The interlink between output, FDI, human capital, public expenditure, inflation, and unemployment: Panel data evidence

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Abstract

This study is conducted to explore the connection between unemployment and economic growth as described by Okun's law. It also examines the Philips curve, which illustrates the inverse relationship between inflation and unemployment. Additionally, the study includes other independent variables, such as inflowed foreign direct investment (FDI), human capital (HC), government expenditure (GE), money supply (MS), and trade openness (TO) in the unemployment equation. The research involves a sample of 106 cross-countries categorized into emerging, developing, and least-developed countries from 2000 to 2021. Various econometric techniques, including first and second-generation unit root tests, Dumitrescu Hurlin panel causality tests, panel pooled mean group (PMG/ARDL), fully modified ordinary least squares (FMOLS), and dynamic ordinary least squares (DOLS) are utilized in the study. The robustness of these methods ensures the validity of the empirical results, which indicate that GDP, FDI, HC, GE, MS, INF, and TO have negative impacts on unemployment for all countries and developing countries. Conversely, there is a positive relationship between inflation and unemployment in emerging countries and between trade openness and unemployment in least-developed countries. To enhance the performance of government expenditure, attract productive FDI, improve human capital, increase per capita GDP, and reduce inflation in developing and least-developed countries, policymakers and authorities should prioritize fiscal and monetary policies aimed at enhancing these indicators to eliminate unemployment rates.

Keywords: *Output, Inflowed FDI; Government expenditure; Inflation; Trade Openness, Unemployment*

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1. Introduction

Unemployment is a critical macroeconomic problem and is an essential objective of economic policies because it affects the income and living standards of people. Therefore, this paper investigates the relationship between unemployment and economic growth, investment, public expenditure, inflation, money supply, and trade openness in both developed and developing countries. The association between change in unemployment and change in economic growth is known as Okun's law, and the connection between unemployment and inflation is acknowledged as the Philips curve.

Okun's law is the negative relationship between the change in economic growth and the change in the unemployment rate. This law provides an essential nexus between the goods and services market and the labor market. Okun (1963) found that, in the United States, the decrease in unemployment by one percent can be attributed to the increase in economic growth by three percent above the possible growth rate. This negative relationship is based on the fact that the increase in investment, consumption, and total expenditure during the period of prosperity enhances the demand for goods and services in the market, which augments the labor demand in the labor market and, therefore, raises the employment rate and decreases unemployment rate, indicating a negative economic growth- unemployment relationship. On the other hand, high unemployment impedes achieving economic growth.

In addition to Okun's law, this paper explores the relationship between unemployment and inflation, identified as the Philips curve. In Keynesian theory, the Philips curve shows a tradeoff or negative relationship between unemployment and inflation. In contrast to Keynesian theory, monetarists believe that there is no tradeoff or negative relation between unemployment and inflation in the long run, which means that the Philips curve is a vertical line in the long run (Mankiw, 2010).

Thus, this paper aims to evaluate the impact of per capita GDP, inflowed FDI, HC, GE, MS, TO, and INF on unemployment rates in 106 countries across the World during the period from 2000 to 2021, including emerging, developing, and least-developed countries. To achieve this goal, the study applies various econometric techniques such as FMOLS, DOLS, and PMG/ARDL alongside first and second-generation unit root tests. Finally, the study also employs the Dumitrescu Hurlin panel causality tests to check the validity of Okun's law alongside the relationship between UNE and

regressors. Empirical results reveal that there are three important findings related to this paper. Firstly, the empirical results reveal that GDP, FDI, HC, GE, MS, INF, and TO have negative impacts on unemployment in all countries and developing countries. Secondly, the effect of inflation on unemployment is positive in emerging countries. Thirdly, trade openness has a positive impact on unemployment in least-developed countries. This paper is organized as follows: section two deals with the literature review, while section three encompasses the research methodology. In sections four and five, the empirical results and conclusions are presented.

2. Literature Review

Numerous empirical studies deal with the association between economic growth and unemployment rates in developed and developing countries. This important macroeconomic topic covers extensive area research, starting with the empirical study by Okun (1963) in the United States, which was the first to conclude the negative relation between output and unemployment.

Also, in the United States, some empirical studies sustained the importance of Okun's law. For example, Arai (2023) found that the connection between economic growth and unemployment is significantly negative, indicating the effectiveness of Okun's law. However, the nexus between inflation and unemployment is weak. In the same vein, in the United States, Valadkhani and Smyth (2015) supported the validity of Okun's law in the US during the period from 1948 to 2015. Furthermore, Okun's coefficient is more robust within-regime asymmetry than across-regime asymmetry. Similarly, in the United States, the study by Yazgan and Yilmazkuday (2009) was in line with previous studies and supported the validity of Okun's law.

In European countries, a lot of experimental studies supported the significance of Okun's law. For example, in order to investigate the soundness of Okun's law in the euro area, the study by Banerji et al. (2015) sustained the effectiveness of economic growth and labor market institutions on unemployment. Moreover, youth unemployment is more sensitive to economic activity than adult unemployment. Also, Institutions factors of labor markets, namely tax wedge, minimum wages, market policies, labor opportunity cost, vocational training, and market duality, play an essential role in explaining youth unemployment in European countries.

In 28 European countries, the literature by Butkus and Seputiene (2019) maintained the importance of Okun's law and the difference between the unemployment responses of youth and adults to economic growth changes. However, they did not find evidence of a difference between unemployment reactions for men and women to economic growth. Similarly, in 13 European countries, the study by Economou and Psarianos (2015) revealed that Okun's coefficient is weaker for countries with high labor market protection. In contrast, it is more significant for countries with low labor market protection. In Spain, the study by Villaverde and Maza (2007) maintained Okun's coefficients for the Spanish regions, and Okun's law was valid for most of the regions.

In the context of Okun's law in Turkey, Cosar and Yavuz (2021) concluded that Okun's law is valid and Okun's coefficient is higher during recessions than revivals. The unemployment of youth (aged between 15- 24 years) is more sensitive to economic shocks than the unemployment of other ages. Similarly, the unemployment of men is more sensitive to economic shocks than the unemployment of women.

In Serbia, by applying both linear Autoregressive Distributed Lag (ARDL) and nonlinear Autoregressive Distributed Lag (NARDL) models, Mihajlovic (2020) examined the effect of economic growth and inflation on the unemployment rate. The results of ARDL and NARDL models showed that economic growth has adverse and significant effects on unemployment in the long and short run, suggesting the soundness of Okun's law in Serbia. Also, the inflation rate has positive and significant outcomes on unemployment in the long and short run. In Greece, in line with the previous studies, Karfaki et al. (2013) discovered that Okun's law is compelling; the response of unemployment to economic growth is stronger during contraction than during the expansion business cycle.

Okun's law was valid in 21 OECD countries to the study by Boda and Povazanova (2021). Also, the results revealed that men's unemployment is more sensitive to output fluctuations than women's unemployment for the majority of countries. Using pooled mean group and panel ARDL models, Huang and Yeh (2013) assessed the influence of economic growth on unemployment in 53 countries (21 OECD countries and 32 non-OECD countries) and 50 states in the US. Okun's law applies in all 53 countries (total sample) and is also effective in the two subsamples (21 OECD and 32

non-OECD countries). Furthermore, the results confirmed the effectiveness of Okun's law in the US and all subsamples of state-level data in the US.

In 38 advanced countries and 58 emerging and developing countries, An et al. (2021) supported the effectiveness of Okun's law, where the response of unemployment to economic growth is higher in advanced countries compared to emerging and developing countries. Also, they supported the different responses to unemployment between genders, where unemployment of women is less receptive to economic growth than unemployment of men. Similarly, the unemployment of youth is less reactive to economic growth than the unemployment of adults. Similarly, in 71 countries classified as 29 advanced and 42 developing, Ball et al. (2019) studied the response of unemployment to economic growth countries. They found that the responses of unemployment to economic growth in advanced countries are higher than the developing countries. Also, in the United States and 20 advanced countries, another study by Ball et al. (2013) established that Okun's Law is stable in most countries. Moreover, the practical study by Yi et al. (2022) uncovered the negative and significant response of unemployment to economic growth in developed and developing countries

To address the acceptance of Okun's law in MENA countries, Khrais and Al-Wadi (2016) observed the effect of real output on the unemployment rate in MENA countries (20 countries) for the period between 1990 and 2016. The results of simple linear regression indicated that the effect of the gross domestic product on unemployment is negative and significant in three countries only (Egypt, Jordan, and the United Arab Emirates) and equal -0.75, -0.50, and -0.14, respectively. However, the negative impact of gross domestic product on Unemployment is not significant for other countries.

To examine Okun's law in Arab countries, using the pooled EGLS model, Abdul Khaliq et al. (2014) observed the effect of gross domestic product and population growth rate on unemployment. They discovered that the influence of economic growth on unemployment is negative and significant. Still, the effect of population growth on unemployment is positive and significant in these Arab countries, suggesting the soundness of Okun's law.

In Jordan, Hjazeen et al. (2021) investigated the impact of economic growth, education, female population, and urban population on the unemployment rate using the ARDL model. The results of the ARDL model sustained the negative and significant impacts of economic growth on

unemployment. They sustained the positive and significant influences of education, the female population, and the urban population on the unemployment rate in Jordan. In Saudi Arabia, Louai and Riache (2019) held the negative relation between output and unemployment and confirmed Okun's law.

In the organization of Islamic cooperation countries, Liu et al. (2022) studied the effect of economic growth, public expenditure, inflation, foreign direct investment, trade openness, and institutional performance on unemployment. They found that economic growth, public expenditure, inflation, foreign direct investment, trade openness, and institutional performance have adverse and significant effects on unemployment in these countries. Also, in Indonesia, Vikia et al. (2023) tested the effect of economic growth, government expenditure, human development, and labor force on unemployment. The results showed that the economic growth rate and labor force have adverse effects on unemployment in the short and long term. However, the effects of government expenditure and human development on unemployment are adverse in the short run, while their effects are positive in the long run.

Using the ADRL model in Ethiopia, the study by Shiferaw (2023) sustained the negative relation between economic growth and unemployment that confirmed Okun's law. To verify whether Okun's law holds In Nigeria, Dankumo et al. (2019) examined the effect of unemployment, corruption, and political instability on economic growth in this country by using the Autoregressive Distributed Lag (ARDL) model. The results of the ARDL model explained that the effects of unemployment and corruption on economic growth are negative but it is not significant. However, the effect of political instability on economic growth is negatively significant. In another study in Nigeria, employing the Johnsen cointegration test, Vector Error Correction Model (VECM), and Granger causality, Michael et al. (2016) sustained the significant and negative effects of unemployment on economic growth in Nigeria. In Ukraine, Faryna et al. (2022) showed a negative relation between inflation and unemployment and, therefore, sustained the validity of the Philips curve.

However, some empirical studies do not support the importance of Okun's law. For example, in Leiria, using autoregressive distribution lag (ARDL) and bounds test to determine the relation between economic growth

and unemployment, Conteh (2021) did not sustain the validity of Okun's law in Leiria. In Turkey, Barıs-Tuzemen and Tuzemen (2019) did not support the effectiveness of Okun's law as the manufacturing industry did not affect unemployment in the short and long run. In Macedonia, the study by Sadiku et al. (2015) used the ECM and VAR models to examine the relationship between economic growth and unemployment in the short and long term. The results of ECM and VAR models showed that the change in the unemployment rate is not affected significantly by the change in economic growth in Macedonia. In Pakistan, Bangladesh, India, Sri Lanka, and China, Lal et al. (2010), using an error correction mechanism (ECM) and modified ordinary least squares (OLS), did not support the validity of Okun's law in these Asian countries. Also, in another study in Jordan, Kreishan (2011) explored the link between unemployment and economic growth. The unit root, cointegration, and simple regression tests were employed to examine the rationality of Okun's law in Jorden. The empirical results revealed that the effect of economic growth on the unemployment rate is negative. Still, it is not significant, which means that Okun's law cannot be confirmed for Jordan.

Some empirical studies support the importance of capital accumulation in determining the unemployment rate. For example, the empirical study by Hegelund (2023), in ten OECD countries, examined the relation among unemployment and independent variables, which are economic growth, investment, interest rate, and productivity, in the short and long run using band spectrum regression. The results of the study showed that investment only has significant and negative effects on unemployment in these countries. Using panel data for 12 OECD countries, Stockhammer et al. (2014) uncovered that Capital investment is the essential variable in explaining changes in unemployment. In contrast, labor market institutions are not an essential variable in explaining these changes. In all OECD countries, the study by Malley and Moutos (2001) supported the importance of capital accumulation. In euro area countries, the results of the empirical study by Arestis et al. (2007) stayed the vital effect of capital stock on unemployment and wages in the European countries. In the same vein, in Sweden, Finland, and Denmark, the study by Karanassou et al. (2007) established that capital stock is a significant determinant of unemployment.

Besides, the literature review sustained the importance of government expenditure. Some studies found a negative impact of government expenditures on unemployment, whereas others sustained the positive influence of government expenditures on unemployment. For example, using panel data from India, Nepram et al. (2021) observed that both government expenditures on development and non-development have positive and significant effects on the unemployment rate. Using the Johansen cointegration test and the vector error correction model (VECM), the empirical study by Abdouelfarag and Qutb (2020) found that increasing government expenditure heightens the unemployment rate in Egypt. However, other studies sustained the positive effect of government expenditures on unemployment. For example, in Indonesia, the study by Akhmad et al. (2022) established that government expenditure has a significant impact on reducing poverty and unemployment. Using the ARDL model and cointegration test in Jordan, Saraireh (2020) found that government spending has negative and significant influences on the unemployment rate. Using Generalized Method of Moments (GMM) techniques, the study by Selase (2019) showed that expenditures on infrastructure and education decrease unemployment in 20 African countries, whereas expenditures on health and defense upsurge unemployment in these countries.

Finally, the relation between trade openness and unemployment is supported by some studies. Some studies sustained the negative connection between trade openness and unemployment. For example, in the organization of Islamic cooperation countries, using dynamic common correlated effects (DCCE) and pooled mean group (PMG), the study by Ali et al. (2021) established that trade openness has a significant and negative impact on the unemployment rate in overall and lower-income countries, while it has a positive impact on unemployment in high-income countries. Similarly, using the RDL mode in Nigeria, the study by Nwosa (2020) discovered that trade openness and inflation have negative and significant impacts on the unemployment rate. In contrast, government expenditure has positive and significant effects on the unemployment rate. Furthermore, using data from 92 countries, the study by Dutt (2009) found that trade openness has a negative influence on unemployment, but trade protection has a positive result on unemployment.

However, some studies sustained a positive association between trade openness and unemployment. For example, in Bangladesh, by applying the VECM model and Johannsen cointegration test, the study by Hossain et al. (2018) examined the relationship between trade openness and public expenditure on education and unemployment. They found that trade openness policy leads to increased unemployment, but expenditure on education leads to a decline in unemployment in Bangladesh. Similarly, in Nigeria, using the vector error correction, the study by Nwaka et al. (2015) revealed that trade openness has a positive association with unemployment. In contrast, real output and income per capita have negative effects on unemployment. In situation of 75 labor- abundant and 44 capital-abundant countries, the study by Anjum and Perviz (2016) examined the impact of trade openness on unemployment. The results of mean group and pooled mean group techniques showed that trade openness has negative and significant impacts on unemployment in the case of labor-abundant countries. However, it has positive and significant impacts on unemployment in the case of capital-abundant countries. The following section covers the study's methodology which incorporates the employed variables and the applied model.

3. Methodology

To explore the impact of real per capita GDP, human capital, inflation, and control variables on unemployment rates, a sample of one hundred-six countries involving least-developed, developing, and emerging countries was selected. Data was collected during the period from 2000 to 2021. Data for the Human capital (HC) was obtained from the UNDP website: Documentation and downloads | Human Development Reports (undp.org). The HC variable is a composite indicator that includes health and education indicators and it is calculated as a geometric mean of both indicators. The grouping countries in the sample were clustered based on their level of income, industrialization, human capital, and other criteria in relation to the IMF, OECD, and WB classifications. Data for other variables are collected from the World Bank via World Development Indicators (WDI):http://data.worldbank.org. The government expenditure (GE) variable represents government expenditure as a ratio to GDP; the consumer price index is used as a proxy for the inflation (INF) rate variable, FDI variable is net inflowed FDI as a ratio of GDP. UNE is the unemployment rate as a ratio

to the labor force, and TO denotes trade openness, which is the sum of exports and imports divided by GDP and is obtained from our world in data (OWID) https://ourworldindata.org/. Table 1 demonstrates a list of grouping countries.

Table 1. Grouping countries

Emerging countries			**Developing countries**			**Least-developed countries**	
Albania	Dominican	Panama	Algeria	India	Sri Lanka	Angola	Malawi
Argentina	Georgia	Paraguay	Belize	Iran	Tonga	Bangladesh	Mauritania
Armenia	Indonesia	Poland	Bolivia	Kenya	Tajikistan	Benin	Mozambique
Azerbaijan	Jamaica	Qatar	Botswana	Kyrgyzstan	Tunisia	Bhutan	Myanmar
Bahrain	Jordan	Romania	Cameroon	Libya	Turkmenistan	Burkina Faso	Nepal
Belarus	Kazakhstan	Russia	Congo	Maldives	Ukraine	Burundi	Rwanda
Bosnia	Kuwait	Saudi Arabia	Cote d Ivoire	Mongolia	Uzbekistan	Cambodia	Senegal
Brazil	Lebanon	Serbia	Ecuador	Morocco	Vietnam	Eretria	Sierra Leone
Brunei	Malaysia	Seychelles	Egypt	Namibia		Eswatini	Sudan
Bulgaria	Mauritius	South Africa	El-Salvador	Nicaragua		Ethiopia	Tanzania
Chile	Mexico	Thailand	Gabon	Nigeria		Guinea	Togo
China	Moldova	Türkiye	Gambia	Pakistan		Haiti	Uganda
Colombia	North Macedonia	UAE	Guatemala	Peru		Liberia	Zambia
Costa Rica	Oman	Uruguay	Honduras	Philippines		Madagascar	

Source: Authors' grouping is based on IMF, OECD, and WB classification

The purpose of this study is to analyze how GDP, FDI, and HC, along with other variables, affect unemployment rates. The study uses robust econometric techniques such as fully modified ordinary least squares (FMOLS), dynamic ordinary least squares (DOLS), and PMG/ARDL to avoid biases and issues associated with serial correlation in the data when using OLS (Kao and Chiang, 2000). The co-integrating relationships are estimated using relevant techniques. To examine the panel co-integrated relationships among variables, the study uses FMOLS and panel DOLS methods. Kao and Chiang (2000) demonstrate that both techniques lead to normally distributed estimators. However, Monte Carlo simulations show that DOLS estimation of co-integration is less biased and has better sample properties than FMOLS estimators in small samples. Additionally, robust regression is used to mitigate the impact of outliers. The functional form of the FMOLS estimator is:

$$\hat{\beta}_{FMOLS} = \{\sum_{i=1}^{N}\sum_{i=1}^{T}(X_{it} - \bar{X}_{it})\ (X_{it} - \bar{X}_{it})\}^{-1} \quad \sum_{i=1}^{N}\sum_{i=1}^{T}(X_{it} - \bar{X}_{it})\ \left(\tilde{Y}_{it} - T_{\Delta_{\varepsilon\mu}}\right) \qquad (1)$$

where $\tilde{Y}_{it}$ is the endogeneity correlation term, and $T\Delta_{\varepsilon\mu}$ is the serial correlation correction term. The DOLS functional form is:

$$\hat{\beta}_{DOLS} = \quad \theta_i + \beta_i X_{it-1} + \sum_{j=P1}^{P2} Z_{ij}\ \Delta X_{it+j} + U_{it} \qquad (2)$$

p_2 is the maximum lead length, and p_1 is the maximum lag length ΔX_{it+j} to eliminate the effect of endogeneity of X_{it} and U_{it}.

Then, the PMG/ARDL model for dynamic panel data is utilized in this study. This model is specifically chosen to account for heterogeneity and cross-sectional dependence, ensuring that the results are both unbiased and robust. The author's choice of this model demonstrates their dedication to methodological rigor and the credibility of the findings. To estimate an ARDL(p, q, q, . . ., q) model using a panel dataset with indexed groups i = 1, 2, . ., N and time periods indexed by t = 1, . . . , T, where T is sufficiently large to allow consistent estimation for each group, certain assumptions are made:

$$y_{it} = \sum_{j=1}^{p}\lambda_{ij*\,yi,t-j} + \sum_{j=0}^{q}\delta'_{ij*}\ x_{i,t-j} + \gamma'_{i*}\,d_t + \varepsilon_{it} \qquad (3)$$

where x_{it} and d_t are $k \times 1$ and $s \times 1$ vectors of regressors, respectively, while the $\lambda_{ij*\,yi}$ are unknown scalars, the $\delta'_{ij*\,S}$ and γ'_{i*S} are $k \times 1$ and $s \times 1$ vectors of unknown parameters to be estimated. Eq.3 can be re-written as follows:

$$\Delta y_{it} = \phi_{i*}y_{i,t-1} + \beta'_{i*}x_{it} + \sum_{j=1}^{p}\lambda_{ij*\,yi,t-j} + \sum_{j=0}^{q}\delta'_{ij*}\ x_{i,t-j} + \gamma'_{i*}\,d_t + \varepsilon_{it} \quad (4)$$

where

ϕ_{i*}=-$\left(1 - \sum_{j=1}^{p}\lambda_{ij*}\right)$, β_{i*} =$\sum_{j=0}^{p}\ \delta_{ij*}$, $\lambda^*_{ij} := -\sum_{m=j+1}^{p}\lambda_{im*}$, $j = 1, \ldots . p-1$ and $\delta^*_{ij} := -\ \sum_{m=j+1}^{q}\delta_{im*},\ j = 1, \ldots ., q-1\ ,\ i = 1, \ldots .,\ N.$

Equation 4 can be further simplified as Equation 5 to obtain

$y_i = (y_i 1, \ldots ,\ y_i T\ )'$and $X_i = (x_i 1, \ldots ,\ x_i T\ )'$. Eq.4 can be written as follows:

$$\Delta y_i = \phi_{i*}y_{i,-1} + X_i\beta_{i*} + \sum_{j=1}^{p-1}\lambda^*_{ij}\,\Delta y_{i,-j} + \sum_{j=0}^{q-1}\Delta\, X_{i,-j}\,\delta^*_{ij} + D\ \gamma_{i*} + \varepsilon_{it} \quad (5)$$

where D:= $(d_1, \ldots ,\ d_T)'$ is a $T \times s$ matrix of observations on the deterministic regressors, such as intercepts and time trends, and $y_{i,-1,}$ and $\Delta\, X_{i,-j}$ are $T \times 1$ and $T \times k$ matrices obtained by stacking $y_{i,-1,}$ and $x_{i,-j}$ respectively. The long-run coefficients on X_i can be obtained as $\theta_{i,*} = -\beta_{i,*}/\,\phi_{i*}$. Pesaran et al. (1999) assume long-run homogeneity such that

$\theta_{i,*} = \theta_*$ for every $i = 1, \ldots, N$. Consequently, each cross-section unit has the same long-run relationship structure as embedded in Pesaran and Shin's (1998) ARDL model. Thus, Eq. 5 can be compactly rewritten as:

$$\Delta y_i = \phi_{i*}\,\xi_i(\theta_*) + w_i k_{i*} + \varepsilon_i \qquad i=1, \ldots., N \qquad (6)$$

where: $\xi_i(\theta_*) = y_{i,t-1} - \mathrm{X}_i\,\theta_* \; = 1, 2, \ldots, N$

is the error correction component, $\mathrm{Wi} = (\Delta y_{i,-1}, \ldots, \Delta y_{i,-p+1}, \Delta X_i, \Delta X_{i,-1}, \ldots, \Delta_{Xi,-q+1}, \mathrm{D})$, and $k_i * = \left(\lambda^{*}_{i1}, \lambda^{*}_{i,p-1}, \delta^{*\prime}_{i1}, \delta^{*\prime}_{i,q-1}, \gamma'_{i*}\right)'$

The negative and significant sign of the error correction term (ECT) indicates a short-term relationship between variables, and the optimal lags for the cointegrating equation are determined based on the Akaike information criterion (AIC). Estimating Equation 6 is complex for several reasons: the equation for each group is nonlinear in ϕi* and θ*, the long-run homogeneity assumption introduces cross-equation parameter restrictions, and the error variances vary across groups. Pesaran et al. (1999) propose a maximum likelihood estimation framework in which the homogeneous long-run parameters are estimated by pooling, while group-wide mean estimates of the heterogeneous short-run parameters and error-correction coefficients are obtained by averaging across groups, leading to the "pooled mean group" estimation terminology.

In their 2021 study, Jin, Greenwood-Nimmo, and Chin emphasized that the PMG estimator uses a hybrid estimation approach. Homogeneous long-run parameters are estimated using maximum likelihood (ML) with pooled data across groups. However, heterogeneous short-run parameters are calculated on a group-specific basis, and their group-wide distribution is summarized by averaging across groups. To check if the study variables are stationary, I used the first-generation unit root test by Levin et al. (2002) and the second-generation cross-sectional augmented CIPS test by Pesaran (2007). You can find the results in Tables 4 and 5. The null hypothesis H_0 for the unit root is tested against the alternative H_1 as follows:

$$H_0: \quad \beta_i = 0 \quad \text{for all i} \qquad (7)$$

$$H_{1:}\ \beta_i < 0 \quad \mathrm{i} = 1; 2\ldots, N_1, \quad \beta_i = 0; \mathrm{i} = N_1 + 1; N_1 + 2, \ldots, N. \qquad (8)$$

Levin et al. (2002) proposed that panel unit root tests can be helpful in analyzing industry-level and cross-country data. Subsequently, second-generation panel data stationarity tests were developed, including the cross-

sectionally augmented panel unit root test (CIPS) introduced by Pesaran (2007). The CIPS test is robust against cross-sectional dependence between countries and tests the null hypothesis of unit roots. CIPS t-statistics are obtained by computing individual augmented Dickey-Fuller (ADF) statistics, allowing for cross-sectional dependence among the observed countries. It yields consistent results even with small sample sizes, and its critical values are compared with the computed CIPS statistics. The functional form of CIPS is:

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} t_i\,(N, T) \qquad (9)$$

where t_i (N, T) exhibits the statistics of the cross-sectional ADF.

After conducting Levin and CIPS tests, FMOLS, DOLS, and PMG/ARDL are employed to estimate the relationships among variables. The study model can be described as follows:

$$UNE = f\,(GDP, FDI, HC, GE, MS, INF, TO) \qquad (10)$$

Some variables are transformed into natural logarithms to reduce data sharpness and heteroscedasticity and make them comparable. Meanwhile, *UNE, FDI, HC, GE, MS,* and *INF* variables are expressed as percentages.

$$UNE_{it} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 FDI_{it} + \beta_3 HC_{it} + \beta_4 GE_{it} + \beta_5 MS_{it} + \beta_6 INF_{it} + \beta_7 \ln TO_{it} + \varepsilon_{it} \qquad (11)$$

Equation eleven illustrates the relationship between unemployment and several independent variables: economic growth, public expenditure, investment, money supply, inflation, and trade openness. Economic growth is included in the unemployment equation because it has a negative correlation with the unemployment rate, as per Okun's law. Government expenditure (GE) and investment (FDI) are also incorporated into the equation, as they represent effective demand and have a negative influence on unemployment, based on the Keynesian model. Furthermore, money supply (MS) is part of the equation as it reflects monetary policy, which has a negative impact on unemployment. Inflation (inf) is included because of its negative relationship with unemployment, according to the Philips curve. Lastly, trade openness (TO) is an independent variable in the unemployment equation based on Ricardo and Heckscher-Ohlin's theories of comparative advantage. The relationship between trade openness and unemployment is negative, according to Ricardo's theory. However, based on Heckscher-Ohlin's theory, trade openness reduces unemployment when the country has labor abundance but increases unemployment when the country has capital abundance.

Table 2. Description of variables and data sources

Variable	Description	Data
UNE	Unemployment rate as a ratio of the total labor force	WDI
GDP	Real per GDP in USD at 2015 constant prices	WDI
FDI	net inflowed foreign direct investment as a ratio of GDP	WDI
HC	Human Capital. The geometric mean of health and	UNDP
GE	Government expenses as a ratio of GDP	WDI
MS	Money supply as a ratio of GDP	WDI
INF	The consumer price index as a proxy of the inflation rate.	WDI
TO	Trade openness. The sum of exports and imports over GDP	OWID

Figures 1, 2, 3, and 4 present a comparison of emerging, developing, and least-developed countries based on unemployment rate, human capital, per capita GDP, and governmental expenditure as a percentage of GDP. For emerging countries, the average unemployment rate is around 8.7%, with the lowest value of 0.1% for Qatar in 2019 and the highest value of 37.3% for North Macedonia in 2005. For developing countries, the average unemployment rate is 8.23%, with a minimum value of 0.2% for Uzbekistan in 2006 and a maximum value of 31% for Libya in 2021. Least-developed countries have an average unemployment rate of 6.87%, with a minimum value of 0.14% for Cambodia in 2017 and a maximum value of 31% for Eswatini in 2006. Qatar, Vietnam, Uzbekistan, and Cambodia stand out with the lowest unemployment rates, while North Macedonia, Libya, and Eswatini present a contrasting picture with the highest rates among the grouping countries. This diversity in the data sparks curiosity and invites further exploration. Figure 2 displays the average per capita GDP for the grouping countries from 2020 to 2021. The average annual real per capita GDP for emerging countries is 11247$, with the highest real per capita GDP of 73491$ for Qatar in 2011 and the lowest of 1249$ for Armenia in 2000. This data underscores the economic disparities among the countries. Developing countries have an average real per capita GDP of 3313$, with Rwanda having the lowest value of 337.6 in 2000 and Libya having the highest value of 13,729$ in 2007. Least-developed countries have an average real per capita GDP of 1051.7$, with Eswatini having the highest value of 3923.6$ in 2021 and Ethiopia having the lowest value of 251.1$ in 2003. These figures highlight the challenges faced by the least-developed countries in achieving economic growth.

Figure 3 shows the average human capital for the grouping countries. The average human capital for emerging countries is 75.3%, with the highest value of 88.8% for the UAE in 2019 and the lowest value of 58.9% for South Africa in 2004. For developing countries, the average human capital is 64.6%, with the highest value of 81.3% for Ukraine in 2017 and the lowest value of 34.76% for Rwanda in 2000. Least-developed countries have an average human capital of 48.4%, with the highest value of 69.45% for Bangladesh in 2021 and the lowest value of 25.8% for Burkina Faso in 2000.

Finally, figure 4 provides the average governmental expenditure as a percentage of GDP for the grouping countries. The average governmental expenditure for emerging countries is 26.5%, with the highest value of 69.1% for Burnie in 2004 and the lowest value of 3.79% for the UAE in 2014. Developing countries have an average governmental expenditure of 24.3%, with the highest value of 181.9% for Libya in 2015 and the lowest value of 8.29% for Cote d'Ivoire in 2001. Least-developed countries have an average governmental expenditure of 19.14%, with the highest value of 84.03% for Eritrea in 2002 and the lowest value of 3.23% for Myanmar in 2005. Figures 5, 6, and 7 in the appendix provide a comparison of UNE, per capita GDP, HC, and GE indicators per country for each grouping of countries based on major differences within grouping countries. The following section demonstrates the empirical results.

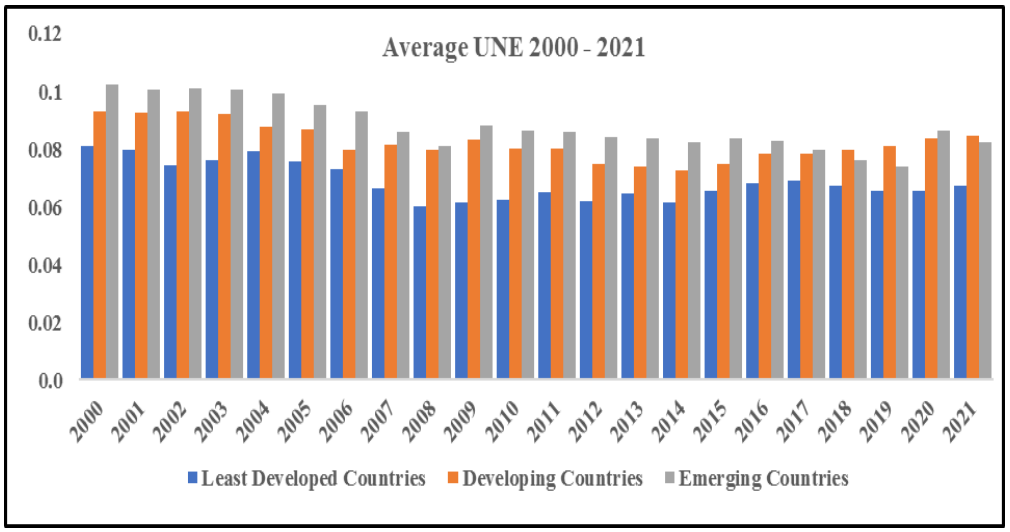

Figure1: Average Unemployment rates for emerging, developing, and least-developed countries from 2000 to 2021.
source: Authors' calculations based on the World Bank database.

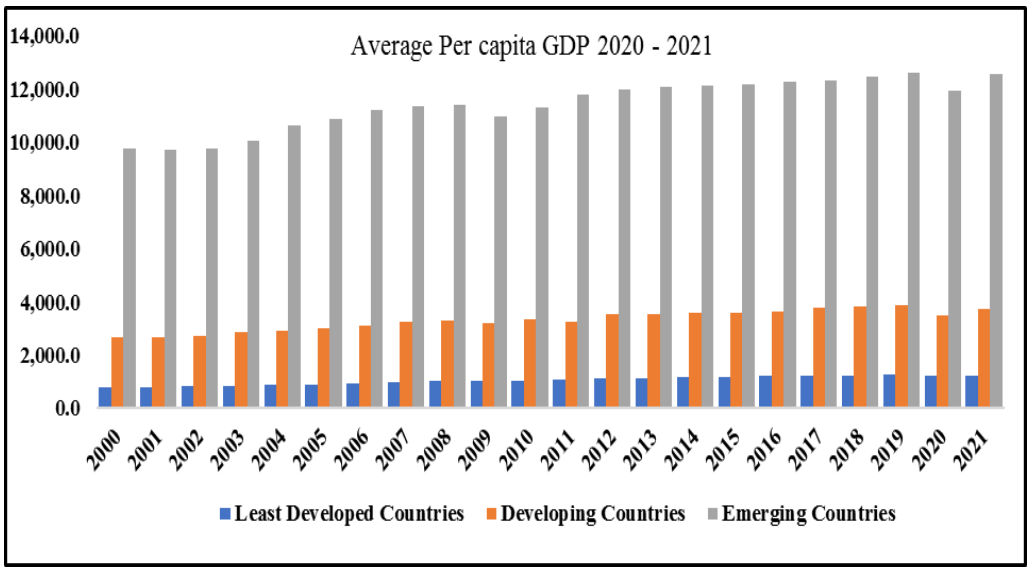

Figure2: Average per capita GDP for emerging, developing, and least-developed countries from 2000 to 2021
source: Authors' calculations based on the World Bank database

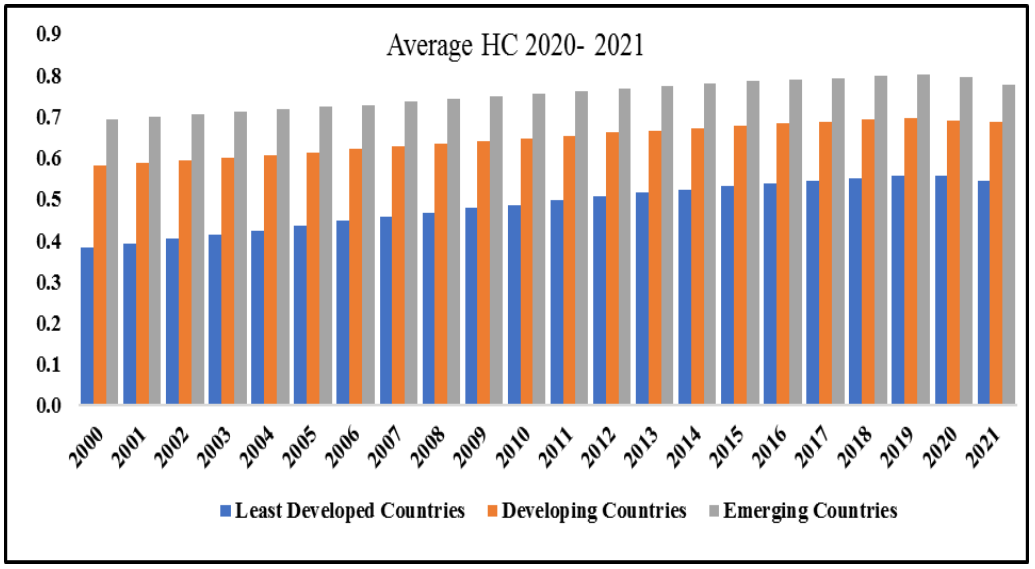

Figure3: Average Human capital for emerging, developing, and least-developed countries from 2000 to 2021
source: Authors' calculations based on the UNDP database

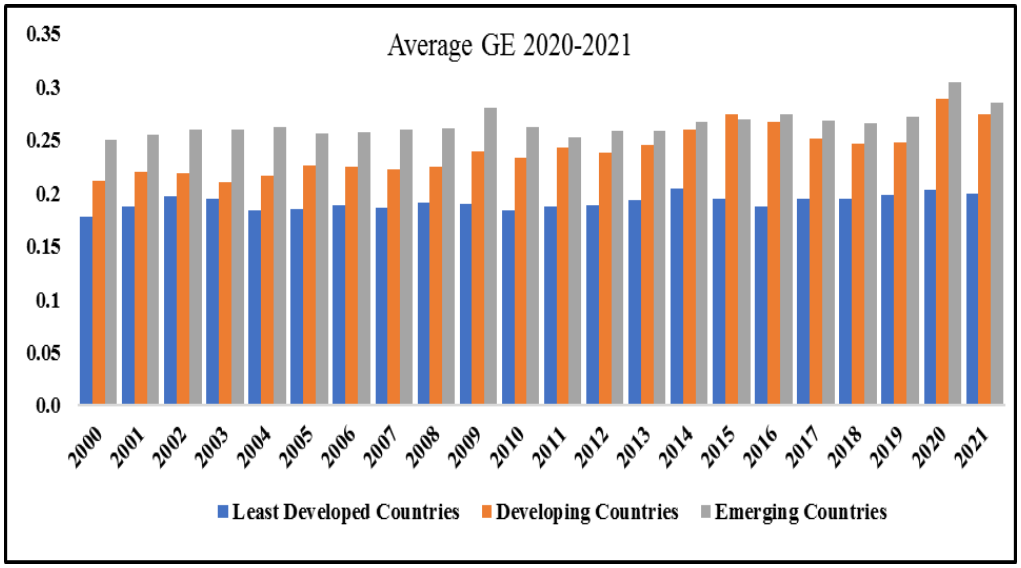

Figure 4: Average Governmental expenditure for emerging, developing, and least-developed countries from 2000 to 2021
source: Authors' calculations based on the World Bank database

4. Empirical Results

The empirical results include five sub-parts: in part 4.1, descriptive statistics and a correlation matrix are included; in part 4.2, the first and second-generation panel unit root tests are presented; in part 4.3, robustness checks are performed; in part 4.4, the panel PMG/ARLD technique is employed; and in part 4.5, the Dumitrescu Hurlin panel causality test is launched.

4.1 *Descriptive statistics and correlation matrix*

Table 3 contains a summary of descriptive statistics and a correlation matrix for the variables under study. The top part of the table displays the main statistics, indicating that HC and TO variables are skewed to the left, while the remaining variables are skewed to the right. The lower part of the table presents the correlation matrix among the variables.

Table 3: Descriptive Statistics

	UNE	LGDP	FDI	HC	GE	MS	INF	LTO
Mean	0.0812	8.0436	0.0402	0.6481	0.2381	0.5120	1.2082	4.2578
Median	0.0619	8.1093	0.0274	0.6875	0.2268	0.4328	1.0022	4.2953
Maximum	0.3732	11.205	1.0334	0.8885	1.8195	2.6100	162.46	5.6716
Minimum	0.0010	5.5417	-0.3717	0.2583	0.0323	0.0521	0.0291	2.4309
Std. Dev.	0.0624	1.1307	0.0601	0.1334	0.1153	0.3590	3.5020	0.4541
Skewness	1.4546	0.1302	6.4010	-0.5613	3.9765	2.2281	42.371	-0.3345

Kurtosis	5.2169	2.6384	78.809	2.3354	42.982	10.390	1933.5	3.1297
Jarque-Bera	1299.9	19.295	57434	165.39	16147	7236.0	3.6E+08	45.115
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sum	189.33	18757	93.813	1511.4	555.13	1193.9	2817.6	9929.1
Sum Sq. Dev.	9.0666	2979.9	8.4281	41.467	31.012	300.48	28587	480.63
Observations	2332	2332	2332	2332	2332	2332	2332	2332
Correlation Matrix								
UNE	1	0.1102	-0.0025	0.0226	0.3410	-0.1474	0.0410	0.0412
LGDP	0.1101	1	-0.0307	0.7616	0.3161	-0.0039	-0.0110	0.3125
FDI	-0.0025	-0.0307	1	0.0271	0.0085	0.0315	-0.0242	0.2473
HC	0.0226	0.7616	0.0271	1	0.2830	0.1809	-0.0031	0.3222
GE	0.3410	0.3161	0.0085	0.2830	1	0.1720	-0.0338	0.1927
MS	-0.1474	-0.0039	0.0315	0.1809	0.1720	1	0.0078	0.1108
INF	0.0410	-0.0110	-0.0242	-0.0031	-0.0338	0.0078	1	-0.0836
LTO	0.0412	0.3125	0.2473	0.3222	0.1927	0.1108	-0.0836	1

Source: Authors' calculations

4.2 *First and second-generation panel unit root tests*

In this section, the first-generation unit root test of Im, Pesaran and Shin (2003) is conducted to check for stationarity. Table 4 displays the unit root tests for the study variables, using both intercept and intercept with trend, to determine whether the variables are stationary at level or first difference. Moreover, the second generation unit root CIPS is used to test for constant and for constant with trend. The results are shown in Table 5, where the variables are found to be significant at different levels of significance. Consequently, the null hypothesis of the presence of a cross-sectional unit root is rejected. Unit root tests are conducted for all clustering countries, emerging, developing, and least-developed.

4.3 *Robustness checks*

In this study, we examined the robustness of variables using FMOLS and DOLS models, as presented in Table 6. The results in Table 6 for all sample countries and developing countries suggest a significant negative relationship between all regressors and UNE. This indicates that an increase in per capita GDP, inflowed FDI, improvement in HC, increase in GE, increase in MS, and trade openness contribute to lower unemployment rates. There is also a negative relationship between inflation rates and UNE, in line with economic theory. These findings are consistent with the studies of Akhmad et al. (2021), Dutt (2009), Liu et al. (2022), Nwosa (2020), Saraireh (2020), and Shiferaw (2023). The empirical results for emerging countries also reveal negative and significant relationships between GDP, FDI, HC, GE, MS, TO, and UNE. However, there is a positive relationship between INF and UNE. On the other hand, there is a negative and significant relationship between

GDP, FDI, GE, HC, MS, and UNE. In contrast, there is a positive relationship between TO, INF, and UNE for least-developed countries (Hossain et al., 2018; Nwaka et al., 2015).

4.4 *Panel PMG /ARLD*

The PMG/ARDL model is utilized to assess the impact of different variables on UNE. The findings are presented in Table 7. The long-run equation in Table 7 indicates a significant negative correlation between GDP, FDI, HC, GE, MS, INF, TO, and UNE for all countries. The negative relation between economic growth and unemployment sustains the validity of Okun's law in all countries. Also, the negative relation between inflation and unemployment supports the Philips curve in these countries. In the case of emerging countries, there exists a significant negative correlation between GDP, FDI, HC, GE, MS, TO, and UNE. However, there is a positive and significant correlation between INF and UNE. (Akhmad et al., 2021; Dutt, 2009; Liu et al., 2022; Nwosa, 2020; Saraireh, 2020; Shiferaw, 2023). For developing countries, there is a negative and significant correlation between GDP, FDI, HC, GE, INF, TO, and UNE. However, there is a positive and significant correlation between MS and UNE. For least-developed countries, there is a significant negative correlation between GDP, FDI, HC, GE, and UNE, while there is no correlation between MS, INF, and UNE. On the other hand, there is a positive correlation between TO and UNE. (Hossain et al., 2018 and Nwaka et al., 2015). The short-run error correction model (ECM) coefficient indicates a negative and significant value, as shown in Table 7.

The policy implications from these results indicate that the policymakers and authorities in these countries could use monetary and fiscal policy tools to enhance investment and output in order to decrease unemployment. Also, to decrease unemployment in these countries, policymakers and authorities can encourage trade with trade partners. Moreover, the policymakers and authorities in these countries should encourage investment in human capital with the aim of declining unemployment.

4.5 *Panel causality test*

In the following analysis, we present the results of the Dumitrescu Hurlin panel causality test for emerging, developing, and least-developed countries. Tables 8a, 8b, and 8c display these results, while Figures 7a, 7b and 7c illustrate the causality interrelationships between regressors for each group of

countries. Additionally, Figures 8a, 8b and 8c depict the relationships among dependent variables and regressors for different groups of countries. This technique involves W bar statistics (representing averages of Wald statistics) and Z bar statistics (calculated from the mean and variance of Wald statistics). The Wald statistics means, which represent the homogeneous non-causality (HNC) hypothesis, are calculated as follows:

$$W_{N,T}^{HNC} = \frac{1}{N}\sum_{i=1}^{N} W_{i,t} \; ; \; Z_{N,T}^{HNC} = \frac{\sqrt{N}\left[W_{N,T}^{HNC} = \frac{1}{N}\sum_{i=1}^{N} E\,(W_{i,t})\right]}{\sqrt{\sum_{i=1}^{N} VAR\,(W_{i,t})}} \qquad (12)$$

where W*i, t* reveals Wald statistics and H_0 = no homogeneous causality in the panel.

Our comprehensive analysis of the relationships between UNE and various factors for all countries has yielded robust results. We have found a bidirectional relationship between GDP, FDI, HC, TO, and UNE, and a unidirectional relationship from MS to UNE and from UNE to GE. The relationships among regressors show either bidirectional or unidirectional links, providing a thorough understanding of the causality relationships. In the case of developing countries, there is a bidirectional relationship between HC, INF, and UNE. At the same time, there is a unidirectional relationship from FDI, TO, and MS to UNE and from UNE toward GE. The relationships among regressors are either unidirectional or bidirectional. For least-developed countries, the relationships among regressors are either unidirectional or bidirectional. The analysis showed a bidirectional relationship between GDP and UNE. However, there is a unidirectional relationship from FDI, MS, and INF toward UNE, while there is no causality relationship between TO and unemployment.

In conclusion, our findings on the causality relationships between regressands and regressors and causality interrelations among regressors are presented clearly and concisely in Tables 8a, 8b, and 8c and Figure 8. This visual representation will help you grasp the complex relationships we have uncovered.

Table 4: Im, Pesaran and Shin W-stat unit root test results for intercept and intercept and trend

Variable			All sample countries	Emerging countries	developing countries	Least-developed
UNE	**Intercept**	level	–2.3338***	–1.5232*	–1.0689	–0.7398
		First Difference		–11.171***	–10.867***	–9.5737***
	Intercept &Trend	Level	1.7286	2.2729	1.4039	–0.6192
		First Difference	– 11.117***	–11.771***	–9.3198***	–6.8486***

		level	–0.3702	–1.4335*	–0.6634	1.4478
		First Difference	–11.287***	–7.318***	–7.6073***	–4.8603***
ln GDP	**Intercept**	Level	4.8008	1.9036	–6.3853***	5.0688
	&Trend	First Difference	–9.763***	–5.935***		–5.4174***
	Intercept	level	–7.3881***	–5.12895**	–4.6265***	–2.5276***
		First Difference				
FDI	**Intercept**	Level	–4.2068***	–3.5438***	–3.0657***	–0.2006
	&Trend	First Difference				–9.2424***
	Intercept	level	–3.9850***	–0.8511		– 3.6642***
HC		First Difference		–14.929***	–3.0831***	
	Intercept	Level	0.1816	1.8537	8.0063	6.2549
	&Trend	First Difference	–20.969***	–12.198***	–12.672***	–3.4847***
	Intercept	level	–0.8061	–13.635***	–0.6231	0.4645
GE		First Difference	–22.237***		–13.795***	–11.0518***
	Intercept	Level	–0.8894	–1.3702*	–0.4075	0.5776
	&Trend	First Difference	–17.332***	– 10.509***	–10.893***	–8.7387***
	Intercept	level	9.1318	4.6431	5.1460	6.6845
MS		First Difference	–19.329***	–13.113***	–10.632***	–9.9703***
	Intercept	Level	0.1703	–0.7793	0.2475	1.2187
	&Trend	First Difference	–15.505***	–10. 302***	–8.8343***	–8.1397***
	Intercept	level	18.4340	–5.3570***	11.0439	–1.0882
INF		First Difference	–6.7767***		–5.6800***	–14.203***
	Intercept	Level	7.9194	4.5406	2.7298	6.0300
	&Trend	First Difference	–4.8920***	–3.7341***	–4.5056***	–12.1347***
	Intercept	level	–4.5102***	–2.3477***	–3.6086***	–1.6228**
		First Difference				
ln TO	**Intercept**	Level	–3.6026***	–2.6871***	–2.5790***	–0.6608
	&Trend	First Difference				–8.3833***

Table 5: Pesaran CIPS unit root results for constant and for constant and trend

Variable		All sample countries	Emerging countries	Developing countries	Least-developed countries
UNE	Constant	–1.9384***	–0. 9690***	–1.2923***	–1.0572***
	Constant& Trend	–2.4396***	–1.4165***	–1.7932***	–2.3600***
ln GDP	Constant	–1.7157***	–0.9829***	–1.3896***	–1.1446***
	Constant& Trend	–1.9099***	–1.4905***	–1.5276***	–1.6636***
FDI	Constant	–1.9972***	–2.0671***	–2.1625**	–1.9726***
	Constant& Trend	–2.4454***	–2.5330***	–2.7214**	–2.5625***
HC	Constant	–1.6677***	–1.5567***	–1.4811***	–1.5434***
	Constant& Trend	–1.5785***	–1.5012***	–1.6243***	–1.4253***
GE	Constant	–1.6390***	–1.3013***	–1.6228***	–1.2946***
	Constant& Trend	–1.6825***	–1.6987***	–1.6808***	–1.8116***
MS	Constant	–1.6521***	–1.7145***	–1.4441***	–1.9100***
	Constant& Trend	–2.0656***	–1.6660***	–1.7361***	–2.0392***
INF	Constant	–0.3694***	–0.6571***	–0.2309***	–0.1936***
	Constant& Trend	–1.3755***	–1.1512***	–1.1599***	–1.3862***
ln TO	Constant	–1.1370***	–0.9850***	–1.5586***	–1.0908***
	Constant& Trend	–1.8334***	–1.7148***	–2.0257***	–1.7783***

Table 6: The impact of coefficients' FMOLS/ DOLS model for the impact of regressors on UNE

Variable	Technique	All sample countries	Emerging countries	Developing countries	Least-developed countries
ln GDP	FMOLS	–0.1187***	–0.0389***	–0.0710***	0.0058*
	DOLS	–0.0627***	–0.0574***	–0.0701***	–0.0425***
FDI	FMOLS	–0.0376***	0.0038	–0.0078	–0.0428***
	DOLS	–0.0328***	–0.0356*	–0.0055	–0.0310**
HC	FMOLS	–0.0615***	–0.0924*	–0.3213***	–0.0717***
	DOLS	–0.0471***	0.0875*	–0.3486***	–0.1295**
GE	FMOLS	–0.0693***	–0.0612*	–0.0130***	–0.0230***
	DOLS	–0.0049***	0.0729***	–0.0167*	–0.0580*
MS	FMOLS	–0.0183***	–0.0017	–0.0300***	–0.0086***
	DOLS	–0.0215***	–0.0114	–0.0229**	–0.0245**
INF	FMOLS	–0.0003***	0.0101***	–0.0064***	0.0002***
	DOLS	–0.0003***	0.0127***	–0.0065***	–1.56E–5
ln TO	FMOLS	–0.0043***	–0.0302***	–0.0123***	0.0115***
	DOLS	–0.0109***	–0.0308***	–0.0110***	0.0024
R^2	FMOLS	0.8525	0.8622	0.9271	0.8797
Adj. R^2	FMOLS	0.8445	0.8542	0.9187	0.8722
R^2	DOLS	0.9173	0.9111	0.9207	0.9303
Adj. R^2	DOLS	0.9088	0.9015	0.9120	0.9224

Table 7: Estimates of the PMG/ ARDL model for the impact of regressors on UNE

Variable	All sample countries	Emerging countries	Developing countries	Least- developed countries
		Long Run Equation		
ln GDP	–0.0263***	–0.0288***	–0.1182***	–0.0213***
FDI	–0.0281***	0.0078	0.421	–0.1080***
HC	–0.3221***	–0.3328***	–0.2690***	–0.1444***
GE	–0.0225***	–0.0830***	–0.0657***	–0.1334***
MS	–0.0327***	–0.0192**	0.0602***	0.0142
INF	–0.0010	0.0207***	–0.0141***	0.0009
ln TO	–0.0002***	–0.0009***	–0.0256***	0.0005***
		Short Run Equation		
ECM	–0.4122***	–0.2070***	–0.4432***	–0.3256***
D ln (UNE(-1)	0.0484	–0.0028	–0.0310	0.1371**
D ln (GDP)	–0.0549***	–0.0837***	–0.0217	0.0276
D(FDI)	0.0122	0.0068	–0.0100	0.1535
D(HC)	0.2282***	–0.0319	0.5044***	0.1877
D(GE)	0.0164	0.0271	–0.0502	0.0164
D (MS)	0.0006	0.0388*	–0.0230	–0.0218
D (INF)	–0.0187	–0.0137	0.0082	–0.0125
D ln (TO)	4.05E-05	–3.90E-06	0.0115*	–4.92E-05

Table 8. a Dumitrescu Hurlin causality test for Emerging countries

Null Hypothesis	W-Stat	Z-Stat	Prob	Conclusion
Ln GDP ⇎UNE	4.8040	6.0035	2.E-09	GDP↔UNE
UNE ⇎ ln GDP	3.9077	3.8480	0.0001	
FDI ⇎ UNE	2.7274	1.0094	0.3128	UNE→ FDI
UNE ⇎ FDI	4.1037	4.3192	2.E-05	
HC ⇎ UNE	5.2556	7.0898	1.E-12	HC↔ UNE
UNE ⇎ HC	5.5607	7.8232	5.E-15	
GE ⇎ UNE	2.5071	0.4795	0.6316	UNE→ GE
UNE ⇎ GE	3.6950	3.3363	0.0008	
MS ⇎ UNE	4.1700	4.4788	8.E-06	MS→ UNE
UNE ⇎ MS	2.3560	0.1161	0.9075	
INF⇎ UNE	5.3096	7.2192	5.E-13	INF→ UNE
UNE ⇎ INF	3.0347	1.7484	0.0804	
ln TO ⇎ UNE	3.4530	2.7543	0.0059	TO↔UNE
UNE⇎ ln TO	4.4727	5.2066	2.E-07	
FDI ⇎ ln GDP	4.1852	4.5152	6.E-06	FDI↔ GDP
ln GDP ⇎ FDI	4.2251	4.6112	4.E-06	
HC ⇎ ln GDP	4.8507	6.1156	1.E-09	HC ↔ GDP
ln GDP ⇎ HC	9.5211	17.348	0.0000	
GE ⇎ ln GDP	3.1945	2.1328	0.0329	GE ↔ GDP
ln GDP ⇎ GE	5.7969	8.3912	0.0000	
MS ⇎ ln GDP	5.2615	7.1035	1.E-12	MS ↔ GDP
ln GDP ⇎ MS	4.0396	4.1650	3.E-05	
INF ⇎ ln GDP	4.9444	6.3411	2.E-10	INF↔ GDP
ln GDP ⇎ MS	4.3849	4.9956	6.E-07	
ln TO ⇎ ln GDP	3.0861	1.8719	0.0612	GDP→ TO
ln GDP ⇎ ln TO	5.4558	7.5710	4.E-14	
HC⇎ FDI	3.3728	2.5614	0.0104	HC→ FDI
FDI ⇎ HC	2.1492	-0.3812	0.7031	
GE ⇎ FDI	3.4517	2.7512	0.0059	GE→ FDI
FDI ⇎ GE	2.8129	1.2150	0.2244	
MS ⇎ FDI	3.2673	2.3077	0.0210	MS→ FDI
FDI ⇎ MS	2.4228	0.2767	0.7820	
INF ⇎ FDI	3.9251	3.8896	0.0001	INF→ FDI
FDI ⇎ INF	2.9817	1.6208	0.1051	
Ln TO ⇎ FDI	4.7786	5.9422	3.E-09	TO↔FDI
FDI ⇎ ln TO	4.1759	4.4928	7.E-06	
GE ⇎ HC	3.1345	1.9885	0.0468	GE↔HC
HC ⇎ GE	4.6715	5.6848	1.E-08	
MS ⇎ HC	2.9702	1.5933	0.1111	HC→ MS
HC ⇎ MS	4.9908	6.4526	1.E-10	
INF ⇎ HC	5.2856	7.1615	8.E-13	INF↔HC
HC ⇎ INF	3.2659	2.3045	0.0212	
ln TO ⇎ HC	2.6678	0.8660	0.3865	HC→ TO
HC ⇎ ln TO	5.8075	8.4166	0.0000	
MS ⇎ GE	3.0212	1.7160	0.0862	MS ⇎ GE
GE⇎ MS	2.7300	1.0155	0.3099	
INF ⇎ GE	5.7309	8.2325	2.E-16	INF → GE
GE⇎ INF	2.9925	1.6470	0.0996	
ln TO ⇎ GE	3.7672	3.5100	0.0004	TO→ GE
GE ⇎ ln TO	2.2266	-0.1950	0.8454	
INF ⇎ MS	5.6463	8.0289	9.E-16	INF↔ MS
MS ⇎ INF	6.0482	8.9955	0.0000	
Ln TO ⇎ MS	3.5924	3.0895	0.0020	TO ↔ MS
MS ⇎ ln TO	4.5694	5.4393	5.E-08	
Ln TO ⇎ INF	3.6262	3.1708	0.0015	TO ↔ INF
INF ⇎ ln TO	9.5425	17.399	0.0000	

Note: The symbol ⇎ denotes no causality exists, → represents a one-way causality association, and ↔represents a two-way causality association.

Table 8. b Dumitrescu Hurlin causality test for developing countries

Null Hypothesis	W-Stat	Z-Stat	Prob	Conclusion
Ln GDP ⇏UNE	4.4055	4.7352	2.E-06	GDP↔UNE
UNE ⇏ ln GDP	2.4620	0.3484	0.7275	
FDI ⇏ UNE	3.7461	3.2469	0.0012	FDI→ UNE
UNE ⇏ FDI	2.8184	1.1528	0.2490	
HC ⇏ UNE	4.6190	5.2171	2.E-07	HC↔ UNE
UNE ⇏ HC	3.3977	2.4605	0.0139	
GE ⇏ UNE	2.4857	0.4018	0.6878	UNE→ GE
UNE ⇏ GE	3.6471	3.0233	0.0025	
MS ⇏ UNE	4.3576	4.6271	4.E-06	MS→ UNE
UNE ⇏ MS	2.8488	1.2213	0.2220	
INF⇏ UNE	4.1652	4.1928	3.E-05	INF→ UNE
UNE ⇏ INF	3.3011	2.2423	0.0249	
ln TO ⇏ UNE	3.8827	3.5551	0.0004	TO→UNE
UNE⇏ ln TO	2.4152	0.2427	0.8082	
FDI ⇏ ln GDP	2.6087	0.6795	0.4968	GDP→ FDI
ln GDP ⇏ FDI	3.8255	3.4261	0.0006	
HC ⇏ ln GDP	5.7186	7.6992	1.E-14	HC ↔ GDP
ln GDP ⇏ HC	5.9039	8.1174	4.E-16	
GE ⇏ ln GDP	2.2563	-0.1161	0.9076	GDP → GE
ln GDP ⇏ GE	4.0746	3.9884	7.E-05	
MS ⇏ ln GDP	3.5365	2.7737	0.0055	MS ↔ GDP
ln GDP ⇏ MS	6.5555	9.5882	0.0000	
INF ⇏ ln GDP	4.9073	5.8679	4.E-09	INF↔ GDP
ln GDP ⇏ MS	3.5522	2.8092	0.0050	
ln TO ⇏ ln GDP	2.4890	0.4091	0.6824	GDP→ TO
ln GDP ⇏ ln TO	4.3505	4.6111	4.E-06	
HC⇏ FDI	3.8379	3.4540	0.0006	HC→ FDI
FDI ⇏ HC	2.4083	0.2271	0.8203	
GE ⇏ FDI	4.0321	3.8925	0.0001	GE↔ FDI
FDI ⇏ GE	3.2322	2.0868	0.0369	
MS ⇏ FDI	3.5114	2.7170	0.0066	MS→ FDI
FDI ⇏ MS	2.9374	1.4216	0.1552	
INF ⇏ FDI	3.3447	2.3408	0.0192	INF↔ FDI
FDI ⇏ INF	4.3001	4.4973	7.E-06	
Ln TO ⇏ FDI	2.6834	0.8479	0.3965	TO⇏FDI
FDI ⇏ ln TO	2.8627	1.2528	0.2103	
GE ⇏ HC	2.8493	1.2225	0.2215	HC→ GE
HC ⇏ GE	4.6842	5.3644	8.E-08	
MS ⇏ HC	4.3152	4.5313	6.E-06	MS↔ HC
HC ⇏ MS	5.7770	7.8309	5.E-15	
INF ⇏ HC	4.9877	6.0494	1.E-09	INF↔HC
HC ⇏ INF	3.8521	3.4859	0.0005	
ln TO ⇏ HC	3.9371	3.6779	0.0002	TO→ HC
HC ⇏ ln TO	3.1614	1.9270	0.0540	
MS ⇏ GE	3.2322	2.0869	0.0369	MS ↔ GE
GE⇏ MS	4.3521	4.6147	4.E-06	
INF ⇏ GE	4.3382	4.5834	5.E-06	INF ↔ GE
GE⇏ INF	3.2576	2.1442	0.0320	
ln TO ⇏ GE	2.5931	0.6443	0.5194	TO⇏ GE
GE ⇏ ln TO	2.5144	0.4666	0.6408	
INF ⇏ MS	8.0292	12.915	0.0000	INF↔ MS
MS ⇏ INF	3.7051	3.1542	0.0016	
Ln TO ⇏ MS	4.5280	5.0118	5.E-07	TO ↔ MS
MS ⇏ ln TO	4.0506	3.9342	8.E-05	
Ln TO ⇏ INF	4.5368	5.0315	5.E-07	TO ↔ INF
INF ⇏ ln TO	5.7174	7.6966	1.E-14	

Note: The symbol ⇏ denotes no causality exists, → represents a one-way causality association, and ↔represents a two-way causality association.
Source: The authors' calculations

Table 8. c Dumitrescu Hurlin Causality Test for least-developed countries

Null Hypothesis	W-Stat	Z-Stat	Prob	Conclusion
Ln GDP ⇎UNE UNE ⇎ ln GDP	4.1981 3.9055	3.6451 3.0810	0.0003 0.0021	GDP↔UNE
FDI ⇎ UNE UNE ⇎ FDI	3.8990 2.2190	3.0683 -0.1710	0.0022 0.8642	FDI→ UNE
HC ⇎ UNE UNE ⇎ HC	4.6808 2.6751	4.5758 0.7085	5.E-06 0.4786	HC→ UNE
GE ⇎ UNE UNE ⇎ GE	3.2124 4.0596	1.7445 3.3780	0.0811 0.0007	UNE→ GE
MS ⇎ UNE UNE ⇎ MS	3.6440 2.2109	2.5768 -0.1867	0.0100 0.8519	MS→ UNE
INF⇎ UNE UNE ⇎ INF	3.8707 2.8149	3.0137 0.9780	0.0026 0.3281	INF→ UNE
ln TO ⇎ UNE UNE⇎ ln TO	3.0017 3.1896	1.3383 1.7005	0.1808 0.0890	TO⇎ UNE
FDI ⇎ ln GDP ln GDP ⇎ FDI	4.1349 2.5528	3.5232 0.4725	0.0004 0.6366	FDI→ GDP
HC ⇎ ln GDP ln GDP ⇎ HC	4.0614 4.5606	3.3816 4.3441	0.0007 1.E-05	HC ↔ GDP
GE ⇎ ln GDP ln GDP ⇎ GE	3.4687 4.3597	2.2387 3.9567	0.0252 8.E-05	GE ↔ GDP
MS ⇎ ln GDP ln GDP ⇎ MS	3.3337 4.4573	1.9783 4.1449	0.0449 3.E-05	MS ↔ GDP
INF ⇎ ln GDP ln GDP ⇎ MS	4.7745 5.6832	4.7565 6.5087	2.E-06 8.E-11	INF↔ GDP
ln TO ⇎ ln GDP ln GDP ⇎ ln TO	3.2213 4.2954	1.7615 3.8328	0.0781 0.0001	GDP→ TO
HC⇎ FDI FDI ⇎ HC	3.2188 2.2118	1.7568 -0.1850	0.0790 0.8533	HC⇎ FDI
GE ⇎ FDI FDI ⇎ GE	2.6134 3.2736	0.5895 1.8624	0.5555 0.0626	GE⇎ FDI
MS ⇎ FDI FDI ⇎ MS	4.0936 2.0227	3.4436 -0.5496	0.0006 0.5826	MS→ FDI
INF ⇎ FDI FDI ⇎ INF	3.5818 3.6327	2.4569 2.5550	0.0140 0.0106	INF↔ FDI
Ln TO ⇎ FDI FDI ⇎ ln TO	2.9920 2.0840	1.3195 -0.4314	0.1870 0.6662	TO⇎FDI
GE ⇎ HC HC ⇎ GE	6.0070 5.5644	7.1330 6.2796	1.E-12 3.E-10	GE↔HC
MS ⇎ HC HC ⇎ MS	2.9759 5.2678	1.2885 5.7077	0.1976 1.E-08	HC→ MS
INF ⇎ HC HC ⇎ INF	4.9657 5.3497	5.1252 5.8655	3.E-07 4.E-09	INF↔HC
ln TO ⇎ HC HC ⇎ ln TO	2.3622 3.7523	0.1054 2.7854	0.9163 0.0053	HC→ TO
MS ⇎ GE GE⇎ MS	4.1256 2.7983	3.5053 0.9461	0.0005 0.3441	MS → GE
INF ⇎ GE GE⇎ INF	4.8703 2.1650	4.9414 -0.2752	8.E-07 0.7831	INF → GE
ln TO ⇎ GE GE ⇎ ln TO	3.2289 2.6825	1.7764 0.7228	0.0757 0.4698	TO⇎ GE
INF ⇎ MS MS ⇎ INF	7.1500 4.7889	9.3371 4.7844	0.0000 2.E-06	INF↔ MS
Ln TO ⇎ MS MS ⇎ ln TO	2.4582 3.5661	0.2903 2.4265	0.7716 0.0152	MS → TO
Ln TO ⇎ INF INF ⇎ ln TO	3.8596 5.5110	2.9923 6.1766	0.0028 7.E-10	TO ↔ INF

Note: The symbol ⇎ denotes no causality exists, → represents a one-way causality association, and ↔represents a two-way causality association.
Source: The authors' calculations

5. Conclusion

The urgency of improving economic indicators for least-developed, developing, and emerging countries cannot be overstated. To address this, it is essential to enhance human capital scores in all dimensions for emerging, developing, and least-developed countries. This will lead to higher economic performance and pave the way for higher economic growth rates and sustainable development. This paper is a call to action, aiming to investigate the crucial impact of GDP, FDI, human capital, global economy, and other variables on unemployment rates. The study methodically analyzed a sample of 106 cross-countries, grouped into emerging, developing, and least-developed countries, from 2000 to 2021 using various econometric techniques, including first and second-generation unit root tests, FMOLS, DOLS, panel PMG, and Dumitrescu Hurlin panel causality tests.

The empirical results for FMOLS, DOLS, and PMG bring a ray of hope, showing that GDP, FDI, inflowed FDI, global economy, money supply, inflation, and trade openness have a positive impact on eliminating unemployment for grouping countries and developing countries. These findings are consistent with the studies of Akhmad et al. (2021), Dutt (2009), Liu et al. (2022), Nwosa (2020), Saraireh (2020), and Shiferaw (2023). On the other hand, there is a positive relation between inflation rates and unemployment rates for emerging countries. Conversely, there is a positive relationship between trade openness and unemployment rates for least-developed countries. These findings are in line with the studies of Hossain et al. (2018) and Nwaka et al. (2015). The results for the panel causality relationships between regressors and dependent variables show either bidirectional or unidirectional relationships. Moreover, results for the panel causality interrelationship among regressors also show either bidirectional or unidirectional relationships.

Authorities, policymakers, and institutions have to focus on implementing effective policies and strategies to enhance GDP growth rates and improve human capital indicators to achieve the Sustainable Development Goals (SDGs) in emerging, developing, and least-developed countries. These policies should aim to eliminate inflation rates, reduce unemployment rates, adhere to proper government expenditure schemes, and enhance money supply functioning. Also, the policy implications from these results indicate that the policymakers and authorities in these countries could

use monetary and fiscal policy tools to enhance investment and output in order to decrease unemployment. Also, to decrease unemployment in these countries, policymakers and authorities can encourage trade with trade partners. Moreover, the policymakers and authorities in these countries should encourage investment in human capital with the aim of declining unemployment.

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Appendix

Figures 5. a, b, c, and d: The GE, HC, GDP, and UNE rates in 2000 and 2021 with the average for emerging countries

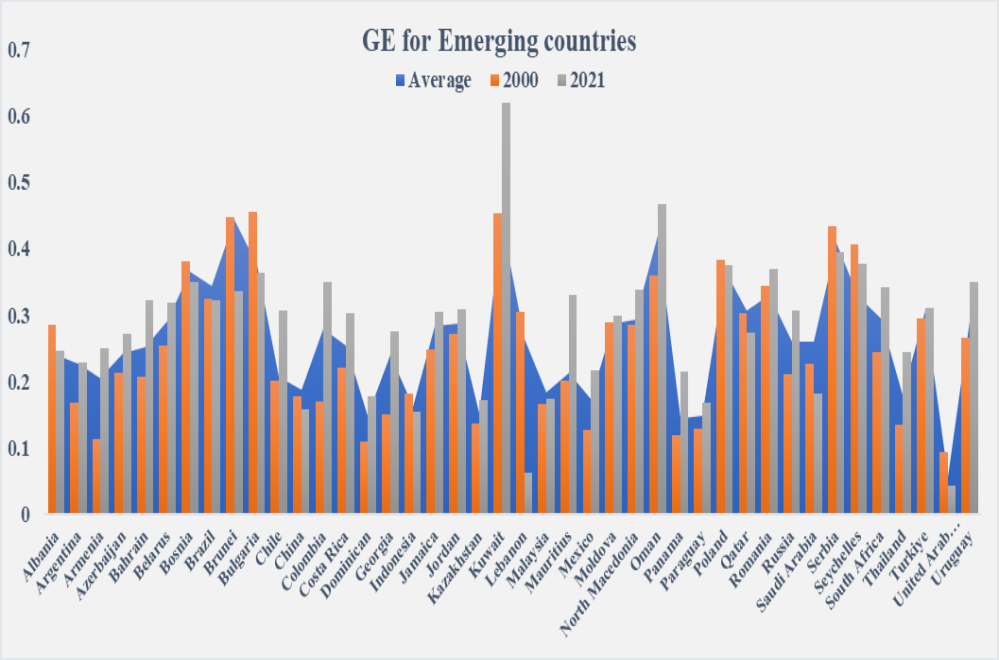


Figure 5. a Government expenditure for emerging countries

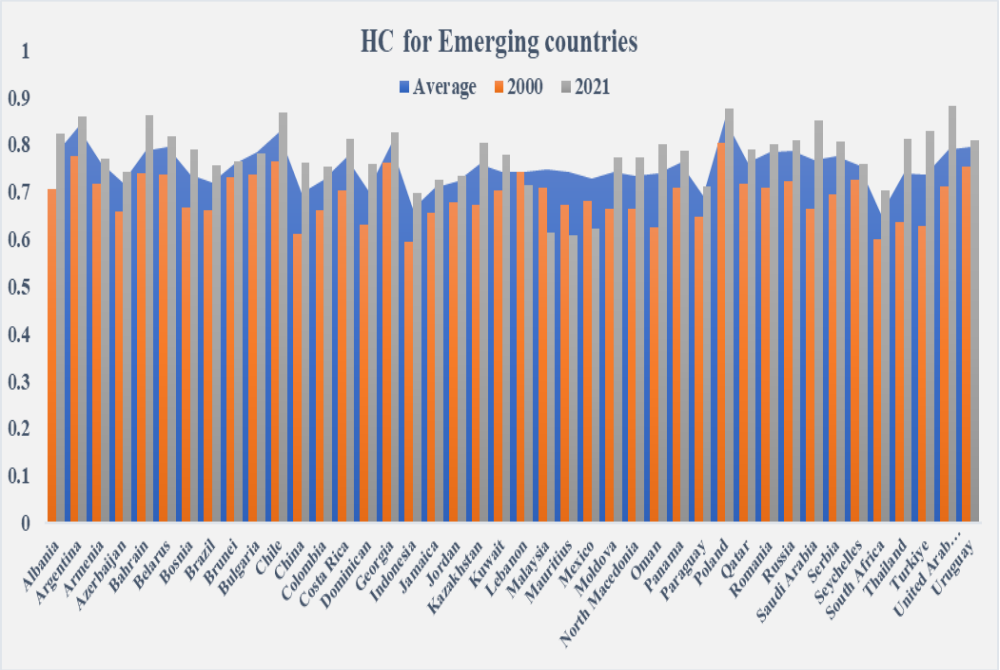


Figure 5. b Human capital index for emerging countries

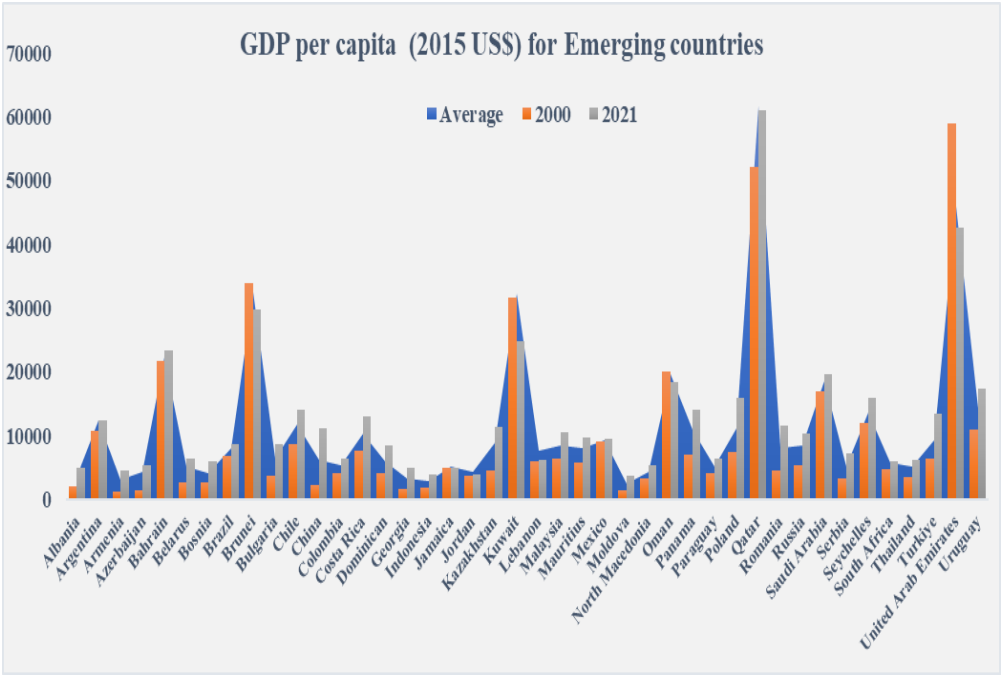


Figure 5. c Per capita GDP for emerging countries

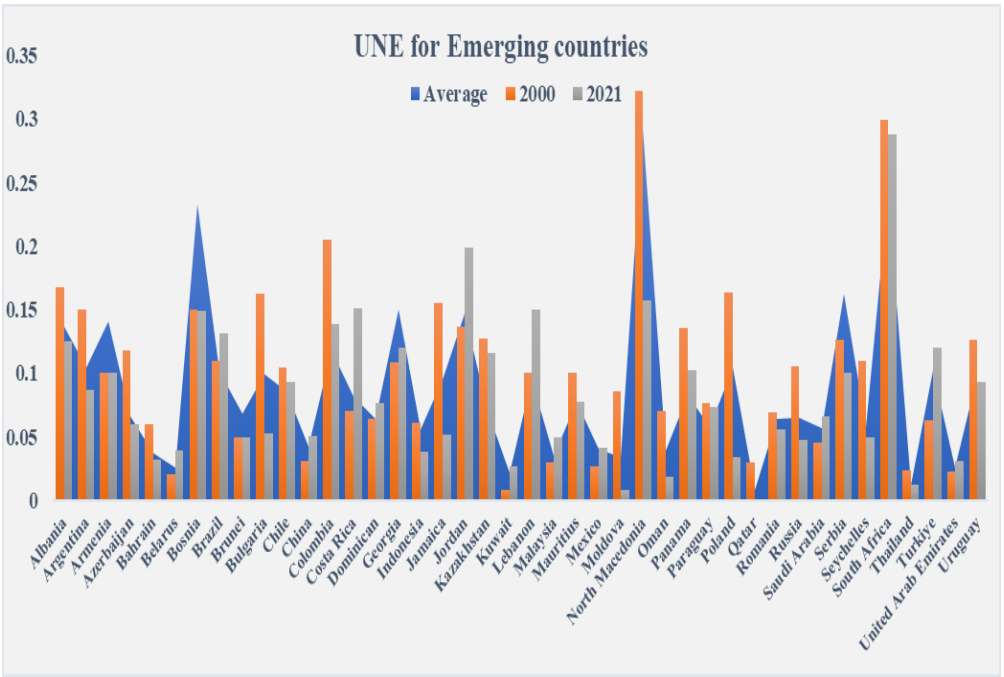


Figure 5.d Unemployment rates for emerging countries.

Source: Authors' calculations based on the WDI and the UNDP databases per country

Figures 6. a, b, c, and d: The GE, HC, GDP, and UNE rates in 2000 and 2021 with average for developing countries

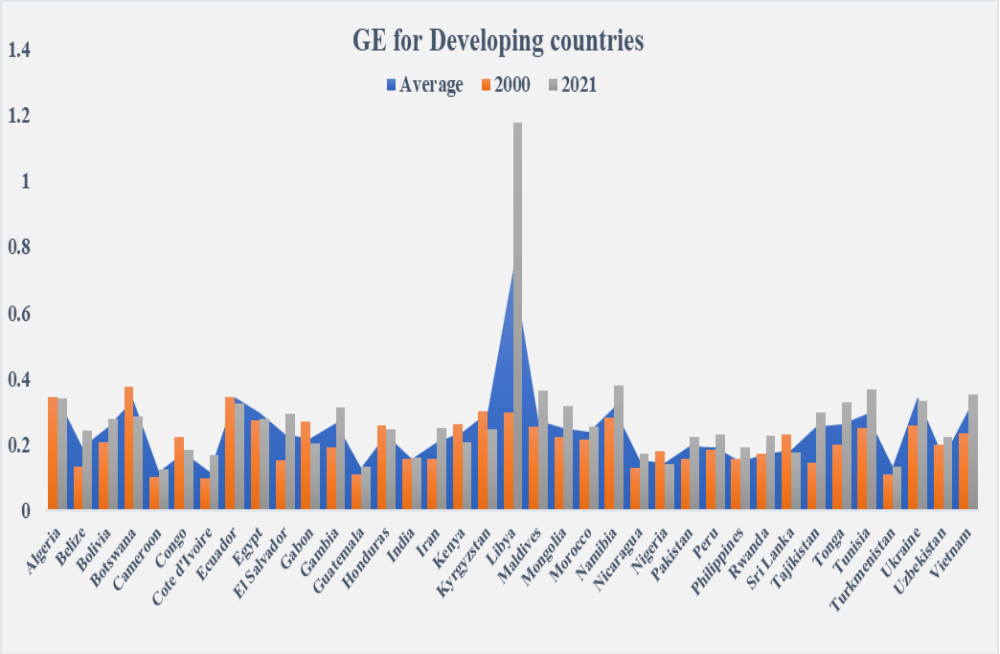


Figure 6. a Government expenditure index for developing countries

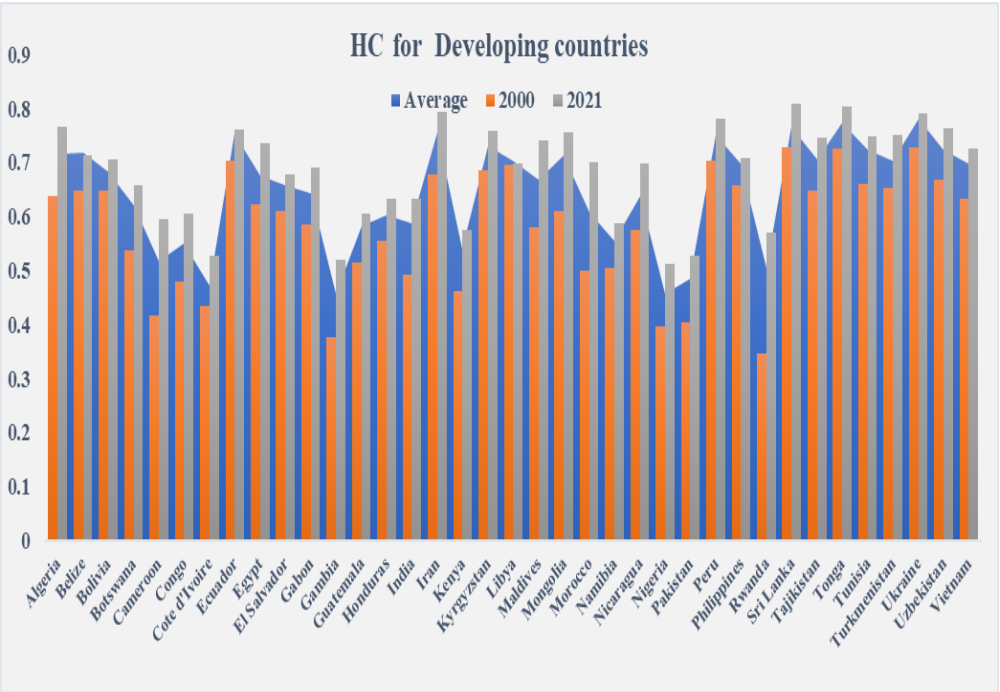


Figure 6. b Human capital index for developing countries

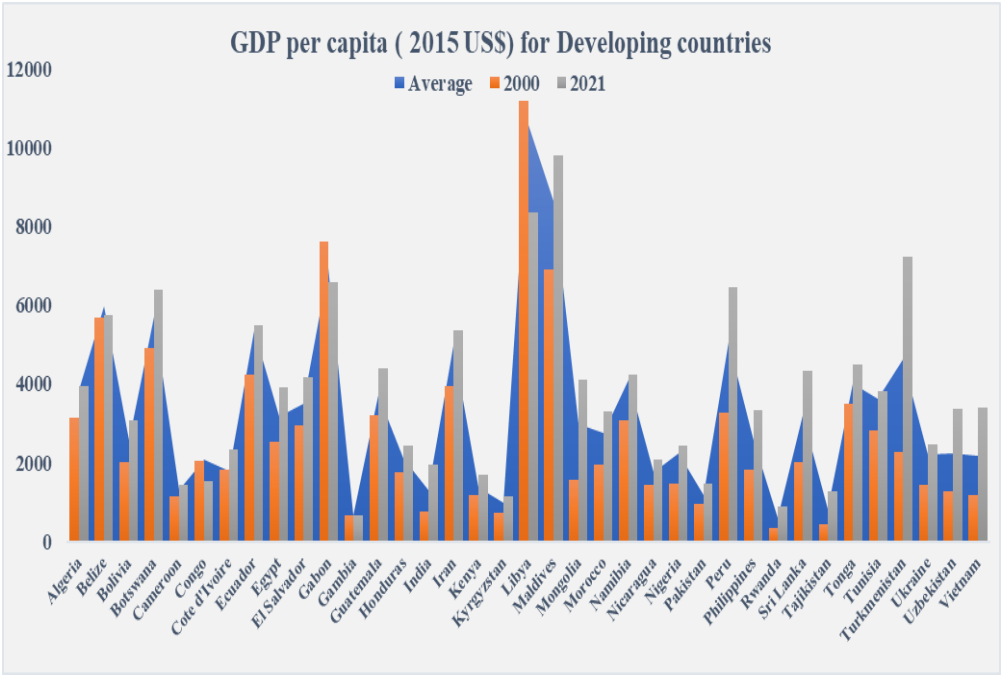


Figure 6. c Per capita GDP for developing countries

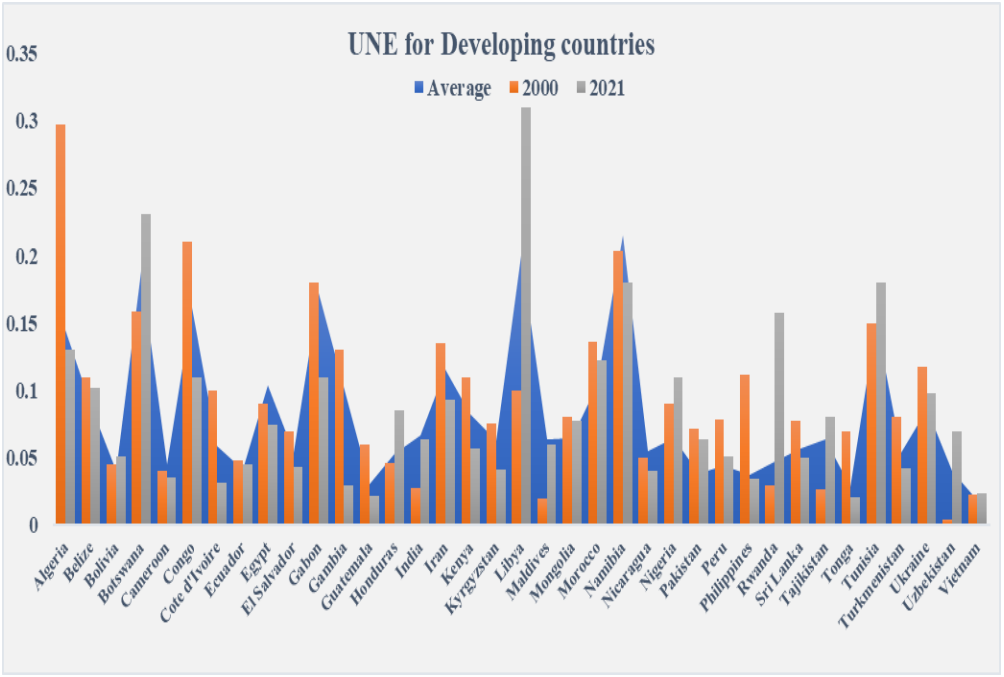


Figure 6.d Unemployment rates for developing countries.

Source: Authors' calculations based on the WDI and the UNDP databases per country

Figures 7. a, b, c, and d: The HDI, IQ, corruption, and Globalization indices in 2000 and 2021 with average for least-developed countries

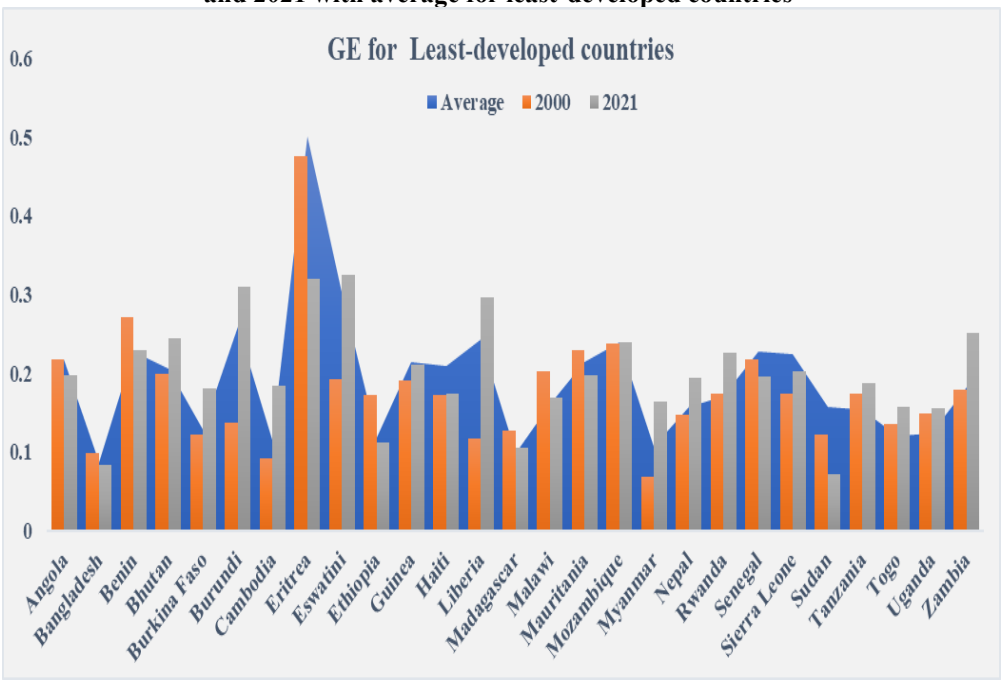


Figure 7. a Government expenditure index for least-developed countries

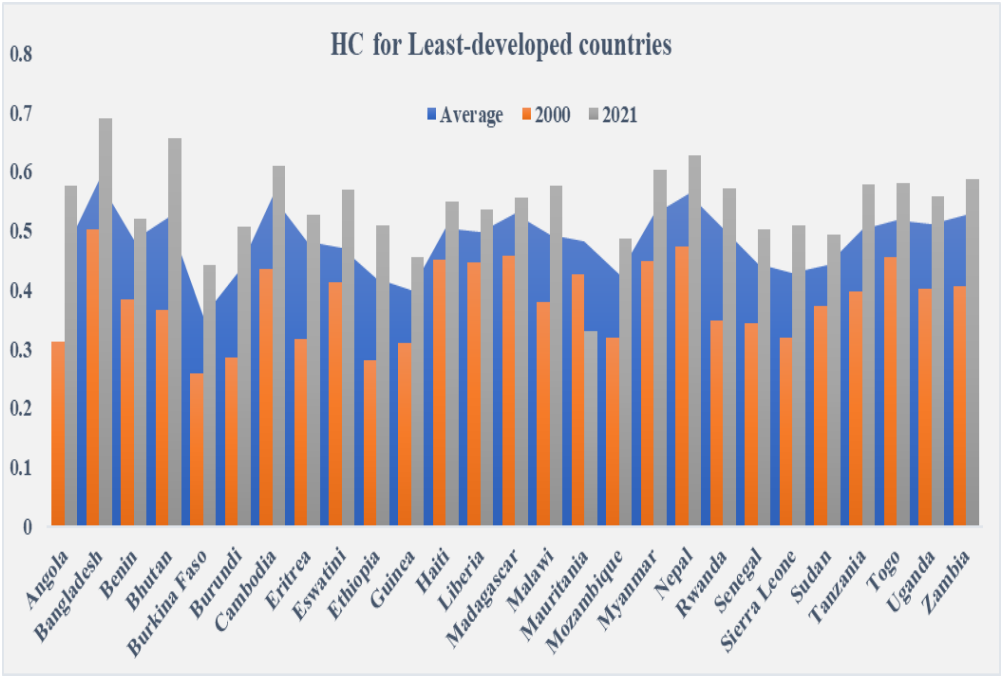


Figure 7. b Human capital index for least-developed countries

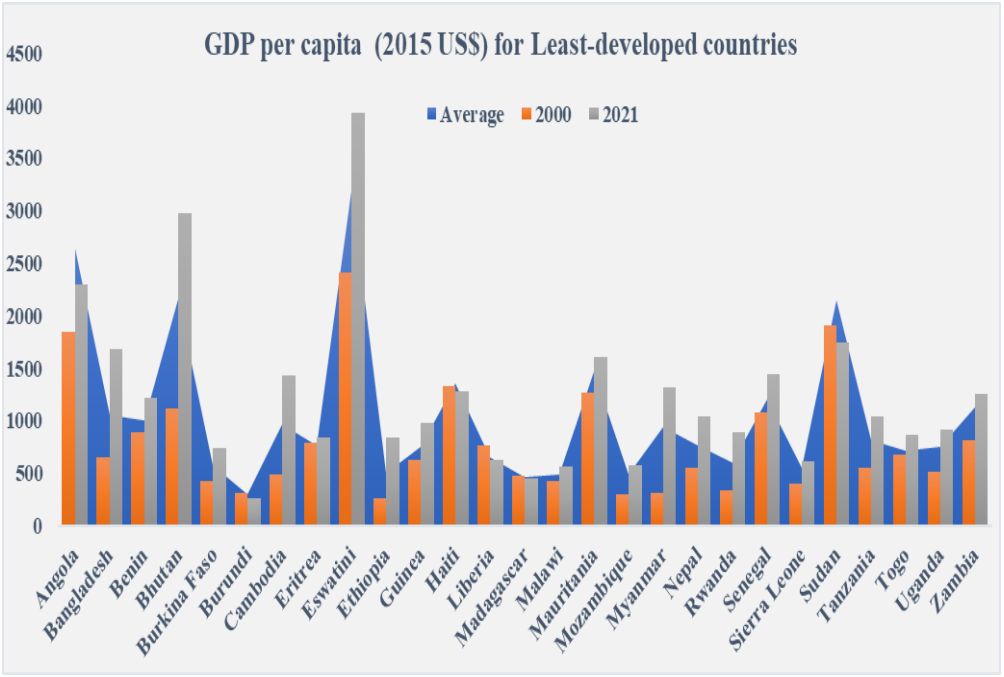


Figure 7. c Per capita GDP for least-developed countries

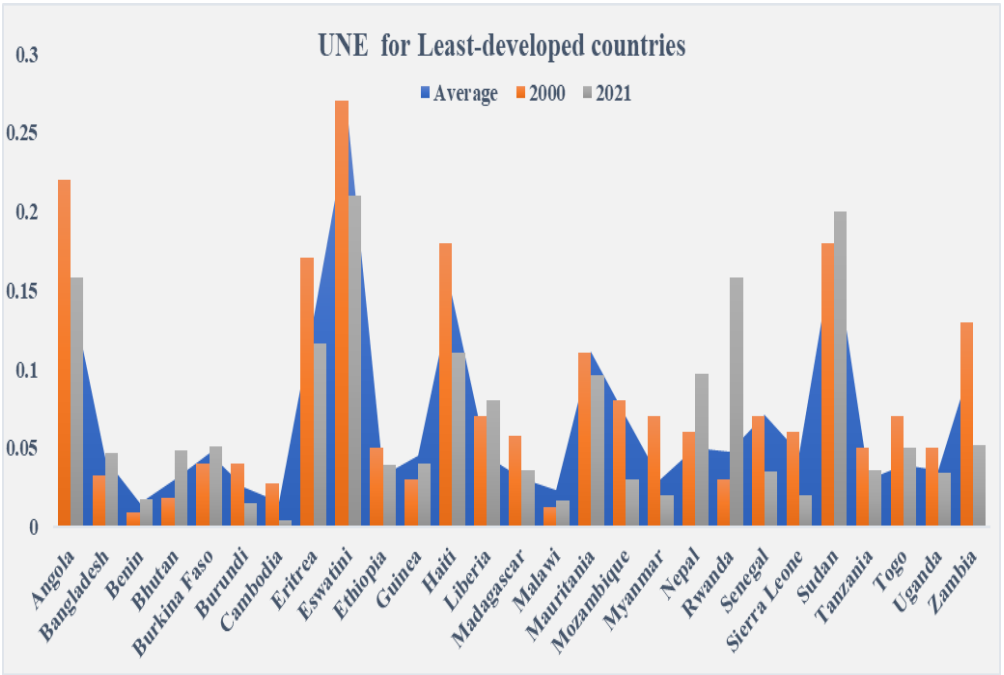
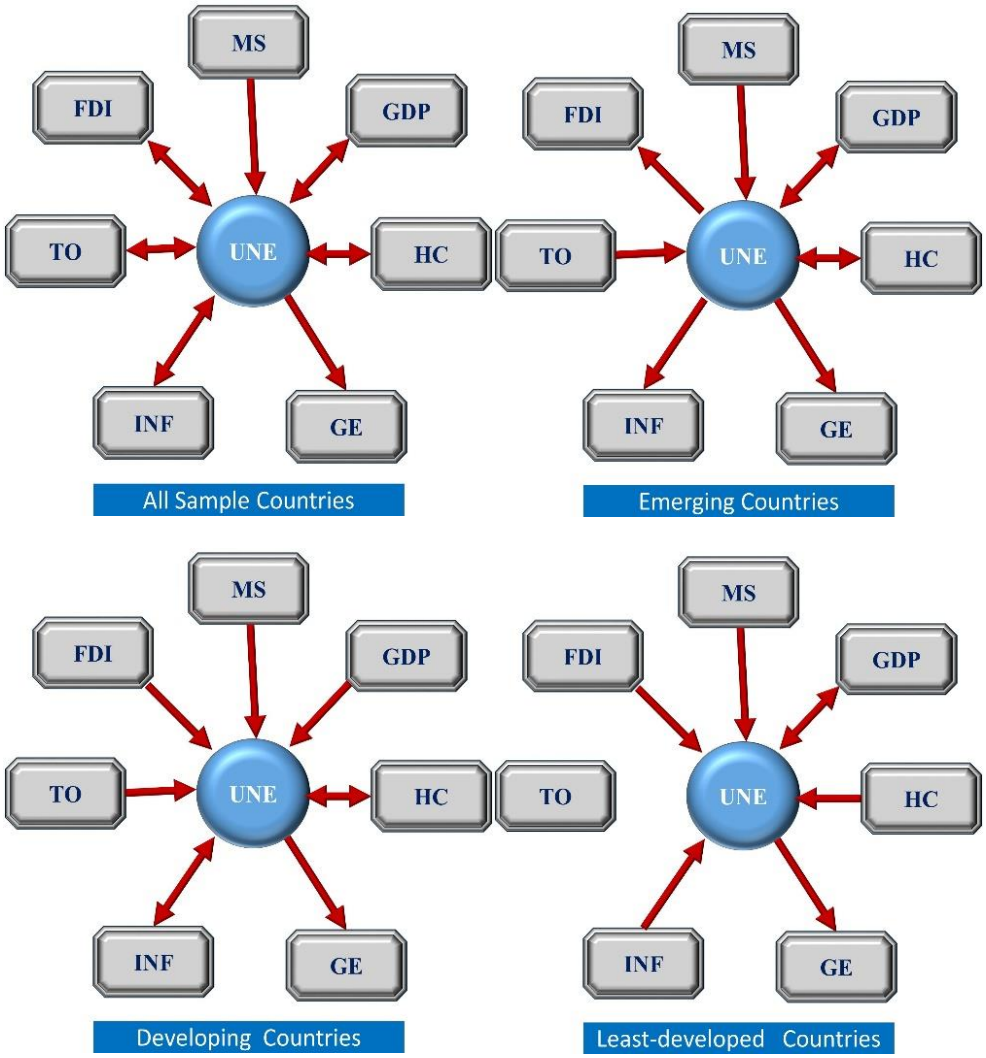


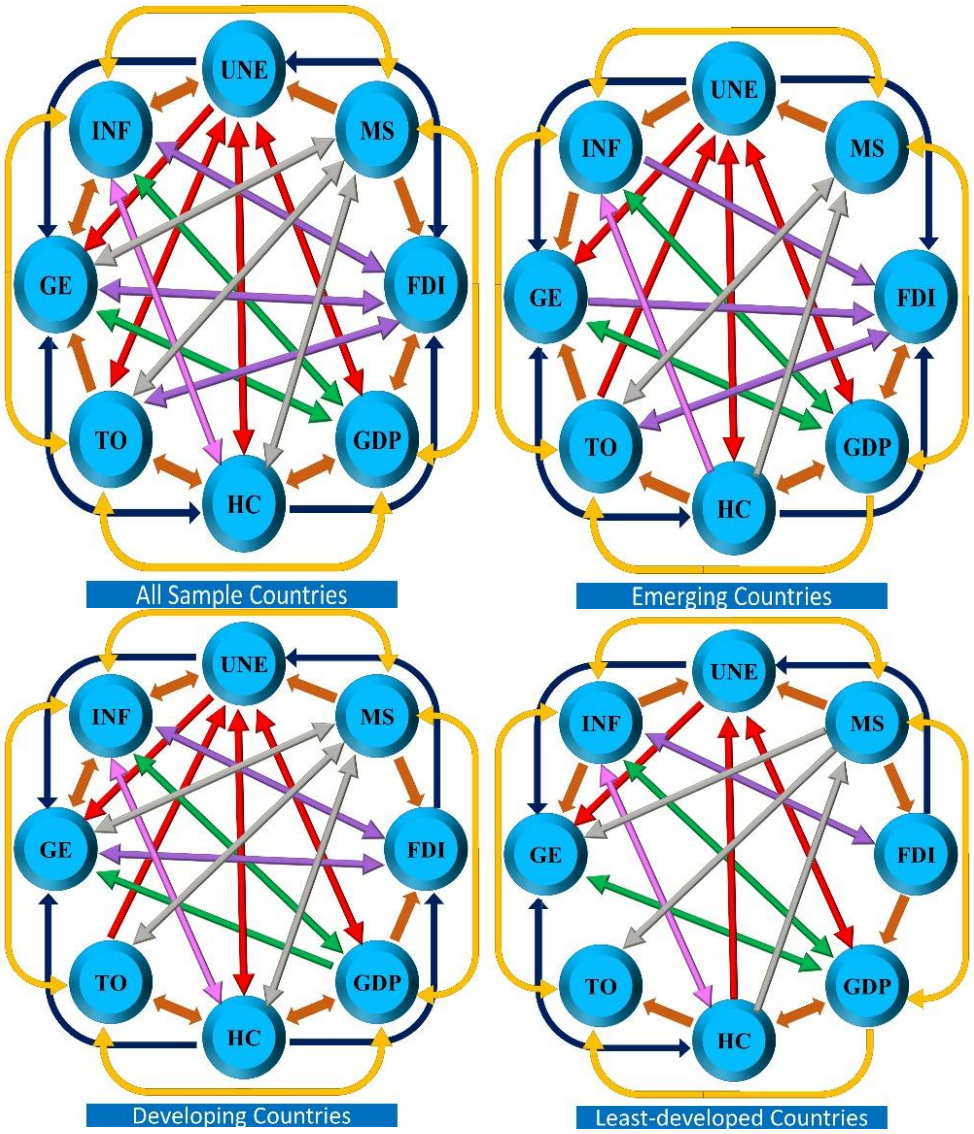
Figure 7.d Unemployment rates for least-developed countries.

Source: Authors' calculations based on the WDI and the UNDP databases



Figures 8 a., b, c, and d: Causality between UNE and regressors based on causality test results for all countries, emerging, developing and least-developed countries

Bidirectional relationship ⟷ **Unidirectional relationship** →



Figures 8 d., e, f, and g: Causality among regressors based on causality test results for all countries, emerging, developing and least-developed countries

Bidirectional relationship **Unidirectional relationship**

المستخلص

تهدف الورقة البحثية لدراسة العلاقة بين معدل البطالة والنمو الإقتصادى والمعروفة بقانون أوكن Okun's law كما ستقوم أيضا بإختبار منحنى فيلبس Philips curve والذى يحدد العلاقة العكسية بين معدلات البطالة والتضخم . كما تشمل الدراسة العديد من المتغيرات المستقلة مثل صافى الإستثمار الأجنبى المباشر، رأس المال البشرى، الإنفاق الحكومى، المعروض النقدى والإنفتاح التجارى. تشمل الدراسة عدد 106 دولة عبر العالم مصنفة لدول ناشئة، نامية، أقل نموا للفترة من 2000 إلى 2021. تم إستخدام العديد من الأساليب القياسية مثل: الجيل الأول والثانى لجذور الوحدة، نموذج Dumitrescu Hurlin لإختبار علاقات السببية ، نموذج متوسط المجموعات المجمعة/ الإنحدار الذاتى المبطأ PMG/ARDL ، طريقة المربعات الصغرى الكاملة المعدلة FMOLS وطريقة المربعات الصغرى الديناميكية DOLS وتم إستخدام تلك الأساليب للتحقق من مصداقية وموثوقية النتائج. أظهرت النتائج وجود علاقة معنوية سلبية بين الناتج، الإستثمار الأ جنبى المباشر، رأس المال البشرى، الإنفاق الحكومى، المعروض النقدى، التضخم، الإنفتاح التجارى من جهة وبين معدلات البطالة من جهة أخرى لجميع دول الدراسة ولمجموعة الدول النامية . بينما أظهرت الدراسة وجود علاقة إيجابية بين التضخم والبطالة فى الدول الناشئة وعلاقة إ يجابية بين الإنفتاح التجارى والبطالة فى الدول الأقل نموا. ولتعزيز أداء وكفاءة الإنفاق الحكومى وجذب الإستثمار الأجنبى المباشر المنتج، ورفع مستويات رأس المال البشرى، زيادة معدلات النمو وخفض معدلات التضخم فى الدول النامية والأقل نموا، فإنه ينبغى على صانعى السياسات ومتخذى القرار إعطاء الأولوية للسياسات المالية والنقدية التى تهدف لرفع المؤشرات سالفة الذكر للحد من معدلات البطالة ولتحقيق معدلات نمو مستدامة.

الكلمات المفتاحية:الناتج، تدفقات الإستثمارالأجنبى المباشر، الإنفاق الحكومى، التضخم، البطالة