

How to Cite:

Khalifa, J. (2024). Determinants of unemployment in Tunisia: Regional panel analysis. *International Journal of Economic Perspectives*, 18(9), 1464–1477. Retrieved from <https://ijeponline.org/index.php/journal/article/view/628>

Determinants of unemployment in Tunisia: Regional panel analysis

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Abstract---This study examined the effects of the Human Development Index (HDI), tourist arrivals, population size, and output of private sector on regional unemployment in Tunisia using a Panel ARDL (PMG) model. The analysis, based on annual data from 2010 to 2020, uncovered a complex set of relationships between these variables and unemployment rates. In the long term, all variables significantly impacted unemployment. Notably, the HDI had a negative effect, suggesting that higher human development helps reduce unemployment. However, tourism, population growth, and private sector output had positive effects, indicating an increase in unemployment. Surprisingly, the tourism sector which is expected to create jobs in industries like hospitality, transportation, and services was found to contribute to rising unemployment, a contradiction to its perceived role in job creation. In the short term, population growth in the South East region was linked to higher unemployment, while the tourism sector increased unemployment in the Center East, but reduced it in the West. Private sector output contributed to unemployment in the South East and South West regions. Furthermore, the Dumitrescu Hurlin Panel Causality tests found no significant causal relationships between the variables. The study recommends diversifying the tourism sector to ensure sustainable job creation, improving human development through investments in education and healthcare, and implementing targeted regional policies to address unemployment disparities. Additionally, promoting private sector incentives and balanced regional growth, alongside further investigation into indirect relationships between variables, is essential for effective policymaking.

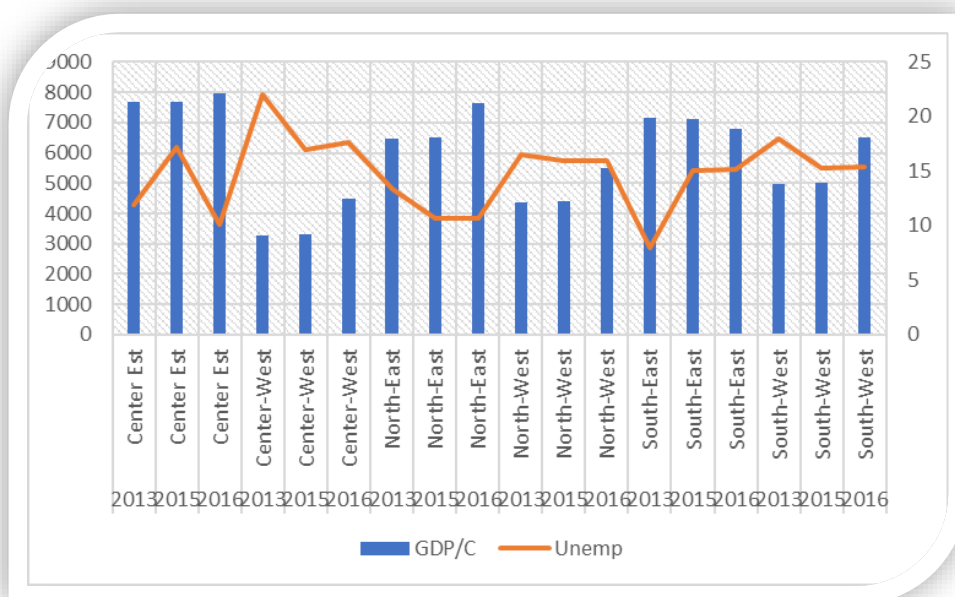
Keywords---Human development index, unemployment rate, tourism sector, private companies, TUNISIA.

1- Introduction

Unemployment remains one of Tunisia's most pressing socio-economic challenges, posing a serious threat to the country's economic stability and social cohesion. The problem is particularly pronounced in certain regions, where structural inequalities have led to persistently high unemployment rates. Addressing these disparities requires a deep understanding of the factors driving unemployment at the regional level, enabling the development of targeted policies that foster inclusive growth.

This study explores the regional determinants of unemployment in Tunisia, a country characterized by significant regional inequalities. It investigates a range of economic, demographic, and educational factors to uncover the root causes of unemployment disparities across regions. By doing so, the study aims to provide a comprehensive understanding of the mechanisms driving unemployment and inform more effective policy responses.

Tunisia's diverse regional landscape, with stark contrasts between urban and rural areas and varying levels of economic development, necessitates a regional approach. This perspective allows for a nuanced analysis, offering insights into the distinct challenges faced by different regions and the tailored policy interventions needed to address them. Ultimately, this research seeks to contribute to the policy debate on unemployment in Tunisia by emphasizing the importance of regional dynamics and proposing evidence-based solutions that align with the specific needs of each region.



Graphic 1: The relationship between regional economic growth and Unemployment in Tunisia during (2013-2015-2016)

Source: author

From 2013 to 2016, a clear relationship between unemployment rates and economic growth emerged in Tunisia. The Center-West region, marked by the lowest GDP per capita, consistently experienced the highest unemployment rates. In contrast, the South-East region, characterized by higher economic growth, recorded the lowest unemployment rates. This regional disparity underscores the strong link between economic performance and labor market outcomes, highlighting the urgent need for targeted policies to address the unequal distribution of growth and employment opportunities across the country. Such policies could foster more balanced economic development and help reduce regional inequalities.

This paper is structured as follows: the literature review section presents a detailed review of the literature on the connection between different variables model. This is followed by the methodology section which presents data and methodology used to achieve the study target. The empirical findings section is devoted to develop the study results. This paper ends with the conclusion section with some recommendations.

2- Literature Review

Tama (2024) investigates the causal relationships and both short-term and long-term connections among corruption, investment, unemployment, and per capita economic growth across 22 Asia-Pacific nations from 2012 to 2020, employing Granger causality and the Vector Error Correction Model (VECM) to address the research questions. The results reveal bidirectional causality between corruption and per capita economic growth, while a unidirectional relationship exists between the unemployment rate and per capita economic growth. However, no causal link was found among the remaining variables. In the short run, corruption does not significantly impact per capita economic growth or unemployment, but it adversely affects the investment rate. In the long run, corruption significantly and negatively influences per capita economic growth, while investment and unemployment positively impact long-term per capita economic growth.

Algül (2024) examined the relationship between higher education and unemployment across 26 Turkish provinces from 2008 to 2021, finding that a 1% increase in the number of Bachelor's degree graduates is associated with a 1.16% increase in the unemployment rate. Uğurlu (2024), exploring whether globalization reduces youth unemployment in Türkiye from 1988 to 2021 using the ARDL approach, found that increased globalization decreases youth unemployment in the long run. Additionally, economic growth, inflation, and foreign direct investments were found to reduce youth unemployment, while urbanization increases it.

Tolesa and Zeleke (2024) identified major factors influencing unemployment in Ethiopia, including high population growth, rural-urban migration, poor education quality, lack of entrepreneurship, corruption, and rapid technological changes. Robinson (2024) analyzed the cyclical nature of unemployment in the United States, highlighting the strong correlation between unemployment and

economic cycles, with unemployment decreasing during economic expansion and rising during downturns.

Vilakati et al. (2024) examined the effect of socio-economic variables like government spending, population growth, and economic expansion on unemployment in South Africa, finding that increased government spending raises unemployment, while population growth reduces it. Asmara and Saleh (2024) found that in Indonesia, economic growth and inflation reduce unemployment, while minimum wage increases it.

Shuaibu and Ohams (2024) investigated the relationship between trade openness, gender gaps, and unemployment in Nigeria, revealing that trade openness reduces unemployment in the long term, though no short-term effects were found. Binuyo et al. (2024) explored how institutional quality affects unemployment in 24 Sub-Saharan African nations, concluding that improved political stability and regulatory quality can reduce unemployment.

Altunöz (2024) analyzed unemployment determinants in Turkey, noting that economic growth and foreign direct investment reduce unemployment, while other factors have a positive relationship with unemployment. Mohamed and Abdi (2024) found that unemployment in Somalia is negatively linked to economic growth, with GDP negatively associated with inflation and external debt.

Mugo and Mugendi (2024) examined Kenya's public debt, finding that domestic debt positively impacts private investment and negatively affects unemployment, while external debt has the opposite effect. Al-Qudah and Nsairat (2024) concluded that GDP growth reduces unemployment in Jordan, while population growth increases it.

Ahmad et al. (2024) studied the effect of inflation and military expenditure on unemployment in Pakistan, noting that inflation and military spending significantly impact unemployment in both the short and long term. Idriss and Enad (2024) found that population growth positively affects unemployment rates in Blida province, particularly in the long run.

Mefteh et al. (2016) analyzed the relationship between economic growth, higher education, unemployment, and poverty in Tunisia, finding that higher education influences unemployment, which in turn affects poverty and economic growth. They also found bidirectional causality between per capita GDP and poverty and between the number of graduates and tertiary education enrollment. Additionally, there was unidirectional causality from graduate unemployment to poverty and from higher education expenditure to poverty rates.

3- The Model Data and Methodology

The point of departure for our empirical model analysis is as follows:

$$Y_{i,t} = f(Y_{i,t-1}, X_{i,t})$$

Where $Y_{i,t}$ represents the unemployment rate in region i during period t , and $X_{i,t}$ is an array of explanatory variables including the regional Human Development

Index (HDI), the tourism sector, and the presence of private companies. This analysis uses annual data from Tunisian regions over the period 2010 to 2020. The selection of variables is grounded in existing literature on the factors influencing regional unemployment rates. To estimate the model, we employ the Pooled Mean Group (PMG) estimator within a dynamic panel ARDL framework, which allows for both short-term dynamics and long-term relationships among the variables. Given the limited empirical research on the determinants of regional unemployment rates in Tunisia, our study draws inspiration from previous works, particularly those by Asmara and Saleh (2024) and Algül (2024). The empirical model we consider is formulated as follows:

$$y_{i,t} = a_0 + \beta(y_{i,t-1}) + \gamma_1(ltours_{i,t}) + \gamma_2(lpop_{i,t}) + \gamma_4(HDI_{i,t}) + \gamma_5(loutpc_{i,t}) + a_i + \varepsilon_{i,t}$$

For $t = 2010, \dots, 2020$; $i = 1, \dots, 6$ (Center East, Center West, North East, North West, South East, South West)

3.1. Nature and source of data

The data for this study are annual and drawn from several key sources, including the databases of the United Nations Development Program (UNDP), the Portal of the Tunisian Government, the National Institute of Statistics, the Tunisian Institute of Competitiveness and Quantitative Studies, and the General Commissariat for Regional Development. The data cover the period from 2010 to 2020 and are specific to Tunisian regions. The table below summarizes the variables used in the model:

Table1: Description of variables

Variable	Description	Logarithmic forms	Units	Source
Unemployment rate (UMPRT)	Percentage of the labor force that is unemployed in region i during period t	-	%	National Institute of Statistics, General Commissariat for Regional Development
Human Development Index (HDI)	Composite index measuring regional human development, including education, health, and income	-	-	United Nations Development Program (PNUD)
Tourism sector (Tours)	Regional tourism activity, often proxied by the number of tourists	Ltours	Person	General commissariat for regional development
Population (Pop)	Regional number of population	Lpop	Person	General commissariat for regional development
Output of private companies (OUTPC)	Number of Output of private companies operating in region i during period t	Loutpc	-	Portal of the Tunisian Government, National Institute of Statistics

Source: author

These variables were selected based on the existing literature and empirical evidence on the factors influencing regional unemployment rates. By analyzing the relationship between unemployment and key economic and social indicators, this study aims to provide a comprehensive understanding of the determinants of regional unemployment in Tunisia.

3.2. Descriptive statistics of variables:

The table below presents the descriptive statistics for the key variables under study: unemployment rate (UMPRT), Human Development Index (HDI), tourism sector (TOURS), population (POP), and output of private companies (OUTPC). The summary statistics include the mean, minimum, maximum, and standard deviation for each variable across the regions from 2010 to 2020.

Table 2: Descriptive statistics of variables

	UMPRT	HDI	TOURS	POP	OUTPC
Mean	14.248	0.711	601353.4	1390909	6276.106
Max	23	0.739	3183179	2904497	46640.00
Min	8	0.653	15888	464443	1419
Std Dev.	3.631	0.025	720626.4	652026.4	7356.051

Source: author`s estimates

These results indicate the variability in the data. For instance, the unemployment rate (UMPRT) has a mean value of 14.248%, and a standard deviation of 3.631. The Human Development Index (HDI) shows relatively lower variability with a standard deviation of 0.025. The tourism sector (TOURS) exhibits the largest variability, with a mean value of 601,353.4 and a standard deviation of 720,626.4. Given the substantial variance in these variables, it is appropriate to proceed with a correlation analysis to explore the relationships between them and assess potential multicollinearity before further econometric modeling.

3.3. Correlation matrix between variables:

The following table presents the correlation matrix between the key variables in the study, including the unemployment rate (UMPRT), Human Development Index (HDI), number of tourist arrivals (TOURS), population (POP), and output per capita of private companies (OUTPC). The correlation coefficients reflect the strength and direction of the relationships between each pair of variables.

Table 3: Correlation matrix between variables

	UMPRT	HDI	Tours	Pop	OUTPC
UMPRT	1				
HDI	-0.497	1			
TOURS	-0.397	0.468	1		
POP	-0.435	0.124	0.735	1	
OUTPC	-0.250	0.251	0.364	0.18	1

Source: author`s estimates

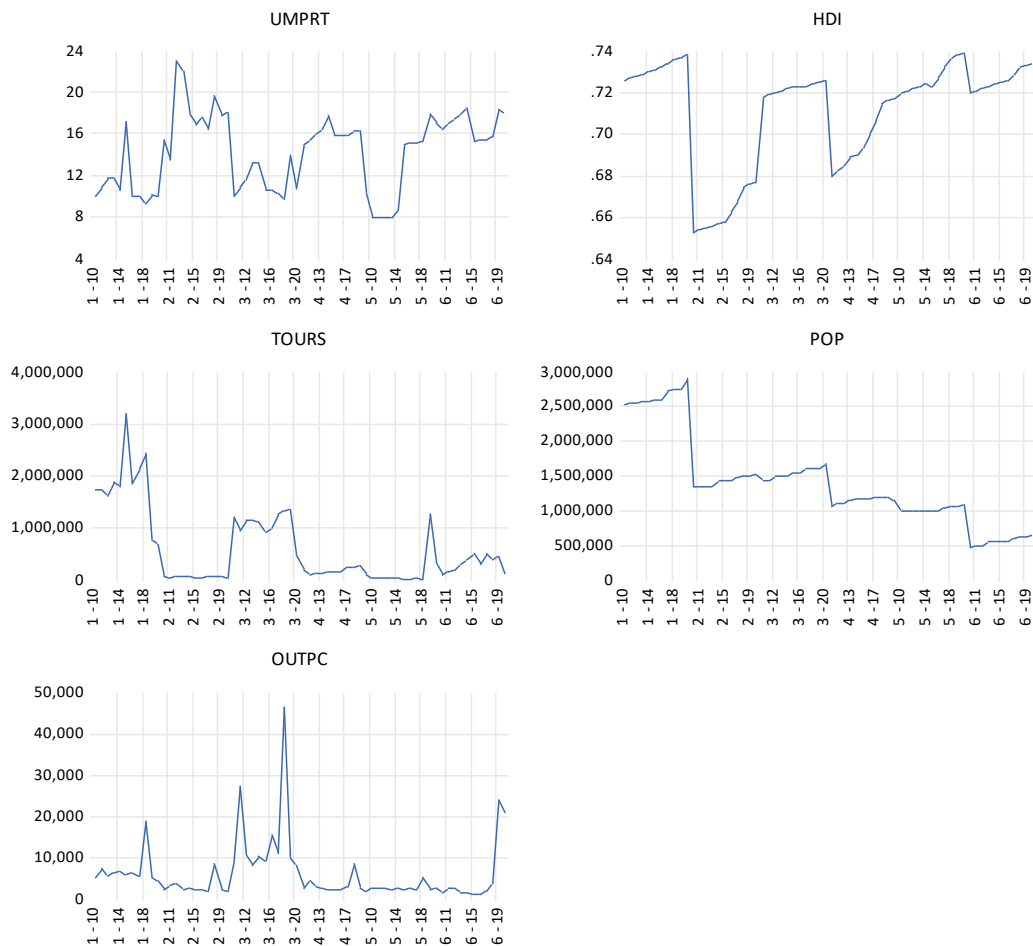
The correlation matrix shows that:

The unemployment rate (UMPRT) has a negative correlation with all other variables, indicating that higher levels of these variables are associated with lower unemployment rates in Tunisia's regions.

The Human Development Index (HDI) is positively correlated with Tourism, population and output of private companies, suggesting that regions with higher HDI also experience growth in tourism, population, and output of private companies.

The number of tourist arrivals (TOURS) shows the strongest positive correlation with population, indicating that regions with higher populations tend to attract more tourists.

3.4. Graphical representation of variables:



Graphic 2: The graphical representation of variables
Source: author's estimates

For the graphical representation of variables, each variable: unemployment rate, Human Development Index, tourist arrivals, population, and output of private companies should be plotted over the period from 2010 to 2020. This would

visually capture trends and fluctuations in each variable, making it easier to observe their behavior over time and their potential relationship with unemployment rates in various regions of Tunisia.

4. Estimation Results

4.1. Test of stationarity of variable

To identify the presence of an autoregressive unit root, this study employed various panel unit root tests, including the Levin, Lin, Chu (LLC), Im, Pesaran, Shin (IPS), Pesaran (CIPS), and Bai and Ng (PANIC) approaches, all of which account for trends and constants. However, before determining the stationarity of the series, it is essential to check for potential cross-sectional dependence among the variables. This step is crucial, as cross-sectional dependence can influence the results of panel data analysis.

To assess cross-sectional dependence, we applied the Breusch-Pagan LM test, which is appropriate when the time dimension exceeds the number of units. Additionally, we used the Pesaran (2006) CSD test. The results of both tests are presented in Table 4.

Table 4: Cross-Section Dependence Test Results

<i>H_0: There exists a cross sectional dependence</i>		
Test	Statistics	Probability value
LM (Breusch Pagan)	14.726	0.471
Pesaran CSD	2.642	0.8

Source: author's estimates

Note: LM refers to the Lagrange Multiplier, and significance at 1% level is indicated.

The results from the Breusch-Pagan LM test and the Pesaran CSD test indicate that we cannot reject the null hypothesis of no cross-sectional dependence, as the p-values exceed the typical significance threshold of 0.05. Specifically, the Breusch-Pagan LM test yields a p-value of 0.471, and the Pesaran CSD test shows a p-value of 0.800, suggesting no evidence of strong cross-sectional dependence.

Given the absence of cross-sectional dependence, first-generation cointegration tests were employed to assess the stationarity of the series. These tests are suitable in the context where cross-sectional independence is confirmed. The results of the stationarity tests are summarized in the following table.

The Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), and Harris-Tzavalis (HT) tests were applied to assess the stationarity of the series. These tests help determine whether the panel data exhibits unit roots or is stationary, which is essential for subsequent econometric analysis. The results of the stationarity tests are presented in the following table:

Table 5: Test of stationarity of variables

Logarithmic form of the variables		Umprt	HDI	Ltours	Lpop	Loutpc
LLC	<i>Levels</i>	-2.1***	0.37	-1.796**	-1.28*	-4.183***
	<i>First difference</i>	-	-3.008***	-2.838***	-4.26***	-
IPS	<i>Levels</i>	-0.932	2.399	-0.421	1.97	-2.93***
	<i>First difference</i>	-1.48*	-0.178*	-1.36*	-1.97**	-
HT	<i>Levels</i>	3.48***	4.798***	1.36*	4.92***	3.2***
	<i>First difference</i>	-	-	2.57***	-	-

***, **, and * denote significance respectively at the 1%, 5%, and 10%.
 LLC: Levin-Lin-Chu; IPS: Im-Pesaran-Shin; HT: Harris-Tzavalis

Source: author's estimates

The results of the Levin-Lin-Chu (LLC) test indicate that all variables are stationary at order I(0), with the exception of the Human Development Index (HDI), which is stationary at order I(1). Meanwhile, the Im-Pesaran-Shin (IPS) test results show that all variables are stationary at order I(1), except for the output of private companies, which is stationary at order I(0). Lastly, the Harris-Tzavalis (HT) test suggests that all variables are stationary at order I(0).

This divergence in the stationarity results underscores the importance of employing multiple tests to ensure robustness in assessing the properties of the data.

4.2. Panel PMG model

Table 6: Panel ARDL estimation

D(UMPRT) PMG/ARDL (1, 1, 1, 1, 1)					
Long Run Equation			Short Run Equation		
Variable	Coefficient	Prob.*	Variable	Coefficient	Prob.*
HDI	-13.725***	0.000	D(HDI)	-11.425	0.125
LPOP	39.054***	0.000	D(LPOP)	-10.64	0.704
LTOURS	4.067***	0.000	D(LTOURS)	1.698	0.118
LOUTPC	0.574***	0.008	D(LOUTPC)	0.713	0.499
ECT : - 0.39*					

Source: author's estimates

The results of the Panel ARDL estimation yield the following insights:

Human Development Index (HDI): A significant negative relationship with unemployment in Tunisia suggests that higher levels of human development are associated with lower unemployment rates in the long run.

Population (LPOP), Tourism (LTOURS), and Output of Private Companies (LOUTPC): These factors exhibit a positive and significant impact on

unemployment in the long run, indicating that growth in population, tourism, and private sector output contributes to rising unemployment over time.

Short-Term Effects: In the short run, none of the variables HDI, population, tourism, or private sector output show a statistically significant effect on unemployment at the national level, as indicated by their high p-values (above 0.05). However, the error correction term (ECT) is significant at the 10% level, suggesting that approximately 39% of any deviation from the long-run equilibrium is corrected annually.

These findings are consistent with the work of Folawewo and Adeboje (2017), who identified that higher human development indices, particularly in education and health, correlate with reduced unemployment in sub-Saharan Africa. They also noted that rapid population growth and insufficient absorptive capacity across various sectors contribute to increased unemployment. Similarly, Bayar and Özel (2021) found that while tourism positively influences economic growth, it can also elevate unemployment rates due to seasonal and structural factors, particularly in regions heavily dependent on tourism. Furthermore, Hao and Zheng (2019) reported that rapid population growth, alongside expansions in the tourism and private sectors, leads to structural unemployment, especially in areas where job creation does not match labor force growth in China. Likewise, Tang and Tan (2015) demonstrated that despite tourism's positive impact on economic growth, its capacity to reduce unemployment is limited, particularly in the short term. They attributed this limitation to sectoral mismatches and an over-reliance on low-skilled jobs in Malaysia.

4.3. Short term coefficients on region basis

Table 7: Summarizes the simulation results

Variable	Center East	Center West	North East	North West	South East	South West
ECT	-1.211***	0.01***	-0.365**	-1.626***	1.031***	0.016
D(HDI)	-3.75	-5.706	7.68	-1.10	-2.884	-3.12
D(LPOP)	-2.32	-7.851	-6.08	-2.57	1.119**	1.25
D(LTOURS)	2.86***	5.1	1.48	-2.153***	3.068***	-0.169
D(LOUTPC)	-2.59***	2.3	-1.192***	-0.336**	4.346***	1.752**

***, **, and * denote significance respectively at the 1%, 5%, and 10%.

Source: author's estimates

Table 7: Short term coefficients on region basis estimation

The short-term effects of key factors on unemployment exhibit significant regional variation across Tunisia:

Tourism: In the Center East and South East regions, tourism has a positive and significant impact on unemployment, suggesting that growth in this sector actually exacerbates unemployment in these areas. In contrast, tourism has a negative and significant effect in the North West, where it reduces unemployment. This finding aligns with Bayar and Özel (2021), who observed that in certain regions, tourism may fail to adequately absorb the labor force and could even contribute to rising unemployment in the short term.

Output of Private Companies: Private sector output negatively impacts unemployment in the Center East, North East, and North West, indicating that higher output from private companies helps to lower unemployment in these regions. However, this relationship is reversed in the South East and South West, where private sector growth is associated with increased unemployment. Similar findings were reported by Hao and Zheng (2019), who noted that in certain underdeveloped regions, private sector growth may paradoxically lead to higher unemployment, particularly when growth is not inclusive or when the skills of the labor force do not match the sector's requirements in China.

Population: Population growth has a statistically significant positive impact on unemployment only in the South East, where it correlates with rising unemployment levels. **Human Development Index (HDI):** In the short run, HDI exhibits a generally negative but statistically insignificant effect on unemployment across most regions, with the exception of the North East, where no significant influence is observed.

The short-term cross-sectional analysis reveals a stark contrast to the long-term panel results. While tourism and private sector growth reduce unemployment in some regions, they exacerbate it in others. Similarly, the effect of population growth on unemployment is highly region-specific, with notable challenges emerging in the South East. Although HDI's influence on unemployment is negative, it remains largely insignificant in the short run across Tunisia.

5. Conclusion and Recommendations

This study examines the determinants of regional unemployment in Tunisia from 2010 to 2020 through the lens of a dynamic panel ARDL (PMG) model. The findings reveal significant long-term and short-term relationships between unemployment and critical economic factors, including the Human Development Index (HDI), population dynamics, tourism, and private sector output.

In the long run, HDI demonstrates a negative correlation with unemployment, indicating that enhancements in education, healthcare, and living standards contribute to lower unemployment rates. Conversely, population growth, tourism expansion, and increased output from the private sector are associated with higher unemployment, highlighting structural challenges within these sectors that hinder their ability to effectively absorb the labor force.

In the short term, regional disparities become apparent. Specifically, tourism appears to increase unemployment in the Center East and South East regions, while it has a decreasing effect in the North West. Additionally, private sector output significantly reduces unemployment in the Center East, North East, and North West, yet contributes to higher unemployment rates in the South East and South West. Population growth positively influences unemployment in the South East, while the impact of HDI on unemployment is generally negative but statistically insignificant across most regions.

These findings align with those of Perugini and Pompei (2009), who observed that population growth and the economic structure of regions can lead to diverse

effects on unemployment, particularly in areas where sectors like tourism and private industry struggle to effectively absorb excess labor.

Recommendations:

Regional-Specific Policies: Tailor economic strategies to address the distinct challenges of each region. The South East and South West need interventions to better integrate private sector growth and tourism-driven jobs, while the North West should focus on enhancing tourism to reduce unemployment.

Human Development Investment: Continuous investment in education, healthcare, and social services is essential, particularly in underdeveloped regions, to lower unemployment.

Private Sector Reform: In regions where private sector growth is linked to higher unemployment, introduce reforms and incentives to boost labor absorption, promote entrepreneurship, and improve the business environment.

Tourism Sector Diversification: Diversify tourism offerings and focus on inclusive growth. Strengthen tourism infrastructure in regions like the North West to reduce regional unemployment disparities.

Population Growth Management: In regions like the South East, where population growth correlates with higher unemployment, policies should balance job creation with population growth, targeting high-employment sectors like technology and renewable energy.

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