

# The impact of energy consumption, foreign direct investment, and education on human well-being: Evidence from the Vietnamese economy

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## ABSTRACT

This paper examines the impact of energy consumption, Foreign Direct Investment (FDI), and education on human well-being in Vietnam. To realize the aim of this research, a human well-being model was established using the Autoregressive Distributed Lag (ARDL) method to evaluate and study focused on the period 1990 - 2020. The results reveal evidence of the long-run positive relationships between human well-being, foreign direct investment, education, and urbanization. In addition, urbanization increases human well-being in the short run. Conversely, foreign direct investment and education reduce human well-being in the short run. Although energy consumption is expected to impact human well-being, the study found no evidence to suggest that energy consumption significantly impacts human well-being in the short and long run. Besides, the results of this study may be of great importance for policymakers and decision-makers in developing policies that attract foreign direct investment capital, education, and urbanization and contribute to the improvement of human well-being in Vietnam.

## 1. Introduction

Enhancing human well-being is one of the goals the United Nations set in 2015, and it is determined to achieve this goal along with other goals by 2030 (United Nations, 2015). Regarding human well-being, economists have used “life satisfaction” to describe this term (Collard, 2003). Besides, terms such as quality of life, living standards, welfare, utility, life satisfaction, needs fulfillment, poverty, and happiness can be used interchangeably when referring to human well-being (Schaafsma, 2020). In addition, Bui et al. (2019) supposed that an array of indicators, including income, expenditure, poverty, employment, and migration, are characteristics mentioned in the term human well-being.

Easterlin (1974) is one of the most famous researchers of human well-being. In an article published in 1974, Easterlin asked, “richer countries are happier countries” (p. 104). Using two international data sets, he found a relationship across countries between aggregate human well-being and income that he described as “ambiguous” and, although perhaps positive, small. A more robust positive relationship between a country’s income and the well-being of its people is the result of Easterlin’s subsequent research (1995). He concluded that “a positive human well-being relationship typically turns up in international comparisons” (Easterlin, 1995, p. 42). Another set of findings, such as Tella et al. (2003), Hagerty and Veenhoven (2003), and Beja (2014), claims that the impact of income on human well-being is more substantial in the short term than in the long term.

Meanwhile, energy consumption, foreign direct investment, and education are indispensable input factors closely related to countries' economic growth. This can be found in studies such as Werner et al. (2018), Latief and Lefen (2019), Dkhili and Dhiab (2018), Wang and Le (2019), Bhattarai and Shrestha (2015), Grant (2017). Besides, Karekezi et al. (2012), Nguyen et al. (2020), and Arpino et al. (2018) also show that energy consumption, foreign direct investment, and education also play an essential role in improving human well-being. However, the above studies, in particular, and existing studies, in general, are focused either on the nexus of energy consumption-human well-being, foreign direct investment-human well-being, or education-human well-being where little effort has been made to test these three links under the same framework. This research is an attempt to fill the gap.

First, there is a lack of studies that examined the relationship between energy consumption, foreign direct investment, education, and human well-being in Vietnam from 1990 - 2020, despite its substantial boost in economic development. Second, when explaining the relationship, using time series analysis on individual countries may offer a more useful framework than panel data analysis of a group of countries (Stern et al., 1996). A single-country study examines the impact of exogenous factors such as energy consumption, foreign direct investment, and education over time. Third, Vietnam also made significant progress in improving social services to achieve the Sustainable Development Goals (SDGs). Fourth, the National Energy Efficiency Program (2019) reports that energy use in Vietnam's economy has changed rapidly in recent decades, transitioning from an agricultural economy based on traditional biomass fuel to a modern mixed economy. Fifth, the United Nations Conference on Trade and Development (2021) reported that Vietnam is among the 20 countries attracting the most Foreign Direct Investment (FDI) globally. Sixth, the United Nations Development Programme (2019) has shown that the expected number of years of schooling has increased from 7.8 (in 1990) to 12.7 (in 2018), and the average number of years of education has increased from 4 (1990) to 8.2 (2018) in Vietnam.

Therefore, the Autoregressive Distributed Lag (ARDL) of Pesaran et al. (2001) is used in this paper to consider the short-term and long-term impacts of energy consumption behavior, foreign direct investment, and education on human well-being. Besides, to reduce the problems of omitted variable bias in econometric estimation, the study extends the above-mentioned multivariate framework further by including the impacts of urbanization into the nexus.

The rest of the paper is organized as follows: Section 2 reviews the literature; Section 3 describes the data and model specification; Section 4 reports and analyzes the empirical results and discussion; Section 5 offers concluding remarks with policy implications.

## **2. Literature review**

### ***2.1. Theoretical background***

Human well-being has attracted the attention of scientists, national governments, and international organizations. Stiglitz et al. (2009) supposed that the measurement system should focus on measuring human well-being rather than economic production. Therefore, the Italian government introduced multidimensional equal and sustainable well-being indicators in 2010 (CNEL & ISTAT, 2010). Meanwhile, the Organization for Economic Cooperation and Development (OECD) has stressed that a well-being framework needs to include quality of life, material living conditions, and sustainability (Organization for Economic Cooperation and Development [OECD], 2011, 2013, 2015, 2017).

Maslow's hierarchy of needs theory is a psychological theory that was published in 1943. This theory is beneficial for research on human well-being. According to Maslow, human behavior stems from the need to satiate one's wants. There are five stages of human wants, ranging from the most fundamental (most urgent) to the most sophisticated (less urgent). These include *Physiological Needs*, *Safety Needs*, *Love/Belonging Needs*, *Esteem Needs*, and *Self-actualization Needs*. Maslow's hierarchy of human needs is built on the following assumptions: (1) Needs are the basis for forming the motivation that motivates people to act. People try to satisfy, first of all, the most critical needs. However, once a need has been satisfied, it is no longer a current motivator, and people try again to find ways to satisfy the next most important need. (2) Higher-level needs only appear when lower-level needs have been satisfied.

Easterlin (1974) argued that higher incomes are associated with higher levels of human well-being within a country that are related to each other before a specific point in time. However, human well-being in a country does not increase in conjunction with improved income after that. Moreover, economic growth will not enhance human well-being if a country has high-income inequality, social inequality, corruption, and lost trust.

Besides, Cobb and Douglas (1928) introduced the production function, which is expressed as  $Y = f(K, L)$  or  $Y = A \cdot K^\alpha \cdot L^\beta$ .  $Y$  is total production,  $A$  is total factor productivity,  $K$  is capital input, and  $L$  is labor input. Based on the ideas of Cobb and Douglas (1928), later scholars such as Solow (1956), Arrow (1962), and Romer (1989, 1990) developed different economic growth theories. Therefore, understanding the factors contributing to economic growth is very important because economic growth will help improve human well-being (Dodds, 1997).

## ***2.2. Empirical studies***

### ***2.2.1. The relationship between energy consumption and human well-being***

Karekezi et al. (2012) asserted that human well-being, reducing poverty, social inclusion, and economic improvement cannot be achieved without access to electricity, fuels, mechanical power, and the range of services that they provide. The countries that reach the highest levels of poverty and underemployment often lack full access to adequate energy services and the modern conveniences they provide. This is most evident in Africa and South Asia, where most people primarily rely on solid fuels (coal and traditional biomass). Besides, Pachauri et al. (2004) also said that high poverty levels affect energy consumption patterns in quantity and quality. Poor people always use traditional and inefficient energy sources like wood and coal.

Relating to the relationship between energy and well-being, recently, the concept of energy poverty has received a lot of attention from scientists. According to Bouzarovski et al. (2012), energy poverty is a condition wherein a household cannot access necessary energy sources essential to satisfying basic human needs. Furthermore, energy poverty has a significant impact on human health. Widespread use of solid fuels for cooking has increased anthropogenic emissions and caused inadequate health standards due to indoor air pollution (Lacey et al., 2017). Zhang et al. (2019) recognized that a large share of households (especially in rural areas) rely on solid fuel (i.e., firewood and coal) for cooking in China.

### ***2.2.2. The relationship between foreign direct investment and human well-being***

Empirical studies on FDI's impact on human well-being can be divided into two branches: The first examines the impact of FDI on employment, and the second focuses on whether FDI affects poverty.

Schulte and Vainio (2010) supposed that greater job satisfaction is associated with lower stress levels, better mental health, and greater life satisfaction. Clark and Oswald (1994) found that unemployment status reduces well-being more than any other single factor. Many empirical studies can find a positive relationship between FDI and employment growth in foreign investment-attracting countries. A unidirectional long-run causality between foreign direct investment and employment was found by Jayaraman and Singh (2007) when they studied in Fiji during the period 1970 - 2003. Nunnenkamp and Bremont (2007) show that FDI positively impacted manufacturing employment in Mexico from 1994 to 2006. However, Akcoraoglu and Acikgoz (2011) found a negative impact of FDI on employment from 1990 to 2010 in Turkey. In Vietnam, Nguyen et al. (2020) argued that there is a negative relationship between FDI and employment.

Furthermore, in contrast to the positive and negative effects, in a study of Egypt from 1974 to 2005, Massoud (2008) found no evidence to suggest a significant relationship between FDI and changes in employment. Aktar et al. (2009) argue that the decline in Turkiye's unemployment rate from 2000 to 2007 came from causes other than FDI. Meanwhile, Nordin (2017) has not confirmed the relationship between FDI and employment in Malaysia.

As for the second strand of literature, some previous studies support the hypothesis that FDI reduces poverty in countries that attract foreign investment (Gohou & Soumore, 2011; Klein et al., 2001; Mirza et al., 2003). Recently, Zaman et al. (2012), Shamim et al. (2014), and Khan et al. (2019) investigated the impact of FDI on poverty reduction in Pakistan and also found a positive relationship between FDI and poverty reduction. On the contrary, Agenor (2002), Chintrakarn et al. (2012), Easterly (2004), Feenstra and Hanson (1996, 1997), and Milanovic (2003) argue that FDI increases poverty in the host countries. Meanwhile, Ogunniyi and Igberi (2014) found that FDI has an insignificant impact on poverty reduction in Nigeria. Besides, Quiñonez et al. (2018) indicated that FDI is not significantly associated with poverty reduction in Latin America.

### *2.2.3. The relationship between education and human well-being*

Education is essential in increasing human well-being at both the aggregate and individual levels (Hill & King, 1995). Education affects human well-being through two channels. The first channel reports that education positively impacts self-esteem, self-confidence, and pleasure. These make people take better self-healthcare. The second channel describes that education helps bring more job opportunities and better income. These enable people to access services that improve their well-being, enhancing their well-being outcomes.

Florida (2010), Yakovlev and Leguizamon (2012), and Arpino et al. (2018) have explored the link between education and human well-being. Several studies show education's positive impact on human well-being (Cuñado & de Gracia, 2012; Florida, 2010). People with more education are likely to have better human well-being (Tsou, 2017). In contrast, various studies have not confirmed the relationship between education and human well-being (Hickson & Dockery, 2008; Inglehart & Klingemann, 2000; Veenhoven, 1996).

### *2.2.4. The relationship between urbanization and human well-being*

People are more satisfied in urban areas when the level of development is low (Easterlin et al., 2011; Requena, 2016). Glaeser (2011) and Albouy (2008) also supposed that people are wealthier and happier in big cities. However, Smyth et al. (2008), Berry and Okulicz-Kozaryn (2011), Sander (2011), Navarro-Azorín and Artal-Tur (2015) found that

urbanization likely increases living costs, congestion, pollution, traffic, crime, work pressure, and a lower willingness among people to cooperate and support each other.

### 3. Model specification and data

#### 3.1. Model specification

Following theoretical background and the empirical studies in human well-being economics, this research assumes that energy consumption, foreign investment attraction, education, and urbanization can impact human well-being and specify the following form of human well-being model:

$$HDI_t = f(EC_t, FDI_t, MSY_t, UR_t) \quad (1)$$

All variables are transformed to logarithmic form for the variance-covariance matrix to be stationary (Chang et al., 2011). Therefore, the model is converted as follows:

$$\ln HDI_t = \alpha_0 + \alpha_1 \ln EC_t + \alpha_2 \ln FDI_t + \alpha_3 \ln MYS_t + \alpha_4 \ln UR_t + u_t \quad (2)$$

To investigate the impact of energy consumption, foreign direct investment, education, and economic growth on human well-being in the model (2), the study applies the Autoregressive Distributed Lag (ARDL) method introduced by Pesaran et al. (2001). This method was chosen for the following reasons: First, ARDL involves using a single reduced-form equation, while other methods use a system of equations (Duasa, 2007). Second, the ARDL applies to time series data and does not require all variables to be integrated in the same order. Variables can be integrated into different orders [I (1)], order 0 - [I (0)], or a combination of both (Pesaran et al., 2001). Therefore, the ARDL model may not be mandatory to check the stationarity of the variables. Third, another superiority of the ARDL approach that is more effective over other estimation techniques is its power to produce efficient and unbiased results in the case of small sample size (Lei et al., 2021; Pesaran & Shin, 1999). Fourth, estimate model (2) from ARDL as follows:

$$\begin{aligned} \Delta \ln HDI_t = & \beta_0 + \sum_{i=1}^n \alpha_{1i} \Delta \ln HDI_{t-i} + \sum_{i=0}^n \alpha_{2i} \Delta \ln EC_{t-i} + \sum_{i=0}^n \alpha_{3i} \Delta \ln FDI_{t-i} \\ & + \sum_{i=0}^n \alpha_{4i} \Delta \ln MYS_{t-i} + \sum_{i=0}^n \alpha_{5i} \Delta \ln UR_{t-i} + \rho_1 \ln HDI_{t-1} + \rho_2 \ln EC_{t-1} + \rho_3 \ln FDI_{t-1} \\ & + \rho_4 \ln MYS_{t-1} + \rho_5 \ln UR_{t-1} + \varepsilon_t \end{aligned} \quad (3)$$

The ARDL analysis procedure is conducted in the following order: (1) Test the evidence of cointegration between variables by the Wald F-statistics, finding long-run relationships between variables. The Wald F-statistics is greater than the upper critical bound; cointegration is present. In contrast, if the Wald F-statistics is less than the lower bound critical value, it is concluded that there is no cointegration relationship between the variables. Moreover, it is considered inconclusive if the Wald F-statistics fall between the upper and lower bound critical values. If the sample is small, the essential values reported in Narayan (2005) will be used from 30 - 80 observations. But if the sample is smaller, less than 30 observations, the critical value reported in Pesaran et al. (2001) will be more appropriate; (2) Determine the optimal lag of variables in the ARDL model using Schwarz information criterion (SBC) or Akaike Information Criterion (AIC); (3) Estimate the ARDL model with determined lags to test the long-term relationship between variables in the model. Besides, appropriate lags in the ARDL framework remove the serial correlation and endogeneity problems (Pesaran & Pesaran, 1997; Pesaran et al., 2001); (4) Calculate the short-run impact

of variables by an Error Correction Model (ECM) based on the ARDL approach to cointegration, the Error Correction Model (ECM) is formulated as follows:

$$\Delta \ln \text{HDI}_t = \beta_0 + \sum_{i=1}^n \alpha_{1i} \Delta \ln \text{HDI}_{t-i} + \sum_{i=0}^n \alpha_{2i} \Delta \ln \text{EC}_{t-i} + \sum_{i=0}^n \alpha_{3i} \Delta \ln \text{FDI}_{t-i} + \sum_{i=0}^n \alpha_{4i} \Delta \ln \text{MYS}_{t-i} + \sum_{i=0}^n \alpha_{5i} \Delta \ln \text{UR}_{t-i} + \theta \text{ECT}_{t-1} + \varepsilon_t \quad (4)$$

Here,  $\text{ECT}_{t-1}$  is the Error Correction Term and determines the adjustment speed of the variables to obtain the long-run equilibrium. It should be noted that the ECT should have a statistically significant negative coefficient. In addition, diagnostic tests are also used in the study to check the model's suitability, such as the considerable impact of the explanatory variable, normality, functional form, autocorrelation, and heteroscedasticity. In the end, we check the stability of the short and long-run models through the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) proposed by Brown et al. (1975).

### 3.2. Data

The study uses annual secondary data of Vietnam in the period 1990 - 2020, which is relatively long and has significant changes in Vietnam compared to before, collected from reputable organizations, including the United Nations Development Programme, Global Change Data Lab, United Nations Conference on Trade and Development and Institute for Management Research Radboud University. Moreover, we use the sample period of 1990 - 2020 with complete, practical, accessible, and manageable data because the data for the chosen variables were not completely updated after 2020.

The main variables chosen for this study are human well-being (Human Development Indicator - HDI) (United Nations Development Programme, 1990), Energy Consumption (EC), Foreign Direct Investment (FDI), education (MYS), and urbanization (UR). Table 1 presents more details of these variables. The variables are chosen to capture the particular characteristics of the Vietnamese economy.

**Table 1**

*Variable Description*

Variable	Proxy	Units of measurement	Source
Human well-being (HDI)	Human Development Indicator	From 0 to 10	United Nations Development Programme (2024)
Energy Consumption (EC)	Primary energy consumption per capita	Kwh	Global Change Data Lab (2024a)
Foreign Direct Investment (FDI)	Foreign direct investment/Gross Domestic Product	% of GDP	United Nations Conference on Trade and Development (2024)
Education (MYS)	Mean years of schooling	Total years	Institute for Management Research Radboud University (2024)
Urbanization (UR)	Urban population	% of the total population	Global Change Data Lab (2024b)

*Note.* The researcher's data analysis

The results of the descriptive statistics are reported in Table 2. We observe that mean and standard deviation indicate considerable normality in data.

**Table 2**

*Summary Statistics*

Variable	Obs	Mean	Std. Dev.	Min	Max
lnHDI	31	-0.4896	0.115	-0.729	-0.342
lnEC	31	8.28	0.749	7.046	9.44
lnFDI	31	3.595	0.636	1.322	4.178
lnMYS	31	1.847	0.235	1.411	2.124
lnUR	31	3.3081	0.1901	3.008	3.620

*Note.* In the natural logarithm of the variable. The researcher's data analysis

#### 4. Empirical results and discussion

In examining the long-run relationship between human well-being and its determinants, the ARDL bounds testing approach carries out the F-test for joint significance of all lagged level variables or cointegration in baseline Equation (3), and the results are reported in Table 3. The computed F-statistics confirm the cointegration between human well-being, energy consumption, foreign direct investment, and education in the long run. The study uses the critical bounds from Narayan (2005) due to 31 observations in this case. Bahmani-Oskooee and Brooks (1999) and Narayan and Smyth (2008) argue that the F-test results for cointegration are sensitive to lag length. The maximum lags are selected by using the AIC criteria in Table 3.

**Table 3**

*Cointegration Result*

Model	Optimal lag	F-statistics	Conclusion
F(lnHDI/ lnEC lnFDI lnMYS lnUR)	(4, 1, 4, 3, 4)	12.651	Cointegration

*Note.* The F-statistics' lower and upper bound critical values for cointegration are 2.152-3.296, 2.523-3.829, and 3.402-5.031 at the 10%, 5% and 1% significance level, respectively. The data are from "The saving and investment nexus for China: Evidence from cointegration tests" by P. K. Narayan, 2005, *Applied Economics*, 37, pp. 1979-1990

The next step explores the long- and short-run relationship between human well-being, energy consumption, foreign direct investment, education, and urbanization in Vietnam. Table 4 presents the results of analyzing the effects of variables on long-term and short-term human well-being. The elasticity of EC concerning human well-being is 0.0008 in the long run and statistically insignificant. This issue means insufficient statistical evidence to conclude that energy consumption supports human well-being in Vietnam. However, the result of the study is also inconsistent with the research results of Afia (2019) and Ouedraogo (2013), which found that energy consumption increases or reduces human well-being, respectively.

For foreign direct investment, the study found that a 1% increase in FDI impacts a 0.009% increase in long-term human well-being. Though this result is what we were expecting, we are not the first to find this result. Mbang (2022) also found similar results through their study of the relationship between FDI inflows and human well-being in

Cameroon. However, this finding is inconsistent with Oyamendan (2022), who finds that foreign direct investment harms human well-being in Nigeria.

Ruggeri et al. (2020) suggested that one of the more critical factors in determining the well-being of an individual is often education. The estimated coefficient shows that education is positively related to human well-being at the 1% significance level in the long run. This result bears a positive sign (0.283). Consistent with the findings of Wang and Sohail (2022), who also report an upbeat assessment of the long-run relationship between education and human well-being in China. Dolan and Metcalfe (2012) argue that education helps people increase their well-being by allowing them to adjust their living, eating, and drinking habits in a better direction.

Urbanization has a long-run positive impact on human well-being and is statistically significant at the 5% level. Any increase of 1% in urbanization causes a rise of 0.813% in human well-being. The result of the study is also similar to the research result of Tripathi (2021).

Table 4 also reports short-run results. The short-run results show no statistical evidence of an impact of energy consumption on well-being was found. At the same time, the explanatory variables, including education, foreign direct investment, and urbanization, have different effects on human well-being. On the one hand, urbanization positively impacts human well-being and is statistically significant at the 10% level. On the other hand, education and foreign direct investment negatively affect human well-being and are statistically significant at the 5% level.

The diagnostic tests for the model are presented in Table 5. The model is adequate since the tests of the explanatory variables are equal to zero, a test of normality, the test of functional form misspecification, the test of autocorrelation, and the test of heteroskedasticity. Furthermore, based on the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) statistical plots, the study found that all coefficients are stable in both the short run and the long run with the selected sample (Figures 1 and 2).

**Table 4**

*Long and Short Runs Results*

Variables	Coefficient
<b>Long run analysis</b>	
lnEC	0.0008
lnFDI	0.009*
lnMYS	0.283***
lnUR	0.813**
<b>Short run analysis</b>	
$\Delta$ lnEC	-0.006
$\Delta$ lnFDI	-0.0162**
$\Delta$ lnMYS	-0.2418**
$\Delta$ lnUR	0.675*
ECT(-1)	-0.7179**

Note. \*, \*\*, and \*\*\* represent 1%, 5%, and 10% levels of significance, respectively. Data analysis result of the research

**Table 5**

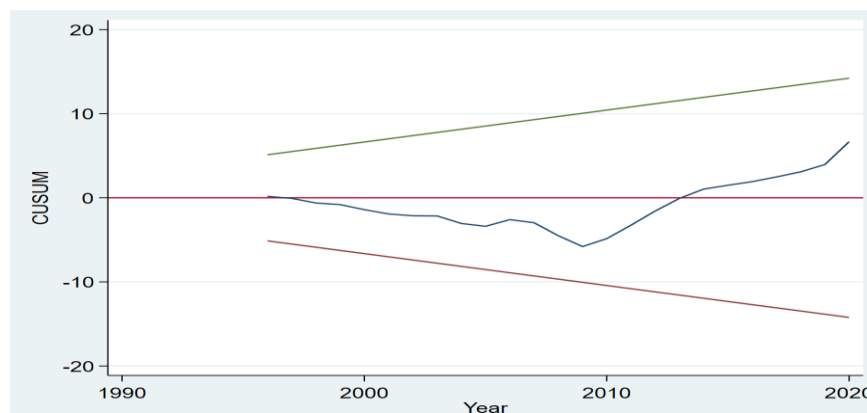
*Diagnostic Tests for the lnHDI Equation*

Diagnostic test	Null hypothesis	Statistics	Decision
Wald-test	H <sub>0</sub> : The explanatory variables are equal to zero	F(4, 6) = 458.33 (0.0000)	Reject H <sub>0</sub>
Jarque-Bera test	H <sub>0</sub> : Normality of error term	chi2(2) = 4.6 [0.1002]	Accept H <sub>0</sub>
Ramsey RESET test	H <sub>0</sub> : The model is correctly specified	F(3) = 3.47 [0.1669]	Accept H <sub>0</sub>
Breusch-Godfrey serial Correlation LM test	H <sub>0</sub> : No autocorrelation	F(1) = 1.166 [0.2803]	Accept H <sub>0</sub>
White's test	H <sub>0</sub> : Homoskedasticity	chi2 = 27 [0.4093]	Accept H <sub>0</sub>

Note. Figures in brackets represent the probability values of the test statistics. Data analysis result of the research

**Figure 1**

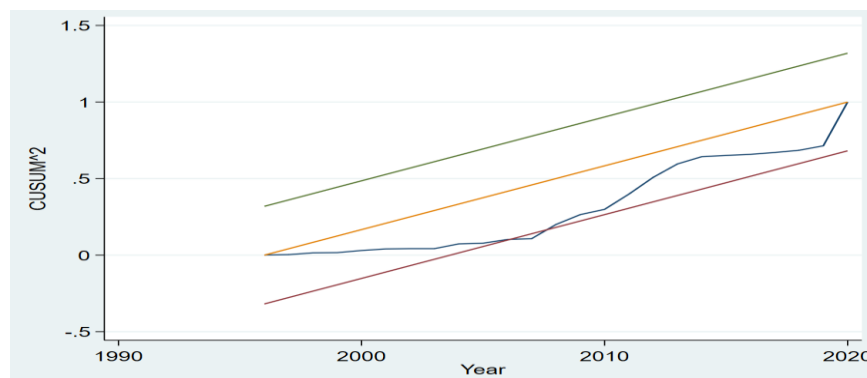
*The Plot of the CUSUM Test for the lnHDI Equation*



Note. Data analysis result of the research

**Figure 2**

*The Plot of CUSUM of Squares Test for the lnHDI Equation*



Note. Data analysis result of the research

## 5. Conclusion and policy implication

This research understood the impact of energy consumption, foreign direct investment, and education on human well-being in Vietnam from 2000 to 2020. To realize the aim of this research, a human well-being model was established using the ARDL method to estimate long-run and short-run impacts. Among the three main variables, only the energy consumption variable has found no statistical evidence of its effects on human well-being in the short and long run. The remaining two main variables include foreign direct investment and education, which have the same impact on human well-being in the short and long run. Meanwhile, urbanization positively affects human well-being in the short and long run. Moreover, the tests diagnose errors that the model may encounter. The results of the tests have shown that the model chosen by the study is entirely appropriate.

The above results have helped add to the overview of the research literature on human well-being, which scientists previously rarely paid attention to. In addition, the research results also help policymakers consider the increases and decreases in human well-being when promulgating policies related to attracting foreign direct investment capital, education, and urbanization. For example, to attract foreign direct investment capital, improve and invest more in infrastructure to make the country an attractive destination for many foreign investors compared to other countries. To educate people encourage them to attend higher education programs. Regarding urbanization, adequate provision of basic services, such as urban roads, water, electricity, medical facilities, etc., is needed to achieve sustainable urban development.

## NO CONFLICT OF INTEREST STATEMENT

All authors declare that they have no conflict of interest.

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