underscores FDI's versatility as both a development tool for emerging economies and a strategic investment vehicle in mature markets.

To promote economic growth, developing countries require a skilled labor force alongside capital investment and modern machinery employing advanced technology. However, saving remains a significant challenge for these nations, as most income is allocated to consumption, with the majority of the population focused on meeting basic survival needs. The technological gap between developed and developing nations is increasingly difficult to bridge, as developing countries often lack the resources to fund the costly R&D necessary for innovation and industrial advancement. A vital solution to help developing countries overcome these capital and technological deficits is attracting international investment, particularly Foreign Direct Investment (FDI).

According to (Hayami & Godo, 2005) FDI flows can narrow the gap between anticipated investment and locally mobilized capital, as FDI tends to drive development through efficient strategies and break the negative cycle of underdevelopment. Moreover, FDI influences the host country's economic growth rate in two ways: expanding capital through capital formation and enhancing capital through technology transfer (Joo & Shawl, 2023). Thus, FDI clearly serves as a critical channel for technology transfer between nations, boosting international trade by facilitating access to foreign markets and potentially acting as a key driver of economic development.

Previous studies have produced mixed results regarding FDI's role in promoting economic growth. Some scholars argue that FDI significantly enhances productivity and growth, particularly when a country has a well-developed financial system and a skilled labor force. However, other studies suggest that FDI's impact may be limited, especially in economies where domestic conditions are not conducive to effectively absorbing foreign capital. In Vietnam, while FDI inflows have grown substantially over the past two decades, further quantitative research is needed to determine the specific contributions of FDI and the labor force to the country's economic development.

This study addresses this research gap by examining the impact of FDI and the labor force on Vietnam's economic growth using the Vector Error Correction Model (VECM). By analyzing data from 2000 to 2023, this paper seeks to provide fresh insights into the short- and long-term relationships between these variables. Specifically, it assesses whether FDI and labor force growth drive sustainable economic development in Vietnam and outlines relevant policy recommendations. The paper is structured as follows: Section 2 reviews relevant literature on FDI and economic growth. Section 3 discusses the methodology and data used in the study. Section 4 presents the quantitative results and analysis. Finally, Section 5 concludes with policy recommendations and implications for forthcoming study.

2. Theoretical Framework

2.1 Overview of FDI

The earliest theories of FDI from the 1970s primarily explored why firms relocate production to other countries and what types of enterprises are capable of making such decisions. Initially, these studies were based on the Industrial Organization (IO) theoretical approach, analyzing the specific firm advantages that multinational corporations (MNCs) possess over domestic companies. One prominent theory is the Ownership, Location, and Internalization (OLI) model by (Dunning, 1981). This model explains that a firm becomes an MNC due to certain advantages, including Ownership advantages, Location advantages, and Internalization advantages. When a firm transitions into an MNC, it possesses specific assets that enable more effective competition, such as technology and patents. Additionally, the firm can leverage geographical or production cost advantages in foreign countries. Moreover,

the decision to internalize production stages rather than outsourcing to external partners helps reduce costs and increase efficiency.

Subsequently, Markusen (1984) further developed this theory by demonstrating how firms can extend their technology to other markets without needing to redevelop it from scratch. Markusen (1997) expanded this theory by showing that trade and investment liberalization can reinforce each other, enhancing both the export and investment capabilities of MNCs. Bergstrand & Egger (2007) contributed further by introducing the role of physical capital and third-country effects, creating a model that integrates knowledge capital and physical capital in trade, FDI, and the revenues of foreign subsidiaries. Additionally, Neary (2007) provided significant research by focusing on how FDI can enhance market power, particularly through cross-border mergers and acquisitions undertaken by firms.

As per (Lipsey, 2001), the concept of FDI first emerged in the late 19th century when businesses began expanding their operations beyond national borders, particularly from advanced countries to emerging countries or other regions. More specifically, the development of FDI is closely linked to the process of economic globalization and the formation of multinational corporations (MNCs). During the late 19th and early 20th centuries, companies fromGermany the the United States,United Kingdom, and other developed nations started investing in colonies or other countries to exploit resources, expand markets, and access cheap labor. This period also marked a shift in the method of international investment, moving from loans or securities-based investments to direct investments in fixed assets such as factories, infrastructure, or businesses in other countries. This transition popularized the concept of FDI and led to its extensive study in economics and international policy.

The widely accepted definition of FDI today was established for the compiling of balance of payments by the International Monetary Fund (IMF) in 1993 and was recognized by the OECD in 1996. According to the IMF, FDI is an investment activity undertaken with the aim of obtaining long-term benefits in an enterprise operating in a territory of an economy other than the economy of the investor, with the investor's purpose being to gain actual management control over the enterprise (International Monetary Fund, 2004). Regarding this concept, two key aspects of FDI stand out: long-term benefits and actual control over the enterprise. When conducting FDI, investors typically pursue long-term benefit objectives. Achieving long-term benefits requires a sustained association between the investor and the enterprise receiving the investment, along with a noteworthy degree of influence over the management of that enterprise. The control over the enterprise includes participating in major decisions that affect its existence and growth, such as approving the company's strategic plans, endorsing action plans set forth by the enterprise's daily management, deciding on profit distribution, and determining the capital contribution among partners. In essence, this control grants substantial influence over the survival and development of the enterprise. Overall, these definitions explain that FDI is not merely a form of financial investment but also a comprehensive business strategy aimed at leveraging global advantages in costs, technology, and location to maximize a company's profits and competitiveness.

There are numerous studies that explain and model FDI, reflecting the various forms in which FDI can be carried out in practice. The two main types of FDI are horizontal FDI and vertical FDI. Additionally, many companies employ a combination of both types of FDI.

(Helpman & Krugman, 1987) conducted research on vertical FDI, which shows that

production is divided into stages. A multinational corporation (MNC) carries out different activities abroad, but these activities remain related to the core business. For example, McDonald's may purchase a large farm in Canada to produce meat for its restaurants.

On the other hand, (Helpman, et al., 2004) focused on horizontal FDI, where an MNC invests in the same type of business operations abroad as it does domestically. This reflects companies seeking larger markets or lower production costs. In other words, horizontal FDI involves foreign direct investment in the same industry. For example, McDonald's opening in Japan and conducting similar operations as in the U.S. is an example of horizontal FDI.

2.2 FDI in Vietnam

During the period from 1976 to 1986, Vietnam's economy was under the context of the centrally planned economy, known as the subsidy period, with a focus on heavy industry as the primary driver for economic growth and development. During this time, the state held a monopoly on foreign economic activities. Vietnam imposed numerous restrictions on trade and international investment, concentrating on state-controlled enterprises before 1986. However, the economy did not develop as expected due to inefficiencies in the public sector, which forced Vietnam to undertake a series of economic reforms..

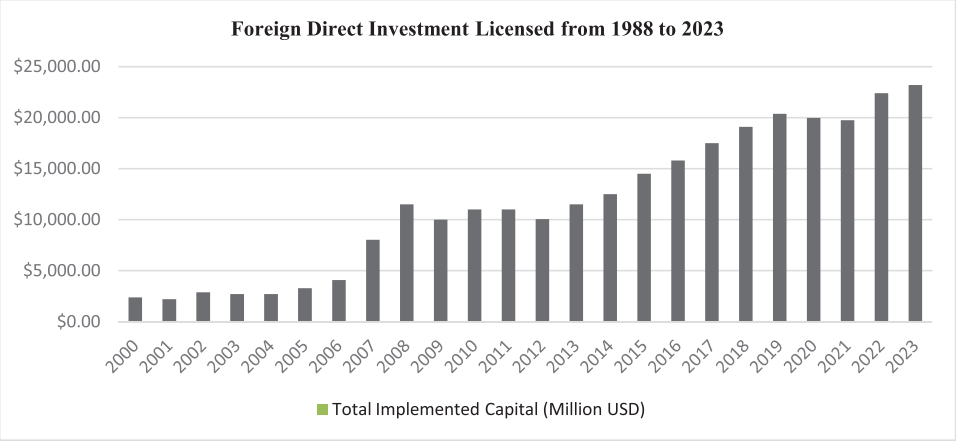

Figure 1. Foreign Direct Investment Licensed from 1988 to 2023
Source: GSO

In 1987, Vietnam enacted the Foreign Investment Law and began attracting Foreign Direct Investment (FDI) in 1988. By the period 1991–1995, FDI had started to show its effectiveness and contribution to the economy, with over $5 billion in inflows during this phase. In the 1996–2000 period, the success in attracting FDI during the previous phase paved the way for a significant increase in capital inflows, totaling nearly $10 billion (marking the first wave of FDI). Major corporations in the industrial sector, such as PouChen and Honda, began investing in Vietnam.

The period from 2001 to 2005 was a challenging time for attracting FDI in Vietnam. International factors, particularly the improvement of the investment environment in several regional countries, notably China, had an impact on Vietnam's ability to attract FDI. At the same time, Vietnam's investment environment was not yet highly appealing to foreign investors. However, thanks to its advantages in macroeconomic

stability and political conditions, FDI inflows were maintained, though at a lower level compared to the 1996-2000 period.

The period from 2006 to 2010 marked a resurgence of FDI inflows, especially in 2007 and 2008, with 1,544 and 1,171 projects attracted, respectively. In 2006, Vietnam saw its first billion-dollar projects from Intel, the chip manufacturer, and Posco, the steel conglomerate, signaling the onset of the second FDI wave. Registered capital continued to rise and set a record in 2008, including Samsung, which has since become one of the largest FDI investors. However, the global economic crisis affected the actual disbursement, which hovered around $10-11 billion, lower than the amounts pledged by FDI enterprises.

The third FDI wave occurred between 2015 and 2019, during which FDI inflows grew and remained stable. However, the COVID-19 pandemic that began in early 2020 disrupted cross-border investment activities, leading to a decrease in FDI inflows, though the fluctuation was not severe.

Figure 2. Economic Growth and FDI

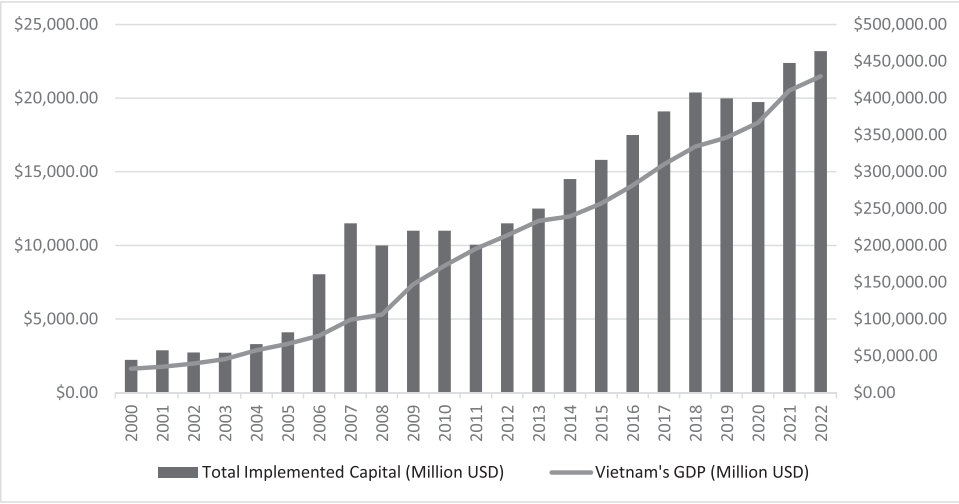

Figure 2. Economic Growth and FDI
Source: GSO and The World Bank

3. Materials and Methods

This study primarily utilizes secondary data collected from the World Bank and the General Statistics Office (GSO). Specifically, data on Vietnam's GDP was gathered from the World Bank, while labor force figures and total realized FDI were obtained from the GSO . The data covers the period from 2000 to 2023.

3.1 Solow Growth Model

The Solow-Swan Growth Model (Solow, 1956); (Swan, 1956), also known as the exogenous growth model, is an economic model used to explain long-term economic growth. The model seeks to account for long-term economic growth by focusing on capital accumulation, labor (or population growth), and productivity increases primarily driven by technological progress. Fundamentally, the model employs a Cobb-Douglas production function, which allows it to incorporate microeconomic foundations into the analysis. The Solow-Swan model is a nonlinear system that includes ordinary differential equations modeling the development of capital per capita.

This model explains how capital, labor, and technological improvements interact to influence the growth of an economy over time, making it a key tool in understanding the sources of long-term economic growth.

The Solow-Swan model assumes a world without government or international trade. A single product is produced using two factors of production: labor (L) and capital (K), within an cumulative production function that satisfies the Inada conditions (Uzawa, 1963), meaning the elasticity must approach one as capital increase. The production function is expressed as:

$$Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha} \quad (1)$$

Where:

$0 < \alpha < 1$ represents the elasticity of output with respect to capital;

Y_t is the total output;

A refers to knowledge or technology, indicating technology that enhances labor efficiency.

This study uses Vietnam's GDP per worker as the dependent variable, while FDI, labor force, trade openness, and Gross Fixed Capital Formation (GFCF) are used as independent variables. The practical form of the model is as follows:

$$GDP_t = f(F_t, L_t, T_t, G_t) \quad (2)$$

Trong đó:

GDP_t is Vietnam's GDP per worker at time t;

F_t is Foreign Direct Investment (FDI) into Vietnam at time t;

L_t is data on Vietnam's labor force at time t;

T_t is data on trade openness at time t;

G_t is data on gross fixed capital formation at time t.

Economic growth can be demarcated as the growth or improvement in the inflation-adjusted market value of goods and services produced by an economy within a year (Roser, 2021).

Economic growth is the increase in the scale of national output or per capita national output over a specific period, typically a year (Akonji, 2013).

Economic growth refers to the rise in real GDP over time, which is equivalent to an increase in national income (Blink & Jocelyn, 2007).

Overall, according to these concepts, changes in the scale of output over time constitute economic growth. Furthermore, an increase in per capita output over time also indicates growth, provided that the growth rate of output surpasses the population growth rate. Thus, economic growth is understood as the increase in the size of national output or per capita output over a specific period, typically one year.

According to (Phan, 2006), Economic growth can be measured through the following indicators:

Measurement by the Change in Real GDP

Since the growth rate of an economy is measured by the increase in production, which is a real variable, real GDP is used as the primary measure. The calculation formula is as follows:

$$g^t = \frac{Y^t - Y^{t-1}}{Y^{t-1}} \times 100$$

Where:

g^t: economic growth rate;

Y^t: real GDP in year t;

Y^{t-1}: real GDP in year $t-1$.

(2) Measurement by the Change in Real GDP Per Capita

This growth rate is considered the most accurate reflection of improvements in the population's living standards. The formula for calculating the change in real GDP per capita is:

$$\delta^t = \frac{y^t - y^{t-1}}{y^{t-1}} \times 100$$

Where:

δ^t: The economic growth rate gauged by the change in real GDP per capita;

y^t: Real GDP per capita in year t.

y^{t-1}: Real GDP per capita in year t-1.

(3) Average Growth Rate Over a Period

The calculation formula is:

$$g_y = \sqrt[n]{\frac{Y_n}{Y_0}} - 1$$

Where:

Y_0: Total output at the inception of the period;

Y_n: Total output at the end of the period;

n: Number of years in the period.

However, to align with the Solow-Swan Growth Model and reflect labor productivity or the average output per worker, thereby assessing the economy's production efficiency, the author uses real GDP per worker as the measure of economic growth. Consequently, the Solow-Swan Growth Model is expressed as follows:

$$Y = AK^{\alpha}L^{1-\alpha}$$

$$\Rightarrow \frac{Y}{L} = A\left(\frac{K}{L}\right)^{\alpha} (3)$$

Thus, from the Solow-Swan Growth Model, where A represents total factor productivity, reflecting the overall efficiency of production factors and often influenced by many factors not directly measurable. In this study, the author considers *A* to depend on the Trade Openness indicators. Similarly, *FDI* and *GFCF* are also part of the capital *K*, so A_t and K_t are expressed as follows:

$$A_t = e^{\beta_0 + \beta_1 T_t + \epsilon_{1t}} \quad (4)$$

$$K_t = e^{\gamma_0 + \gamma_1 F_t + \gamma_2 G_t + \epsilon_{2t}} \quad (5)$$

Where:

β_0 is a constant;

β_1: coefficient reflecting the degree of influence of each trade openness indicator T_t on TFP;

γ_1,γ_2: corresponding coefficients reflecting the degree of influence of FDI and GFCF on capital *K* at time *t*.

According to a World Bank report, China's economy grew from 147 billion USD in 1980 to over 14.7 trillion USD in 2020, an exceptional economic growth rate, approximately tenfold, attributed to the implementation of economic openness and the transition from a centrally planned economic model to a state-controlled market economy model after 1978 (Brandt & Rawski, 2010). Another example is the economic reform in India in 1991. Before 1991, India was a country following a model that was half socialist and half capitalist, characterized by restrictions on the development of bourgeois enterprises. At that time, the GDP of the economy was 320 billion USD. However, when the country transitioned to a free-market economy model, its GDP by 2020 had reached 3.5 trillion USD (Joshi & Little, 2003).

It can be seen that the reforms helped India not only overcome the economic crisis but also rise to become one of the major and fastest-growing economies in the world. Thus, choosing an exponential function allows the model to capture the exponential impact of variables on TFP (Total Factor Productivity). This aligns with the reality that implementing improvements in governance or upgrading technology can reduce costs, expand production scale, and increase labor productivity, leading to economic growth that is not just linear but exponential. For convenience, the group of authors denotes $\frac{Y_t}{L_t}$ is y_t to represent GDP calculated based on the labor force. From equations (3), (4), and

(5), we have:

$$y_t = e^{\beta_0+\beta_1 T_t+\epsilon_{1t}} \left(\frac{e^{\gamma_0+\gamma_1 F_t+\gamma_2 G_t+\epsilon_{2t}}}{L_t}\right)^{\alpha} (6)$$

Taking the natural logarithm of both sides of equation (6), we have:

$$ln(y_t) = lne^{\beta_0+\beta_1 T_t+\epsilon_{1t}} + \alpha ln\left(\frac{e^{\gamma_0+\gamma_1 F_t+\gamma_2 G_t+\epsilon_{2t}}}{L_t}\right)$$

$$\Rightarrow ln(y_t) = \beta_0 + \beta_1 T_t + \epsilon_{1_t} + \gamma_0 + \gamma_1 F_t + \gamma_2 G_t + \epsilon_{2_t} - ln(L_t)$$

$$\Rightarrow ln(y_t) = (\beta_0 + \alpha\gamma_0) + \beta_1 T_t + \alpha\gamma_1 F_t + \alpha\gamma_2 G_t - \alpha ln(L_t) + (\alpha\epsilon_{2_t} + \epsilon_{1_t}) (7)$$

$$\Rightarrow ln(y_t) = \delta_0 + \delta_1 T_t + \delta_2 F_t + \delta_3 G_t - \delta_4 ln(L_t) + \varepsilon_t (8)$$

4. Results and Discussion

4.1 Testing the Stationarity of Time Series

In this study, the author employs the Augmented Dickey-Fuller (ADF) unit root test to observe the stationarity of the variables

Table 1. Results of the unit root test for the variables

Variables	P-value	T-Statistic	Stationarity	Order of Integration
$ln\ \ y$	0.1223	-3.112374	Non-stationary	I(1)
y	0.0176	-3.426371	Stationary	
T	0.6189	-1.925312	Non-stationary	I(1)
ΔT	0.0487	-2.969512	Stationary	
F	0.9851	-0.346769	Non-stationary	I(1)
$\Delta\ t$	0.0001	-5.1366 99	Stationary	
G	0.8467	-1.373128	Non-stationary	I(1)
$\Delta\ t$	0.0101	-3.694931	Stationary	
$ln\ L\ )$	0.9996	0.814710	Non-stationary	I(1)
$\Delta\ lnL\ )$	0.0322	-3.157797	Stationary	

Source: *Calculated by the author*

The results in Table 1 show that all variables are stationary at the first difference, meaning they are combined of order 1, I(1). At the same time, none of the variables are stationary at the second difference, meaning they are not integrated of order 2, I(2). Thus, the results are suitable for conducting research based on the VECM framework.

4.2 Determination of the Number of Lags

Table 2. Results of the Values of Criteria Determined by Lag Order.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1120.241	NA	$1.35e$	89.93931	90.13433	89.99340
1	-967.6356	244.1691	$2.47e$	79.01085	79.98595	79.28130
2	-939.0245	36.62232*	$1.01e$ *	78.00196	79.75714*	78.48877*
3	-922.3307	16.02601	$1.31e$	77.94646*	80.48172	78.64963

Note: *indicates the optimal choice based on the criteria
Source: Calculated by the author

The outcomes in Table 2 indicate that a lag of 2 is the optimal choice for the model based on the HQ and FPE criteria. However, the results show inconsistency among the criteria. Specifically, the HQ criterion has a value of 78.48877 at lag 2, reflecting a balance between the model's complexity and accuracy. The AIC criterion selects a lag of 3, the SC criterion selects a lag of 1, and the LR test shows a significant decrease in the LR value from lag 0 to lag 1, followed by a gradual decline at lags 2 and 3. This suggests that lag 1 significantly improves the model, but the improvement becomes less pronounced from lag 2 onward. Therefore, the author proposes a lag of 2 as the optimal lag, as it is supported by the HQ and FPE criteria. Additionally, the values of AIC and SC do not differ significantly between lags 2 and 3, and choosing lag 2 helps avoid overfitting, which could occur if lag 3 were selected.

4.3. Johansen Test

Table 2. Results of the Cointegration Test Criteria for the VECM Model.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**P-value**
None *	0.877029	77.48677	47.85613	0.0000
At most 1	0.409313	22.99584	29.79707	0.2463
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**P-value**
None *	0.877029	54.49093	27.584334	0.000
At most 1	0.409313	13.68820	21.13162	0.3912

Note: * indicates refusal of the hypothesis at the 5% significance level.
Source: Calculated by the author

The combined results of the Trace and Maximum Eigenvalue tests suggest that there is 1 cointegrating equation at the 5% significance level. This indicates the presence of a long-term equilibrium association among the variables, allowing for the application of the VECM model to analyze both short-term dynamics and long-term equilibrium adjustments.

4.4 Vector Error Correction Estimates

Table 3. Results of the Long-Term Cointegration Equation

Cointegrating Eq:	CointEq1
$lnln(y_{-1})$	1.000000
T_{-1}	-0.004756
F_{-1}	$-5.69e^{12}$
G_{-1}	$-4.72e^{12}$
lnL_{-1}	0.683951
c	3.505424

Source: Calculated by the author

The results from the Vector Error Correction (VEC) model provide an overview of the relationships between variables in both the long term and short term. The model was estimated using data from 1998 to 2023, with explanatory variables including trade *(T),* foreign direct investment *(F)*, fixed asset investment *(G)*, and the labor force *(ln(L)*). The long-term cointegrating equation describes the long-term relationship between per capita GDP *(ln(y))* and the explanatory variables as follows:

$$ln(y_{t-1}) - 0.004756T_{t-1} - 5.69e^{-12}F_{t-1} - 4.72e^{-12}G_{t-1} + 0.683951\, ln\, ln(L_{t-1}) + 3.505424 = 0$$

The long-term outcomes indicate that trade (T) has a strong negative effect on per capita GDP, with a coefficient of 0.004756, suggesting that this relationship is statistically significant. Foreign direct investment *(F)* and fixed asset investment *(G)* have a very small impact on *ln(y)*, indicating that these factors are not statistically significant in the long-term model.

In contrast, the labor force has a strong positive effect on per capita GDP, with a coefficient of 0.683951, demonstrating that a large and growing labor force will drive economic development. In the short term, the Error Correction Model (ECM) shows a rapid adjustment of the variables to return to the long-term equilibrium state. Specifically, the adjustment error term (CointEq1) has a coefficient of 0.061935, indicating that this adjustment is relatively slow and exhibits a delay.

4.5 Diagnostic Testing

Table 4. Results of the Homoskedasticity Test of Residuals

Joint test		
Chi-sq	Df	Prob.
184.5752	180	0.4405

Source: Calculated by the author

The author conducted a test for heteroskedasticity of the residuals in the VEC model, as shown in Table 4. The p-value of 0.4405 is higher than the typical significance level, indicating that there is not sufficient evidence to reject the hypothesis of no heteroskedasticity in the model's residuals. This implies that the model does not suffer from issues related to heteroskedasticity.

Table 5. Results of the Normality Test of Residuals in the VECM

	Skewness	Kurtosis	Jarque - Bera
Joint test	0.8037	0.8680	0.9389

Source: Calculated by the author

The outcomes of the normality test for the residuals show that the residuals of the model do not exhibit significant skewness and do not have unusual kurtosis or flatness. The tests for Skewness, Kurtosis, and Jarque-Bera all indicate that the residuals of the VECM can be considered normally distributed, with no issues related to non-normality. This confirms that the model does not have problems associated with non-normal residuals.

Table 6. Results of the Serial Correlation Test of Residuals in the VECM

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F -stat	df	Prob.
1	15.92559	25	0.9170	0.504650	(25, 16.4)	0.9401
2	23.32759	25	0.5584	0.857375	(25, 16.4)	0.6447
3	17.78313	25	0.8515	0.584562	(25, 16.4)	0.8899
4	35.58851	25	0.0781	1.693137	(25, 16.4)	0.1360
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F -stat	df	Prob.
1	15.92559	25	0.9170	0.504650	(25, 16.4)	0.9401
2	385.8580	50	0.0000	NA	(50, NA)	NA
3	NA	75	NA	NA	(75, NA)	NA
4	NA	100	NA	NA	(100, NA)	NA

Note: *The likelihood ratio statistic is adjusted using the Edgeworth expansion.
Source: Calculated by the author

Thus, the results in Table 6 regarding the serial correlation test of the residuals in the model indicate no significant serial correlation at lags 1, 2, 3, and 4.

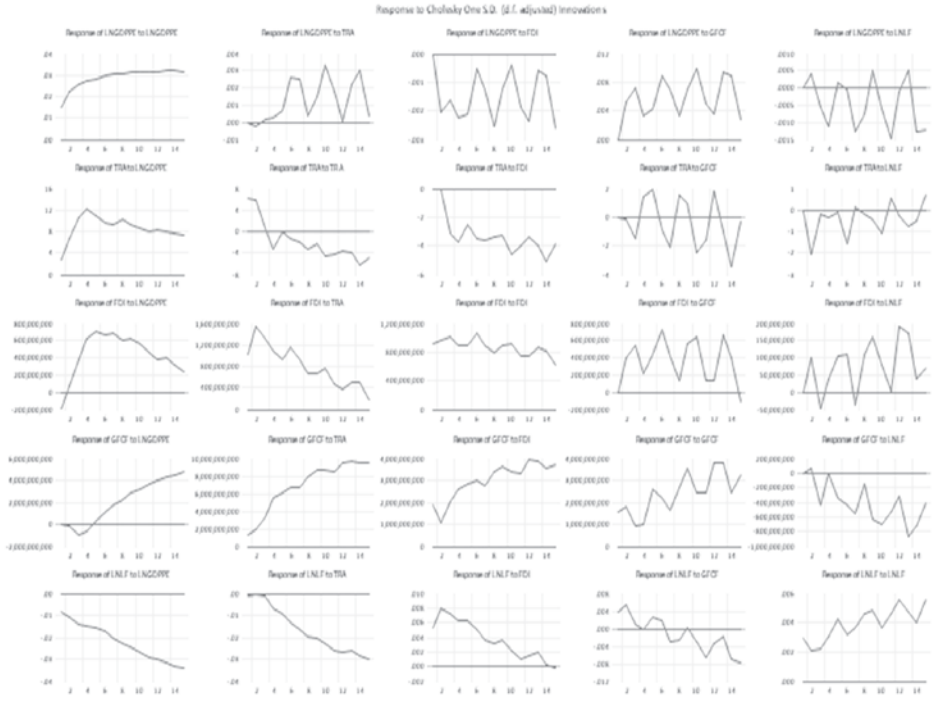

Figure 3. Results of impulse response analysis
Source: Calculated by the author

The outcomes of the impulse response analysis (impulse response) in the VECM, using the Cholesky Decomposition method, indicate how the variables in the model respond to a one-unit shock from other factors. First, ln (y) shows a strong short-term reaction to its own shock, reaching a maximum increase in the first period (0.014736), then gradually declining and stabilizing in subsequent periods. This reflects the short-term effect of the variables in the model on economic growth. Similarly, T (Trade openess) exhibits a very strong response in the first period (6.358830), but the intensity of the response diminishes and stabilizes in later periods, indicating that a shock to trade has a significant short-term impact that weakens over time.

For FDI (foreign direct investment), although the initial response is very large (1.03e^9), it begins to decline and stabilize in subsequent periods, suggesting that foreign direct investment has a strong short-term influence but tends to stabilize in the long term. For GFCF, the impact of the initial shock is also very pronounced, reaching a high increase in the first period (1.54e^9), followed by a slight decline in later periods, reflecting the adjustment of fixed asset investment following the shock. Finally, ln(L) (labor force) shows a mild immediate response to its own shock, with stability and a slight decline over time, reflecting a less intense and more stable impact of the labor force on the other variables in the model.

Overall, the results indicate that while shocks to the variables in the model have a strong short-term impact, this influence diminishes over time, reflecting the adjustment and stabilization of economic factors within the model.

5. Conclusion

This study analyzed the long-term and short-term drivers of key economic factors influencing per capita GDP in Vietnam using the Vector Error Correction (VEC) model. The outcomes displayed strongest impact of GFCF and the labor force on per capita GDP in the long term, while FDI showed insignificant effect. Trade also exhibited a long-term negative relationship with labor-adjusted GDP, suggesting that changes in trade structure may have lasting consequences for economic growth. The impulse response analysis indicated that, although per capita GDP responds strongly to shocks from trade, FDI, and GFCF in the short term, these impacts diminish over time, particularly for trade and FDI, highlighting their short-term nature. In contrast, the effects of fixed asset investment and labor force quality are more sustainable, underscoring their critical role in achieving sustainable economic growth.

Based on these findings, several policy recommendations are proposed for Vietnam's further development. First, increasing investment in infrastructure and fixed assets is essential, as GFCF significantly influences per capita GDP. The government should continue to prioritize investments in infrastructure, education, healthcare, and key industries. Second, reforming trade policies is crucial, as trade shocks have short-term impacts, and policies should focus on promoting exports and reducing dependence on imports. Third, encouraging foreign direct investment, particularly in high-tech industries and modern manufacturing, is necessary to leverage FDI's strong short-term impact. Fourth, investing in human capital through education, vocational training, and skill development will ensure that the labor force is equipped to meet the demands of modern industries. Finally, enhancing labor productivity through technological advancements and innovation policies will be a key factor in achieving sustainable growth.

In conclusion, this study emphasizes that Vietnam's economic growth can be further boosted by focusing on strategies that prioritize investment in infrastructure, improve trade and investment policies, and enhance the quality of the labor force. These measures are key to ensuring sustainable growth and resilience against global economic challenges.

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