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Socio-Economic Indicators and their Impact on Sustainable Economic Development: An In-depth Analysis of Egypt

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ABSTRACT

This research paper investigates the sophisticated relationship between socio-economic indicators and sustainable economic development in Egypt, employing a Linear Regression Model to provide an accurate analysis. Focusing on key variables such as Population, Life Expectancy at Birth, and Labor Force, the study seeks to discern their impact on Gross Domestic Product (GDP). With R Square of 0.9443, the model exhibits strong explanatory power. Noteworthy coefficients include a positive relationship between Population and GDP (β = \$9,302.27), a negative relationship between Life Expectancy at Birth and GDP (β = −\$45.77 Bln), and a positive relationship between Labor Force and GDP (β = \$10,097.49). These findings contribute subtle insights to the literature and offer policymakers valuable information for fostering sustainable economic development in Egypt.

Keywords: Sustainable Growth, Socio-economic Indicators, Population, Life Expectancy at Birth, Labor Force
JEL Classifications: B22

1. INTRODUCTION

In the pursuit of understanding the sophisticated dynamics between socio-economic indicators and economic growth, this research attempts to conduct an in-depth analysis focused on the context of Egypt. The economic path of nations is often shaped by a lot of factors, and decoding the specific impact of socio-economic indicators becomes essential for effective policy formulation (Ahmed and Sallam, 2020).

In the initial stages of our analysis, we started to explore the complex relationship between socio-economic indicators and sustainable economic development in Egypt using a Linear Regression Model. The model incorporated five key independent variables—Population, Life Expectancy at Birth, Labor Force, Net Migration, and Unemployment. However, upon conducting hypothesis tests, we identified that two of these variables, Net Migration and Unemployment, demonstrated statistical insignificance in their impact on Gross Domestic Product (GDP). Recognizing the importance of refining our model for precision and interpretability (Uddin et al., 2023), we have subsequently streamlined our analysis to focus on the remaining three variables—Population, Life Expectancy at Birth, and Labor Force. This strategic adjustment not only enhances the relevance and reliability of our findings but also ensures a more targeted exploration of the socio-economic factors that significantly contribute to or hinder sustainable economic development in the Egyptian context (Venkatesan et al., 2022).

Against this backdrop, the major research question guiding this study is: "How do key socio-economic indicators, namely Population, Life Expectancy at Birth, and Labor Force, influence the economic growth of Egypt?" By examining these variables within the framework of a precise econometric model, we aim to unravel the nuanced relationships and contribute valuable insights to both the academic discourse and policy-making landscape.

This research not only seeks to clarify the statistical associations between the chosen indicators and Gross Domestic Product (GDP) but also endeavors to provide practical recommendations for policymakers seeking to foster sustainable economic development in Egypt.

1.1. Research Hypothesis

Hypothesis testing is an essential step in the analysis of the Linear Regression Model (Mahmoud and Vogt, 2021), enabling us to assess the statistical significance of each independent variable. For the model with five independent variables (Population, Life Expectancy at Birth, Labor Force, Net Migration, and Unemployment), the null and alternative hypotheses for each coefficient (β) can be formulated as follows:

- Population (POP):
  - Null Hypothesis (H_0): The population coefficient (β_1) is equal to zero
  - Alternative Hypothesis (H_a): The population coefficient (β_1) is not equal to zero.
- Life Expectancy at Birth (LEB):
  - Null Hypothesis (H_0): The life expectancy coefficient (β_2) is equal to zero
  - Alternative Hypothesis (H_a): The life expectancy coefficient (β_2) is not equal to zero.
- Labor Force (LF):
  - Null Hypothesis (H_0): The labor force coefficient (β_3) is equal to zero
  - Alternative Hypothesis (H_a): The labor force coefficient (β_3) is not equal to zero.
- Net Migration (NETM):
  - Null Hypothesis (H_0): The net migration coefficient (β_4) is equal to zero
  - Alternative Hypothesis (H_a): The net migration coefficient (β_4) is not equal to zero.
- Unemployment (UEM):
  - Null Hypothesis (H_0): The unemployment coefficient (β_5) is equal to zero
  - Alternative Hypothesis (H_a): The unemployment coefficient (β_5) is not equal to zero.

The statistical significance of each hypothesis will be assessed using t-tests, with the aim of determining whether each independent variable has a significant impact on the dependent variable "Gross Domestic Product" (Hosan et al., 2022). If the P-value associated with a coefficient is below the significance level (0.05), the null hypothesis is rejected in favor of the alternative hypothesis, indicating that the variable is statistically significant in explaining variations in GDP (Ahmad et al., 2023).

2. LITERATURE REVIEW

The literature surrounding the relationship between socio-economic indicators and sustainable economic development offers a rich tapestry of insights, theories, and empirical findings. Various studies have delved into the intricate dynamics that characterize this nexus, providing a foundation for understanding the complexities inherent in shaping a nation's economic trajectory.

One significant stream of research has explored the role of population in economic development. Classical theories, such as the Malthusian perspective, initially posited that rapid population growth could hinder economic progress (Bloom et al., 2015). However, contemporary scholarship has introduced nuanced perspectives, acknowledging that population dynamics can act as both a driver and a challenge for sustainable economic development. Studies by Bloom and Finlay (2008) highlight the potential demographic dividend associated with a youthful population, emphasizing the importance of effective population management policies (Bloom and Finlay, 2008) and (Balbaa et al., 2024).

Life expectancy at birth has emerged as another pivotal socio-economic indicator influencing economic development (Hansen and Lønstrup, 2015) and (Abdurakhmonov, 2023). Healthier populations are often associated with higher productivity and a greater capacity for economic engagement. Researchers, including Acemoglu and Johnson (2007), have underscored the positive correlation between improvements in life expectancy and economic growth (Acemoglu and Johnson, 2007) and (Bloom et al., 2015), attributing this relationship to enhanced human capital and workforce productivity (Becker, 1964) and (Metawa and Metawa, 2023).

Labor force dynamics play a central role in the economic development discourse. The influential work of Becker (1964) introduced the concept of human capital, emphasizing the role of education and skills in fostering economic growth (Becker, 1964), (Schultz, 1961) and (Abdurashidova et al., 2023). Subsequent research, such as Barro (1991) and Mankiw et al. (1992), has further elucidated the critical role of a skilled and educated labor force in sustainable economic development (Mankiw et al., 1992) and (Barro, 1991).

Empirical studies on Egypt, while fewer in number, have contributed to the global dialogue on socio-economic indicators and economic development. Roudi-Fahimi and Moghadam (2003) have explored demographic trends in the country (Roudi-Fahimi and Moghadam, 2003), (Lokshin et al., 2010) and (Shokry et al., 2022), offering valuable insights into the challenges and opportunities posed by population dynamics. Nevertheless, there remains a notable gap in the literature regarding the specific impact of life expectancy, labor force dynamics, and other socio-economic indicators on Egypt's sustainable economic development.

This study aims to build upon and extend existing literature by conducting a rigorous in-depth analysis focused on Egypt. By utilizing an econometric model and drawing from global and regional literature, this research seeks to fill the gaps in understanding the relationships between key socio-economic indicators and sustainable economic development in the Egyptian context.

3. METHODOLOGY

The methodology employed in this research involves a systematic approach to examining the relationship between socio-economic indicators and sustainable economic development in Egypt. The primary analytical tool is the Linear Regression Model, allowing for a quantitative assessment of the impact of key variables on Gross Domestic Product (GDP).

3.1. Data Collection

The integrity and reliability of this study rest upon an accurate and comprehensive approach to data collection, drawing from reputable sources to clarify the complex dynamics of socio-economic indicators in the context of Egypt.

The Gross Domestic Product (GDP) data, reflecting the sum of value added by resident producers, product taxes, and subsidies (Raihan et al., 2023), were sourced from the World Bank national accounts data and the OECD National Accounts data files, ensuring a solid foundation for economic analyses. Total Population estimates, crucial for understanding demographic shifts (Hegazy, 2014), were compiled from diverse sources such as the United Nations Population Division, national statistical offices, Eurostat, and the U.S. Census Bureau, providing an accurate and comprehensive view of Egypt's demographic landscape. Life Expectancy at Birth data, essential for gauging overall societal well-being (Lee, 2003) and (Mahmoud and Vogt, 2021), was derived from reputable sources including the United Nations Population Division and various national statistical offices. Labor Force and Unemployment data, essential in assessing the economic dynamics of the nation (Sadiku et al., 2015), were precisely gathered from the World Bank's World Development Indicators database, International Labour Organization, and the United Nations Population Division. Additionally, Net Migration, representing the net total of migrants (immigrants minus emigrants) during the period, was sourced from the United Nations Population Division's World Population Prospects: 2022 Revision.

This careful curation of data (Table 1) from globally recognized and authoritative sources ensures the accuracy and reliability of the information enhance our analysis of Egypt's socio-economic indicators and their impact on sustainable economic development.

- Time Frame: The study covers the period between 1991 and 2021 to ensure temporal relevance and consistency in the data.
- Variable Selection:

Dependent Variable: GDP serves as the dependent variable, representing the economic output of Egypt

Independent Variables: The independent variables include Population, Life Expectancy at Birth, Labor Force Net Migration and Unemployment. These were selected based on their significance in the literature and their potential impact on sustainable economic development (Shaaban and Scheffran, 2017).

- Model Specification:

A Linear Regression Model is formulated to express the relationship between the dependent and independent variables.

Table 1: Research data

Year	Gross domestic product	Population	Life expectancy at birth	Unemployment	Labor force	Net migration
	GDP	POP	LEB	UEM	LF	NETM
1991	37,387,836,490.53	58,611,032.00	64.76	9.38	16,171,285.00	−63,804.00
1992	41,855,986,519.42	59,989,142.00	65.03	8.92	16,784,931.00	−41,760.00
1993	46,578,631,452.58	61,382,200.00	65.47	10.92	17,515,926.00	−42,612.00
1994	51,897,983,392.65	62,775,847.00	65.82	10.93	18,400,048.00	−11,479.00
1995	60,159,245,060.45	64,166,908.00	66.31	11.04	18,571,620.00	−31,423.00
1996	67,629,716,981.13	65,565,195.00	66.74	9	18,866,025.00	7,378.00
1997	78,436,578,171.09	66,993,728.00	67.20	8.37	19,171,581.00	14,366.00
1998	84,828,807,556.08	68,446,011.00	67.47	8.03	19,483,789.00	11,316.00
1999	90,710,704,806.84	69,907,887.00	67.74	7.95	20,736,023.00	−163.00
2000	99,838,543,960.08	71,371,371.00	68.01	8.98	20,772,661.00	−2,815.00
2001	96,684,636,118.60	72,854,261.00	68.31	9.26	20,792,031.00	927.00
2002	85,146,067,415.73	74,393,759.00	68.56	10.01	20,589,710.00	73,253.00
2003	80,288,461,538.46	75,963,322.00	68.40	10.91	21,665,373.00	37,743.00
2004	78,782,467,532.47	77,522,427.00	68.61	10.32	22,756,745.00	31,302.00
2005	89,600,665,557.40	79,075,310.00	68.78	11.049	23,853,891.00	−18,144.00
2006	107,426,086,956.52	80,629,670.00	68.98	10.49	24,954,020.00	−28,511.00
2007	130,437,828,371.28	82,218,755.00	69.13	8.8	26,081,669.00	−32,607.00
2008	162,818,181,818.18	83,844,783.00	69.32	8.517	26,485,023.00	−46,339.00
2009	189,147,005,444.65	85,501,064.00	69.48	9.087	27,281,764.00	−55,856.00
2010	218,983,666,061.71	87,252,413.00	69.66	8.756	28,739,910.00	−18,831.00
2011	235,989,672,977.63	89,200,054.00	69.88	11.849	29,061,496.00	158,511.00
2012	279,116,666,666.67	91,240,376.00	70.09	12.597	29,544,119.00	−2,118.00
2013	288,434,108,527.13	93,377,890.00	70.05	13.154	30,181,706.00	163,449.00
2014	305,595,408,895.27	95,592,324.00	70.42	13.105	30,655,760.00	5,961.00
2015	329,366,576,819.41	97,723,799.00	70.48	13.052	30,540,697.00	−79,150.00
2016	332,441,717,791.41	99,784,030.00	70.84	12.45	30,927,659.00	4,132.00
2017	248,362,771,739.13	101,789,386.00	71.30	11.767	30,428,646.00	−23,281.00
2018	262,588,632,526.73	103,740,765.00	71.37	9.855	29,899,860.00	−61,050.00
2019	318,678,815,489.75	105,618,671.00	71.36	7.851	29,708,924.00	−59,715.00
2020	383,817,841,547.10	107,465,134.00	70.99	7.939	29,815,652.00	4,476.00
2021	424,671,765,455.70	109,262,178.00	70.22	7.4	30,223,373.00	−32,370.00

The model is expressed as:

$$GDP_i = \beta_0 + \beta_1 \cdot POP_i + \beta_2 \cdot LEB_i + \beta_3 \cdot LF_i + \beta_4 \cdot UEM_i + \beta_5 \cdot NETM_i + \varepsilon_i$$

- Estimation and Coefficient Analysis:

The model is estimated using econometric techniques, such as Ordinary Least Squares (OLS), to obtain coefficients (β_0, β_1, β_2, β_3, β_4, β_5) that quantify the relationship between variables.

Coefficients are interpreted in the context of the research question, indicating the magnitude and direction of the impact of each variable on GDP.

- Assumption Testing:

Assumptions of the Linear Regression Model, including linearity, independence, homoscedasticity, and normality of errors, are tested to ensure the validity of the results.

- Model Fit Assessment:

The goodness of fit of the model is evaluated using metrics such as the Multiple R, R Square, and adjusted R Square, providing insights into the explanatory power of the model.

- Statistical Significance Testing:

Hypothesis tests, such as t-tests, are conducted to assess the statistical significance of the coefficients and validate the impact of each variable on GDP.

By employing this methodology, the research aims to provide a comprehensive and statistically sound analysis of the relationship between socio-economic indicators and sustainable economic development in Egypt.

3.2. Data Analysis

The Data Analysis section embarks on a comprehensive exploration of the complex relationships between socio-economic indicators and sustainable economic development in Egypt, employing a Linear Regression Model with five essential independent variables—Population, Life Expectancy at Birth, Labor Force, Net Migration, and Unemployment. This multivariate approach initially aimed to unveil the nuanced impact of each variable on Gross Domestic Product (GDP).

$$GDP_i = \beta_0 + \beta_1 \cdot POP_i + \beta_2 \cdot LEB_i + \beta_3 \cdot LF_i + \beta_4 \cdot UEM_i + \beta_5 \cdot NETM_i + \varepsilon_i$$

Where:
- GDP_i is the Gross Domestic Product for observation i.
- POP_i is the Population for observation i.
- LEB_i is the Life Expectancy at Birth for observation i.
- UEM_i is the Unemployment for observation i.
- LF_i is the Labor Force for observation i.
- $NETM_i$ is the Net Migration for observation i.
- β_0 is the intercept term.
- β_1, β_2, β_3, β_4, β_5 are the coefficients of the respective independent variables.
- ε_i is the error term.

3.2.1. Descriptive statistics

Our analysis begins with a comprehensive exploration of descriptive statistics, acting as the initial lens through which we examine the core characteristics of our socio-economic dataset. In this introductory phase, our objective is to purify the complexities of key variables—Gross Domestic Product (GDP), Population, Life Expectancy at Birth, Unemployment, Labor Force, and Net Migration—into clear and brief summaries. By calculating measures such as mean, median, standard deviation, and range, we aim to provide readers with a foundational understanding of the central tendencies and variabilities inherent in the economic landscape of Egypt. This preliminary exploration is integral to separate out the broader context and complexity that will be further examined through correlation and regression analyses, offering a comprehensive perspective on the interaction of socio-economic indicators in the Egyptian context.

The descriptive statistics revealed in (Table 2) provide a comprehensive insight into the key socio-economic indicators for Egypt. Starting with Gross Domestic Product (GDP), the average stands at approximately $171.22 billion, with data points exhibiting a significant variation around this mean, ranging from $37.39 billion to $424.67 billion. The positive skewness (0.63) indicates a slight rightward skew in the distribution, while the negative kurtosis (−0.96) suggests a distribution with lighter tails than a normal distribution.

Moving to Population (POP), the mean population is around 82.04 million, with a standard deviation of approximately 15.45 million. The data range spans from 58.61 million to 109.26 million, with a positive skewness (0.21) suggesting a slight rightward skew in the distribution. The negative kurtosis (−1.16) indicates lighter tails than a normal distribution.

Life Expectancy at Birth (LEB) averages at approximately 68.73 years, with a narrow standard deviation of about 1.91 years. The range of life expectancy extends from 64.76 years to 71.37 years. The distribution shows a slight leftward skew (negative skewness of −0.55) and negative kurtosis (−0.56), indicating a distribution with lighter tails.

Turning to Unemployment (UEM), the average unemployment rate is around 10.06%, with a standard deviation of approximately 1.73%. Unemployment rates range from 7.40% to 13.15%, displaying a slight rightward skew (positive skewness of 0.38) and negative kurtosis (−1.00).

The Labor Force (LF) exhibits an average of approximately 24.54 million, with a standard deviation of approximately 5.11 million. The range spans from 16.17 million to 30.93 million, and the distribution shows a slightly negative skew (skewness of −0.14) and negative kurtosis (−1.62).

Finally, Net Migration (NETM) reveals an average of approximately −4,490.77, with data points varying around this mean by approximately 55,131.88. The range of net migration extends from −79,150 to 163,449. The positive skewness (1.76) and positive kurtosis (3.83) indicate a rightward skew and heavier tails in the distribution.

In summary, these descriptive statistics offer an understanding of the central tendencies, variabilities, and distributional characteristics of each variable, providing a solid foundation for the subsequent analyses of Egypt's socio-economic landscape.

3.2.2. Correlation analysis

We continue our analysis with a comprehensive examination of the correlation matrix, revealing the interconnections and dependencies between variables. The correlation matrix serves as a critical tool in interpreting the strength and direction of relationships, offering insights into how changes in one variable may correspond to changes in another (Abduvaliev et al., 2023). As we go through the matrix, the focus is on figure out the connections between Gross Domestic Product (GDP), Population (POP), Life Expectancy at Birth (LEB), Unemployment (UEM), Labor Force (LF), and Net Migration (NETM). Each correlation coefficient clears up a unique side of the complex socio-economic landscape, paving the way for a deeper exploration of the factors shaping Egypt's economic trajectory.

The correlation matrix (Table 3) provides insights into the strength and direction of relationships between pairs of variables. In this matrix:

- GDP and Population (POP):
The correlation coefficient of 0.95 indicates a strong positive correlation between GDP and population. This implies that as the population of Egypt increases, there is a corresponding increase in the Gross Domestic Product. However, it's essential to note that correlation does not imply causation.

- GDP and Life Expectancy at Birth (LEB):
The correlation coefficient of 0.85 suggests a strong positive correlation between GDP and life expectancy at birth. This implies that higher levels of economic output are associated with longer life expectancies. Improvements in living standards and healthcare may contribute to this positive correlation (Del-Aguila-Arcentales et al., 2022).

- GDP and Unemployment (UEM):
The correlation coefficient of 0.19 indicates a weak positive correlation between GDP and unemployment. The weak correlation suggests that there is a slight tendency for higher GDP to be associated with higher unemployment, but the relationship is not strongly explicit.

- GDP and Labor Force (LF):
The correlation coefficient of 0.92 indicates a very strong positive correlation between GDP and the labor force. This suggests that as the labor force in Egypt expands, there is a corresponding increase in the Gross Domestic Product. This aligns with the common economic understanding that a larger and more productive labor force can contribute to economic growth (Abdurashidova and Balbaa, 2023).

GDP and Net Migration (NETM):

The correlation coefficient of 0.03 indicates a very weak positive correlation between GDP and net migration. This implies that there is a minimal association between the net migration rate and the Gross Domestic Product in Egypt. The low correlation suggests that other factors may have a more substantial impact on GDP.

In summary, the correlation matrix highlights the varying strengths of relationships between these socio-economic indicators in Egypt. It provides a valuable overview, but further analysis and consideration of other factors are necessary for a comprehensive understanding of the dynamics influencing Egypt's economic landscape.

Table 2: Descriptive statistics

Indicator	GDP	POP	LEB	UEM	LF	NETM
Mean	171,216,228,375.54	82,040,635.23	68.73	10.06	24,537,481.19	−4,490.77
Standard Error	20,844,891,858.29	2,775,240.34	0.34	0.31	917,519.52	9,901.98
Median	107,426,086,956.52	80,629,670.00	68.98	9.86	24,954,020.00	−11,479.00
Standard Deviation	116,059,446,035.64	15,451,884.25	1.91	1.73	5,108,532.49	55,131.88
Kurtosis	−0.96	−1.16	−0.56	−1.00	−1.62	3.83
Skewness	0.63	0.21	−0.55	0.38	−0.14	1.76
Range	387,283,928,965.18	50,651,146.00	6.61	5.75	14,756,374.00	242,599.00
Minimum	37,387,836,490.53	58,611,032.00	64.76	7.40	16,171,285.00	−79,150.00
Maximum	424,671,765,455.70	109,262,178.00	71.37	13.15	30,927,659.00	163,449.00
Sum	5,307,703,079,641.77	2,543,259,692.00	2,130.77	311.74	760,661,917.00	−139,214.00
Count	31.00	31.00	31.00	31.00	31.00	31.00

Table 3: The correlation matrix

Indicator	GDP	POP	LEB	UEM	LF	NETM
GDP	1					
POP	0.94853	1				
LEB	0.847319	0.951087	1			
UEM	0.187472	0.167152	0.206767	1		
LF	0.916451	0.958277	0.94969	0.312276	1	
NETM	0.033255	0.0123	0.105078	0.319875	0.083258	1

3.2.3. Hypothesis testing

The hypothesis testing phase of our regression analysis delves into the significance and reliability of the relationships identified between Gross Domestic Product (GDP) and key independent variables—Population (POP), Life Expectancy at Birth (LEB), Unemployment (UEM), Labor Force (LF), and Net Migration (NETM). The initial interpretation of the regression statistics, ANOVA table, coefficients, and confidence intervals provides a comprehensive overview of the model's overall fit and the individual contributions of each variable. Now, we proceed to subject these relationships to rigorous hypothesis tests to ascertain their statistical significance, guiding us in drawing robust conclusions about the impact of each independent variable on GDP.

The hypothesis testing outcomes (Table 4) reveal essential insights into the statistical significance of the relationships within our regression model. The high multiple correlation coefficient (R) of 0.97 suggests a strong positive linear relationship between the independent and dependent variables. The ANOVA table reinforces this, with an F-statistic of 92.61 and an extremely low P-value (0.00), indicating the overall statistical significance of the regression model.

Moving to the coefficients, we find distinctive patterns in their statistical significance and impact on Gross Domestic Product (GDP). The intercept, represent the estimated GDP when all independent variables are zero, holds statistical significance, anchoring the baseline for our analysis.

Notably, the relationship between Population (POP) and GDP exhibits statistical significance; for each one-unit increase in population, GDP is estimated to rise by $9,687.15, a finding supported by a $P < 0.05$. Contrastingly, Life Expectancy at Birth (LEB) showcases a statistically significant negative influence on GDP. This implies that for every one-unit decrease in life expectancy, GDP is estimated to decrease by approximately $49.69 billion, a noteworthy insight into the economic dynamics associated with demographic factors. Moreover, the labor Force (LF) variable presents a statistically significant association, indicating that for every one-unit increase in the labor force, GDP is estimated to increase by $10,417.58. This underscores the economic impact of workforce dynamics on overall productivity.

On the other hand, the negative coefficient for Unemployment (UEM), while suggesting a correlation between higher unemployment and lower GDP, lacks statistical significance ($P > 0.05$). Caution is advised in drawing definitive conclusions from this relationship. Besides, In contrast, the positive coefficient for Net Migration (NETM) is not statistically significant ($P > 0.05$), suggesting a weak relationship.

The details surrounding the involved connections between each variable and GDP enrich our comprehension of their respective contributions to the economic landscape. Concurrently, the 95% confidence intervals for the coefficients provide a range within which we can confidently estimate the true values of these relationships, further enhancing the precision of our analysis.

In summary, the model appears fitting for the data with a high R-square and significant coefficients for population, life expectancy, and labor force. However, through the accurate hypothesis testing, we discovered that Net Migration and Unemployment lack statistical significance in their impact on GDP.

3.2.4. Regression analysis

In response to the results of the hypothesis testing which revealed a statistical insignificance of Net Migration and Unemployment variables, our focus has been refined to the three remaining variables—Population, Life Expectancy at Birth, and Labor Force—prioritizing precision and relevance in our investigation. The forthcoming regression analysis section will delve into these refined variables, unveiling the statistically significant socio-economic factors shaping Egypt's sustainable economic development landscape.

$$GDPi = \beta_0 + \beta_1 \cdot POPi + \beta_2 \cdot LEBi + \beta_3 \cdot LFi + \varepsilon_i$$

Table 4: Hypothesis testing

Regression Statistics						
Multiple R	0.974051472					
R Square	0.94877627					
Adjusted R Square	0.938531524					
Standard Error	28774429056					
Observations	31					
ANOVA						
Indicator	**df**	**SS**	**MS**	**F**	**Significance F**	
Regression	5	3.83395E+23	7.66789E+22	92.61101006	0.00	
Residual	25	2.06992E+22	8.27968E+20			
Total	30	4.04094E+23				
Indicator	**Coefficients**	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	2,554,457,851,063.42	617,180,784,265.69	4.14	0.00	1,283,350,231,849.71	3,825,565,470,277.13
POP	9,687.15	1,496.20	6.47	0.00	6,605.66	12,768.64
LEB	−49,691,261,996.88	10,275,322,362.63	-4.84	0.00	−70,853,684,544.70	−28,528,839,449.07
UEM	−1,731,253,260.73	3,810,729,241.69	-0.45	0.65	−9,579,597,048.10	6,117,090,526.64
LF	10,417.58	4,709.01	2.21	0.04	719.19	20,115.97
NETM	154,371.64	104,552.25	1.48	0.15	−60,957.75	369,701.02

Where:
- GDP_i is the Gross Domestic Product for observation i.
- POP_i is the Population for observation i.
- LEB_i is the Life Expectancy at Birth for observation i.
- LF_i is the Labor Force for observation i.
- β_0 is the intercept term.
- β_1, β_2, β_3 are the coefficients of the respective independent variables.
- ε_i is the error term.

The new regression results (Table 5) continue to explore the relationship between Gross Domestic Product (GDP) and the independent variables: Population (POP), Life Expectancy at Birth (LEB), and Labor Force (LF). Here's our interpretation of the updated results:

a. Regression Statistics:
   - Multiple R: The multiple correlation coefficient (R) is 0.97, indicating a strong positive linear relationship between the independent and dependent variables
   - R Square: About 94.43% of the variability in GDP is explained by the independent variables
   - Adjusted R Square: Adjusted for the number of predictors, the model still explains about 93.81% of the variability in GDP
   - Standard Error: The standard error of the estimate is approximately $28.87 billion, representing the typical deviation of the observed values from the regression line.
b. ANOVA table:
   - The ANOVA table tests the overall significance of the regression model
   - F-Statistic: The F-statistic is 152.58 with a very low P-value (0.00), indicating that the overall regression model is statistically significant.
c. Coefficients:
   - Intercept: The intercept represents the estimated GDP when all independent variables are zero. It is statistically significant
   - POP (Population): For every one-unit increase in population, GDP is estimated to increase by $9,302.27. This relationship is statistically significant ($P < 0.05$)
   - LEB (Life Expectancy at Birth): For every one-unit decrease in life expectancy, GDP is estimated to decrease by approximately $45.77 billion. This relationship is statistically significant ($P < 0.05$)
   - LF (Labor Force): For every one-unit increase in the labor force, GDP is estimated to increase by $10,097.49. This relationship is statistically significant ($P < 0.05$).
d. Confidence Intervals
   - 95% confidence intervals for the coefficients indicate the range within which we can be reasonably confident to estimate the true values of these relationships.

In summary, the updated model maintains a strong fit with the data, and the selected variables (Population, Life Expectancy at Birth, and Labor Force) continue to be statistically significant predictors of GDP. The adjusted R-square suggests that the model accounts for a high proportion of the variability in GDP. The results provide insights into the estimated impact of changes in population, life expectancy, and labor force on the Gross Domestic Product.

4. RESULTS

The results of the data analysis provide valuable insights into the relationships between socio-economic indicators and sustainable economic development in Egypt. We began our analysis with a comprehensive model incorporating five key independent variables—Population, Life Expectancy at Birth, Labor Force, Net Migration, and Unemployment. However, subsequent hypothesis testing revealed that Net Migration and Unemployment were statistically insignificant in their influence on Gross Domestic Product (GDP). Consequently, our refined analysis focused on the remaining three variables—Population, Life Expectancy at Birth, and Labor Force.

a. Model Fit:
   The Linear Regression Model, with the refined set of variables, demonstrates strong statistical significance (F-statistic = 152.58, p-value < 0.001), indicating that the model provides a meaningful explanation of the variability in GDP.
b. Coefficient Analysis:
   - Population (POP): The coefficient (β_1) for Population is statistically significant (t-stat = 6.93, $P < 0.001$), suggesting that, on average, a one-unit increase in population is associated with an increase of $9,302.27 in GDP.

Table 5: Regression analysis

Regression Statistics						
Multiple R	0.971750326					
R Square	0.944298695					
Adjusted R Square	0.938109661					
Standard Error	28873000802					
Observations	31					
ANOVA						
Indicator	**df**	**SS**	**MS**	**F**	**Significance F**	
Regression	3	3.81585E+23	1.27195E+23	152.58	0.00	
Residual	27	2.25086E+22	8.3365E+20			
Total	30	4.04094E+23				
Indicator	**Coefficients**	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	2,306,245,715,346.95	589,574,630,714.62	3.91	0.00	1,096,538,496,304.10	3,515,952,934,389.80
POP	9,302.27	1,342.76	6.93	0.00	6,547.15	12,057.39
LEB	−45,769,801,201.58	9,921,689,779.86	−4.61	0.00	−66,127,427,066.94	−25,412,175,336.22
LF	10,097.49	4,006.14	2.52	0.02	1,877.57	18,317.40

- Life Expectancy at Birth (LEB): The coefficient (β_2) for Life Expectancy at Birth is statistically significant (t-stat = −4.61, $P < 0.001$). A one-unit decrease in life expectancy is associated with a decrease of approximately $45.77 billion in GDP.
- Labor Force (LF): The coefficient (β_3) for Labor Force is statistically significant (t-stat = 2.52, P = 0.02), indicating that, on average, a one-unit increase in the labor force is associated with an increase of $10,097.49 in GDP.

c. Model Interpretation:
The adjusted R Square of 0.9381 signifies that the model explains approximately 93.81% of the variability in GDP, reflecting a strong explanatory power.

These results provide a subtle understanding of the socio-economic factors influencing Egypt's sustainable economic development, emphasizing the significant impact of population dynamics, life expectancy, and the labor force. The statistically significant coefficients offer valuable insights for policymakers seeking to formulate targeted strategies for fostering economic growth in the country.

5. DISCUSSION

The findings of our analysis offer captivating insights into the complex relationship between socio-economic indicators and sustainable economic development in Egypt. Notably, the refinement of our model to focus on three variables—Population, Life Expectancy at Birth, and Labor Force—has yielded statistically significant results, shedding light on the key drivers influencing the nation's economic landscape.

5.1. Population Dynamics

The positive and statistically significant coefficient for Population suggests that, on average, a growth in population is associated with an increase in Gross Domestic Product (GDP). This finding aligns with the concept of a demographic dividend, indicating that a larger working-age population can contribute to economic expansion (Raihan et al., 2023) (Hussain et al., 2023). Policymakers may consider strategies for harnessing this demographic advantage through targeted investments in education, employment, and skills development.

5.2. Life Expectancy Impact

Conversely, the negative and statistically significant coefficient for Life Expectancy at Birth underscores the interaction between health outcomes and economic development. While improvements in life expectancy are associated with enhanced human capital and workforce productivity, the negative coefficient suggests that certain health-related challenges may be impeding economic growth (Domashova and Politova, 2021) and (Nashwan et al., 2020). Addressing these challenges through targeted healthcare interventions may prove vital in fostering sustainable economic development.

5.3. Labor Force Contribution

The positive and statistically significant coefficient for Labor Force reinforces the critical role of a skilled and actively engaged workforce in driving economic growth (Abdurashidova and Balbaa, 2023). Investments in education, vocational training, and initiatives promoting employment opportunities can further capitalize on the positive relationship observed in the model (Farzanegan et al., 2020) and (Nassef et al., 2023).

5.4. Model Implications

The overall model, with its high adjusted R Square of 93.81%, indicates that the selected variables collectively explain a substantial portion of the variability in GDP. This strong explanatory power enhances the reliability and relevance of the model's predictions.

5.5. Policy Recommendations

In light of these findings, policymakers are presented with a valuable foundation for crafting targeted strategies to promote sustainable economic development. Focusing on initiatives that manage population growth, improve healthcare outcomes, and invest in education and employment opportunities can be instrumental in fostering long-term economic prosperity.

5.6. Limitations and Future Research

It is essential to acknowledge the limitations of our study, including potential omitted variables and the cross-sectional nature of the data. Future research could explore additional socio-economic factors and employ longitudinal analyses to capture dynamic changes over time.

In conclusion, this discussion highlights the multifaceted nature of the relationships revealed in our analysis. The findings contribute not only to the academic discourse but also offer actionable insights for policymakers seeking to navigate the complex ground of socio-economic indicators and sustainable economic development in Egypt.

6. CONCLUSION

In conclusion, this research has provided a comprehensive analysis of the intricate relationship between socio-economic indicators and sustainable economic development in Egypt. The meticulous examination of a Linear Regression Model, initially encompassing five key variables—Population, Life Expectancy at Birth, Labor Force, Net Migration, and Unemployment—yielded valuable insights into the factors shaping the nation's economic trajectory.

The decision to refine the analysis based on statistical significance has enhanced the precision of our findings. The refined model, focusing on Population, Life Expectancy at Birth, and Labor Force, has revealed compelling results. Notably, population dynamics demonstrate a positive association with economic growth, emphasizing the potential advantages of a demographic dividend. Simultaneously, the negative association between life expectancy and GDP highlights the complex interplay of health outcomes on economic development. Investments in healthcare infrastructure and disease prevention may be pivotal in addressing this challenge. Furthermore, the positive impact of a skilled and actively engaged labor force underscores the importance of educational and employment-focused policies in driving economic prosperity.

The model's high explanatory power, reflected in the adjusted R Square of 93.81%, attests to its robustness in capturing the variability in GDP. These findings hold significant implications for policymakers in Egypt, offering a foundation for targeted strategies that harness the demographic dividend, improve healthcare outcomes, and invest in education and employment opportunities.

While this study provides valuable contributions to the understanding of Egypt's economic landscape, it is essential to acknowledge its limitations. Future research endeavors may explore additional socio-economic factors, incorporate longitudinal analyses for temporal insights, and consider the evolving dynamics of a globalized economy.

In essence, this research serves as a stepping stone for policymakers, researchers, and stakeholders, providing a nuanced understanding of the socio-economic factors influencing sustainable economic development in Egypt. As the nation navigates the complexities of a rapidly changing world, the insights gleaned from this study contribute to the ongoing dialogue on fostering enduring economic prosperity.

REFERENCES

Abdurakhmonov, F.A. (2023), Global socio-economic problems and approaches to their resolution. Journal of Journal of Sustainable Development and Green Technology, 3(2), 35-39.

Abdurashidova, M., Balbaa, M., Nematov, S., Mukhiddinov, Z., Nasriddinov, I. (2023), The impact of innovation and digitalization on the quality of higher education: A study of selected universities in Uzbekistan. Journal of Intelligent Systems, 32(1), 20230070.

Abdurashidova, M.S., Balbaa, M.E. (2023), The impact of the digital economy on the development of higher education. In: Koucheryavy, Y., Aziz, A., editors. Internet of Things, Smart Spaces, and Next Generation Networks and Systems. NEW2AN 2022. Lecture Notes in Computer Science. Vol. 13772. Cham: Springer.

Abduvaliev, A.A., Isadjanov, A.A., Dadabaev, U.A., Balbaa, M.E. (2023), Neutrosophic framework for analyzing factors of innovation in the development of Uzbekistan: Features and modern tendencies. International Journal of Neutrosophic Science, 21(3), 34-46.

Acemoglu, D., Johnson, S. (2007), Disease and development: The effect of life expectancy on economic growth. Journal of Political Economy, 115(6), 925-985.

Ahmad, M., Kuldasheva, Z., Nasriddinov, F., Balbaa, M.E., Fahlevi, M. (2023), Is achieving environmental sustainability dependent on information communication technology and globalization? Evidence from selected OECD countries. Environmental Technology and Innovation, 31, 103178.

Ahmed, O., Sallam, W. (2020), Assessing the potential of improving livelihoods and creating sustainable socio-economic circumstances for rural communities in upper Egypt. Sustainability, 12(16), 6307.

Balbaa, M.E., Dadabaev, U., Akhmedova, D., Iskandarova, M. (2024), Fostering economic growth and global trade through digitalized international transport corridors: Examining the role of the eTIR convention in the proposed China-Kyrgyzstan-Uzbekistan railways for Uzbekistan's development. Journal of American Journal of Business and Operations Research, 11(1), 31-42.

Barro, R.J. (1991), Economic growth in a cross section of countries. The Quarterly Journal of Economics, 106(2), 407-443.

Becker, G.S. (1964), Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. Chicago: University of Chicago Press.

Bloom, D.E., Chatterji, S., Kowal, P., Lloyd-Sherlock, P., McKee, M., Rechel, B., Rosenberg, L., Smith, J.P. (2015), Macroeconomic implications of population ageing and selected policy responses. Lancet, 385(9968), 649-657.

Bloom, D.E., Chatterji, S., Kowal, P., Lloyd-Sherlock, P., McKee, M., Rechel, B., Rosenberg, L., Smith, J.P. (2015), Macroeconomic implications of population ageing and selected policy responses. Lancet, 385(9968), 649-657.

Bloom, D.E., Finlay, J.E. (2008), Demographic Change and Economic Growth in Asia, PGDA Working Papers, Program on the Global Demography of Aging. Available from: https://econpapers.repec.org/repec: gdm:wpaper:4108

Del-Aguila-Arcentales, S., Alvarez-Risco, A., Jaramillo-Arévalo, M., De-la-Cruz-Diaz, M., Anderson-Seminario, M.D.L.M. (2022), Influence of social, environmental and economic sustainable development goals (SDGs) over continuation of entrepreneurship and competitiveness. Journal of Open Innovation: Technology, Market, and Complexity, 8(2), 8020073.

Domashova, J., Politova, A. (2021), The corruption perception index: Analysis of dependence on socio-economic indicators. Procedia Computer Science, 190, 193-203.

Farzanegan, M.R., Hassan, M., Badreldin, A.M. (2020), Economic liberalization in Egypt: A way to reduce the shadow economy? Journal of Policy Modeling, 42(2), 307-327.

Hansen, C.W., Lønstrup, L. (2015), The rise in life expectancy and economic growth in the 20th century. The Economic Journal, 125(584), 838-852.

Hegazy, I.R. (2014), Urban strategies and environmental policy: Towards urban sustainability within the Egyptian context. Environmental Development, 11, 190-207.

Hosan, S., Karmaker, S.C., Rahman, M.M., Chapman, A.J., Saha, B.B. (2022), Dynamic links among the demographic dividend, digitalization, energy intensity and sustainable economic growth: Empirical evidence from emerging economies. Journal of Cleaner Production, 330, 129858.

Hussain, J., Kui, Z., Khan, A., Akhtar, R., Ali, R., Yin, Y. (2023), Proposing a sustainable investment index for measuring economic performance and sustainability: A step toward clean and affordable energy. Sustainable Energy Technologies and Assessments, 60, 103564.

Lokshin, M., El-Laithy, H., Banerji, A. (2010), Poverty and economic growth in Egypt, 1995-2000. Journal of African Studies and Development, 2(6), 150-165.

Mahmoud, M., Vogt, J. (2021), Socio-economic transformation in rural areas: From agriculture to limestone in a Coptic village in middle Egypt. The Extractive Industries and Society, 8(3), 100946.

Mankiw, N.G., Romer, D., Weil, D. (1992), A contribution to the empirics of economic growth. Quarterly Journal of Economics, 107, 407-437.

Metawa, N., Metawa, S. (2023), Enhancing business sustainability through strategic approach for ESG integration and risk score analysis. Journal of Financial Technology and Innovation, 3(1), 30-37.

Nashwan, M.S., Shahid, S., Chung, E.S. (2020), High-resolution climate projections for a densely populated Mediterranean region. Sustainability, 12(9), 3684.

Nassef, M., Mohammed, N., Ibrahim, M. (2023), Investigating the socio-economic sustainability within the Egyptian museums over the last decade. Sustainability, 15(24), 16746.

Raihan, A., Ibrahim, S., Muhtasim, D.A. (2023), Dynamic impacts of economic growth, energy use, tourism, and agricultural productivity on carbon dioxide emissions in Egypt. World Development

Sustainability, 2, 100059.

Roudi-Fahimi, F., Moghadam, V.M. (2003), Empowering Women, Developing Society: Female Education in the Middle East and North Africa. Washington, DC: Population Reference Bureau (PRB).

Sadiku, M., Ibraimi, A., Sadiku, L. (2015), Econometric estimation of the relationship between unemployment rate and economic growth of FYR of Macedonia. Procedia Economics and Finance, 19, 69-81.

Shaaban, M., Scheffran, J. (2017), Selection of sustainable development indicators for the assessment of electricity production in Egypt. Sustainable Energy Technologies and Assessments, 22, 65-73.

Shokry, S., Tanaka, S., Wahaballa, A.M. (2022), Cost-benefit analysis of unconventional arterial intersection designs: Cairo as a case study. Sustainability, 14(24), 17016.

Uddin, I., Ahmad, M., Ismailov D., Balbaa, M.E., Akhmedov, A., Khasanov, S., Ul Haq, M. (2023), Enhancing institutional quality to boost economic development in developing nations: New insights from CS-ARDL approach. Research in Globalization, 7, 100137.

Venkatesan, R., Sumithra, M., Buvaneswari, B., Selvalingeshwaran, R. (2022), Food ordering systems' newness. Journal of Cognitive Human-Computer Interaction, 4(1), 15-20.