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A Proposed Statistical Model to Study the Impact of Economic Conditions on Marriage and Divorce Rates in Egypt

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Abstract

This research aims to develop a comprehensive statistical model to study the impact of economic and social variables on marriage and divorce rates in Egypt during the period 1990–2022, based on data from the Central Agency for Public Mobilization and Statistics (CAPMAS) and the World Bank. The research utilized three of the most advanced economic models: Dynamic Linear Regression (DOLS), Auto distributed Lag (ARDL), and Bayesian Autoregression (BVAR), to analyze the short- and long-term relationships between economic variables and marriage and divorce indicators.

The quantitative results showed that the unemployment rate and the inflation rate are the most influential economic variables on family stability. The ARDL model demonstrated that a 1% increase in unemployment leads to a 1.95-unit decrease in the marriage rate and a 0.016-unit increase in the divorce rate. Meanwhile, the DOLS model indicated that high inflation contributes to a decrease in marriage rates in the short term and an increase in them in the long term due to accumulated economic pressures. The BVAR model showed that acute economic shocks, such as price increases or labor market volatility, have reciprocal effects on marriage and divorce rates over time. The coefficient of interpretation (R^2) for the divorce equation was 0.93, and for the HDI, it was 0.99, reflecting the strong structural correlation between these variables.

The Human Development Index (HDI) demonstrated a highly significant double-dip effect (at the 5% level), where a one-unit increase in the HDI leads to an increase in the marriage rate of approximately 67.01 units, while simultaneously increasing the divorce rate of approximately 24.41 units. This pattern reflects the "contradictory frontiers" of development: it raises living standards and facilitates family formation, but it also increases individual autonomy and the ability to choose separation when interests conflict. The fertility rate was also statistically

significant (at the 10% level), showing a positive correlation with both marriage (+11.37) and divorce (+3.46) rates, indicating economic stress within families with high reproductive burdens.

Variables that proved statistically insignificant in most models include GDP per capita growth rate, female labor force participation, population growth rate, and the demographic dependency ratio. The coefficients for these variables appeared weak and insignificant in both the DOLS and ARDL models, although their signals are consistent with socio-economic theory, reflecting slow changes in social structure and family roles whose effects only become apparent in the long term.

The Johansen cointegration test confirmed the existence of seven long-term cointegration equations among the studied variables, indicating their collective movement toward a shared socio-economic equilibrium. Causality analysis using the Granger test showed that the Human Development Index (HDI), the marriage rate, and the average age of women at marriage are among the variables contributing to changes in divorce rates in Egypt, at a significance level of less than 1%.

The results clearly reveal that marriage and divorce in Egypt are not purely individual behaviors, but rather a direct reflection of economic and social transformations. Every increase in inflation and unemployment rates leads to the postponement of marriage and an increase in divorce. While human development contributes to improving quality of life and raising marriage rates, it simultaneously reinforces individualism, which may increase the likelihood of separation. The study concluded that economic and social policies in Egypt must adopt an integrated approach that balances economic development with family stability. This can be achieved by reducing inflation and unemployment and directing human development programs toward supporting family values and commitment, thus ensuring that development serves as a tool for strengthening social cohesion, not dismantling it.

Keywords:

Marriage Rate, Divorce Rate, Economic Conditions, Egypt, Cointegration, BVAR, DOLS, ARDL

Introduction:

Marriage and divorce are among the most important social phenomena reflecting individuals' interaction with their economic and social circumstances, and they serve as key indicators for measuring societal stability and cohesion. The relationship between the economy and the family is close; economic crises, inflation rates, unemployment, and income levels all influence individuals' decisions regarding family formation or dissolution. In many countries, major economic shifts have had direct effects on family behavior, with marriage rates tending to decline during periods of economic recession, while divorce rates rise under pressure of living conditions and declining levels of social welfare.

In the Egyptian context, this relationship is particularly significant given the structural changes the Egyptian economy has undergone over the past three decades, from economic reform programs and the transition to free market mechanisms to periods of inflationary volatility and high unemployment, especially in the years following 2016. These transformations have not only affected income and living standards but have also extended to the social structure of the Egyptian family. Data from the Central Agency for Public Mobilization and Statistics (CAPMAS) indicates a significant decline in marriage rates since 2015, coupled with a steady rise in divorce rates, particularly in urban areas and among middle- and working-class families. This trend raises important questions about the extent to which macroeconomic variables such as unemployment, inflation, GDP, and human development influence the behavior and crucial decisions of Egyptian families.

Several previous studies have examined the relationship between economic conditions and family indicators in various international contexts. For example, a study by Kök & Kutlar (2021) in Turkey showed that unemployment is positively correlated with divorce rates, while inflation does not exhibit a significant impact. Similarly, a study by Schneider & Hastings (2021) in the United States demonstrated that divorce rates temporarily decrease during economic recessions due to the "financial constraints effect," but then rise again after conditions improve as a result of accumulated psychological and economic pressures. Research by Bremmer & Kesselring (2004) demonstrated a long-term equilibrium relationship between divorce and women's participation in the labor market, while Heller & Edwards (1999) confirmed that rising education levels and urbanization increase the likelihood of divorce globally amidst the social changes accompanying development.

Despite the importance of these studies, most focused on Western or Asian contexts, while the Arab region in general, and Egypt in particular, lacks recent quantitative studies that combine economic and social analysis of the family using advanced econometric models. This study differed from previous studies in three key aspects:

First, it integrated several modern economic models (BVAR, DOLS, ARDL) to analyze the relationship between economic and social variables in both the short and long term, allowing for more precise measurement of their interactions.

Second, it covered a long period, from 1990 to 2022, a period that witnessed major economic transformations in Egypt. Third, it incorporates demographic and social variables such as fertility rates, women's participation in the labor market, the Human Development Index, and the demographic dependency ratio, thus providing a comprehensive view that links the economy to society.

Therefore, this study aims to fill a significant knowledge gap in the literature on the relationship between the economy and the family, by presenting an integrated statistical model that illustrates how major economic variables shape the family structure in Egypt, and how policymakers can formulate balanced economic and social policies that contribute to strengthening family stability and reducing the rising divorce rate.

Literature Review:

A study by Bao, et al., 2023 titled highlighted the relation of the number of siblings one grew up with to divorce in later life. Using longitudinal data from Add Health, a US national study, which tracked thousands of people from adolescence through adulthood, the authors analyzed the effect of sibling number on marital stability using logistic regression models, including controls for education, income, religious background, and demographic characteristics. On average, an additional sibling reduces the likelihood of divorce by 2% to 3%, reinforcing the idea that family resources are optimally invested when more siblings exist, creating essential social skills of negotiation, tolerance, and conflict resolution needed to sustain a successful marriage. The results indicated that the inverse relationship between sibling number and divorce remained strong even after adjustment for socioeconomic factors, reflecting the role of the family environment in childhood, specifically in large families, in teaching resource sharing and fostering early social interaction, hence enhancing one's ability to adapt to the demands of married life and reducing the likelihood of future separation.

In the study by Kutlar (2021) aimed to analyzing the impact of economic recessions on divorce rates in Turkey between 2001 and 2019. In this respect, they test the relationship between some selected macroeconomic indicators such as an unemployment rate, inflation, GDP per capita, and labor force participation rate, with annual divorce rates. The official data were obtained from the Turkish Statistical Institute (TurkStat) and the Central Bank of Turkey. They used Ordinary Least Squares (OLS) regression analysis for investigating the statistical relationship among the variables. Results showed that unemployment correlates positively with divorce rates; that is, the high rate of unemployment increases divorces because of increased psychological and financial stress within families. Another variable was that of inflation, which was not effective in affecting divorce rates, while higher per capita GDP reduces the probability of divorce, signifying that improved income encourages marital stability. The study further documented that the major economic recessions that Turkey has faced, particularly those in 2001, 2008, and 2018, correspond to the significant increases in divorce rates. The researchers thus concluded that economic crises increase pressures on families, posing the need for social and economic policy interventions which can reduce their impacts on family stability. (Kutlar, 2021)

The Study of Schneider, (2021), was one of the foundational studies that restructured academic knowledge about the complex relation of economic fluctuations with divorce rates. This hard analytical work utilized longitudinal data from the American Community Survey, covering all 50 US states and the District of Columbia from 2009 to 2019, based on multilevel regression models for estimating causal relations. These results found a countercyclical relationship, two-sided in its dynamics: a higher level of unemployment immediately reduces divorce rates in the short run because of the "financial constraint effect" that makes households reluctant to bear the high costs of separation during times of general economic uncertainty. On the contrary, a fall in real estate assets, the main component of American household wealth, associated with an increase in foreclosure rates, leads to a strong increase in divorce rates after a certain time, as psychological and social stressors linked to the loss of wealth and housing stability cumulate. What really sets this study apart is the methodological contribution since it breaks down economic conditions into their basic components, hence allowing the assessment of the causal mechanisms operating at different times in a more precise way. It shows that family stability being influenced by the economy is not a one-way process but rather dynamic, in which financial, psychological, and social factors interact within a complicated temporal frame. Botezatu, M. A., Tăbușcă, A. & Hosszu, A. (2023)

The paper by K. Djamba, et al. in 2012, analyzed the relationship between average household size and divorce rates at the county level in the United States. More importantly, it analyzed whether household size is a social indicator influencing marital stability. Data from the 1990 and 2000 US censuses were obtained in this study, and multiple linear regression analysis was employed to measure the effect of average household size, the main independent variable, on the divorce rate, the dependent variable, while controlling for a host of other variables: religious homogeneity, unemployment rate, among others. The negative associations between the divorce rate and average household size were found for both years of data analyzed. This means that the divorce rates were lower for those counties with a high mean household size. This impact is strongest within the year 2000 sample when household size was the second-strongest predictor of the divorce rate, next only to religious homogeneity. This therefore suggests that bigger households would encompass more substantial social and economic support networks that contribute to marital stability and reduce the risks for divorce.

Bremmer & Kesselring, 2004 sought to investigate the causal association that exists between the rates of divorce and female participation in the labor force and the median female income, with a focus on determining whether these variables are joined by long-run relationships using techniques of cointegration. For this purpose, annual data from 1948 to 1995 was considered for the aforementioned rates and median female income. Unit root tests were conducted to determine the characteristics of the time series in order to establish the stationarity of the time series. Further, cointegration techniques were employed to estimate the long-run relationships, and Bayesian VAR models were constructed to assess the causal dynamics of the variables under consideration and also to determine their responses to the shocks. The findings observed a long-term equilibrium relationship among the three variables: the higher the rate of divorce, the stronger was the female participation in the labor force, while greater female participation in the labor force contributed to lower rates of divorce, and higher median female income contributed to both a high rate of divorce and greater female participation in the labor force (Bremmer & Kesselring, 2004).

The study of Heller & Edwards (1999), is considered one of the pioneering and most comprehensive studies in the field of macro-level family sociology. It offers a deep comparative analysis of the structural factors underlying the phenomenon of divorce throughout the world. This study used an intensive quantitative methodology to analyze data from 111 countries over three decades, testing in a systematic manner theory of modernization and development. Results demonstrated a significant association between economic and social modernization processes and rising divorce rates. Greater urbanization, higher female labor force participation, and the spread of secular education were found to be significant factors stimulating this phenomenon worldwide. On the other hand, it was indicated that strong religious affiliations and traditional family structures acted as protective factors that contributed to lower divorce rates. These results provide a robust explanatory framework for the researcher to understand the local phenomenon of divorce in any country, including an Arab context, within this wider general global context. They not only support consistency with findings in Arab countries, such as the ones on the role of women's employment and economic pressures found in Egyptian and Jordanian studies, but also provide a lens for understanding how the distinctive cultural characteristics of the Arab societies, such as strong family relations, relate with global forces of modernization, which enriches the analysis and provides it with more nuance and a more comparative and academically rigorous perspective. Heller & Edwards (1999)

This is in line with the findings of Bremmer & Kesselring, 2004, which explained that the HDI and divorce both are positively related. It also reinforces the hypothesis that greater education and income raise people's independence and reduce the economic barriers to divorce.

Both the ARDL and DOLS confirm that unemployment and economic stress raise divorce and lower marriage. This is in full agreement with the findings of Kutlar (2021) in Turkey, confirming that financial and psychological stress are key channels undermining family stability.

This study differs from most previous studies in its analytical methodology and time scope. It is among the first studies to employ long-term time series analysis to measure the relationship between economic and social variables and marriage and divorce rates in Egypt during the period 1990–2022.

Most previous studies relied on cross-sectional data or short periods, resulting in findings that reflect limited time snapshots without tracking structural trends or long-term dynamics in the relationships between variables.

The following are the most prominent methodological and substantive differences between this study and previous studies:

In terms of data type:

This study used annual time series data spanning more than three decades, enabling the analysis of dynamic relationships between marriage and divorce rates and major economic variables (inflation, unemployment, GDP per capita, and the Human Development Index).

Previous studies, such as those by Kutlar (2021), Bremmer & Kesselring (2004), and Heller & Edwards (1999), relied on cross-sectional data or panel data covering shorter periods or multiple countries, without delving into the temporal changes within a single country.

Regarding the statistical analysis methodology:

The current study employed advanced time series analysis models, such as Bayesian Autoregression (BVAR), Dynamic Linear Regression (DOLS), and Autodistributed Linear Regression (ARDL). These models are capable of measuring short-term and long-term relationships and the temporal interaction between variables.

In contrast, most previous studies used Ordinary Linear Regression (OLS) or static and random regression models, which assume the stability of relationships over time and do not address issues of causality or cointegration between variables.

Regarding the scope of variables:

This study expanded the scope to include interconnected economic and demographic variables, including fertility rates, female labor force participation, the demographic dependency ratio, and average age at marriage, alongside macroeconomic indicators. Previous studies have largely focused on a limited number of variables, such as unemployment or income, without analyzing the impact of complementary social variables.

In terms of outputs and policies: The time-series methodology enabled the detection of phase changes and lagged effects that are undetectable in cross-sectional studies.

The analysis showed that some variables, such as the Human Development Index (HDI), affect marriage and divorce in two different ways over the long term. This finding was not clearly evident in previous studies, which did not distinguish between the immediate and cumulative effects of economic variables.

In short, this study is distinguished by its ability to explain the interrelationship between the economy and family structure in Egypt, offering a more in-depth predictive and analytical perspective compared to previous studies that merely described or statistically correlated the relationship without analyzing temporal causality.

1.1. Theoretical Framework and Study Hypotheses

Building on the synthesis of previous literature, this study constructs a conceptual framework for analyzing the determinants of marriage and divorce rates in Egypt, focusing on the specific role of economic conditions. Marriage and divorce are perceived as complex outcomes influenced by economic, social, legal, and demographic factors through several important dynamics:

The Economic Context: Economic stability is a basic precondition and protective factor for marriage, while economic shocks increase the likelihood of divorce. Macroeconomic indicators, such as unemployment, inflation, and GDP per capita, impact directly on the ability of individuals to establish and maintain financially secure families. As has similarly been argued for Turkey (Kutlar, 2021), economic pressure will increase financial and psychic burdens on the household and, in turn, raise divorce rates. Correspondingly, economic growth would ease the material constraints to union formation and increase marriage rates (Becker, 1981). The countercyclical pattern reported by Schneider and Hastings (2021) further implies that the timing of these effects is likely to be complex, with divorce being depressed in the immediate wake of financial constraint despite longer-term pressures.

The Socio-Legal and Developmental Context: Social structures and legal frameworks provide the intervening mechanisms between economic factors and family processes. As noted in cross-national studies, the processes of female empowerment, rising education, and urbanization are linked with changes in family formation and dissolution. In Egypt, the legal reforms that have taken place, such as the introduction of (khulo) laws, have changed the cost and availability of divorce for women. The HDI is hypothesized to have a two-way influence: it can increase marriage chances through rising living standards while also leading to increased divorce rates due to increased economic independence and reduced stigma from marital dissolution.

- The Demographic Context: The demographic structure of a population is a critical determinant of marital trends. A youthful population, as in Egypt, creates a large cohort at risk of both marriage and, consequently, early divorce. Demographic characteristics, such as the average age at marriage, are key indicators of marital stability; earlier marriages are typically associated with greater risk. Moreover, research indicates that household structure and early socialization, as captured by the inverse relationship between sibling number and divorce (Bao & Merry, 2023, cited in Downey, 2023), can generate social capital that contributes to marital resilience.

The study examines how both the marriage and divorce rates change over time with regards to the macroeconomic conditions in Egypt. Because such decisions are interdependent and may be influenced by past trends, only advanced time-series models (like BVAR, DOLS, and ARDL) can account for these interdependencies and allow the disentanglement of short-run shocks from the long-run equilibrium relationships.

To apply the investigation, the following hypotheses are proposed:

Study Hypotheses:

O General Hypothesis 1:

Economic change has a statistically significant effect on the divorce rate in Egypt during the study period.

Sub-hypothesis: The study hypothesizes a statistically significant inverse relationship between improved economic conditions and the divorce rate; the better and more stable the economic situation, the lower the divorce rate.

O General Hypothesis 2:

Economic change has a statistically significant effect on the marriage rate in Egypt during the study period.

Sub-hypothesis: There is a statistically significant positive relationship between improved economic conditions and the marriage rate.

O General Hypothesis 3:

The study hypothesizes a statistically significant relationship between the marriage rate and the divorce rate over the long term.

2.2. Data and Methodology

2.2.1. Data Source

Longitudinal data from 1990 to 2022 for the Arab Republic of Egypt are used in this study. The primary source for the data on marriage and divorce, as well as demographic variables, was obtained from the official database courtesy of the Central Agency for Public Mobilization and Statistics, CAPMAS. Data for the HDI were extracted from the World Bank development indicators database, World Bank (2023). These datasets provide nationally representative annual time-series data that enable the analysis of long-term trends in family formation and dissolution within their socioeconomic context.

The dataset combines key variables at the same level of observation. First, it integrates yearly information on marital status transitions, captured by the number of marriages and divorces annually, and further standardized into rates per thousand of the mid-year population. Second, it includes a variety of harmonized macroeconomic and demographic indicators that allow for a multivariate analysis of economic determinants of marital stability. This integrated dataset allows a sound exploration of the dynamic relationship between economic conditions and family dynamics during 33 years characterized by phases of economic stability, reform, and upheaval in Egypt.

2.2.2. Methodology

Empirical analysis applies an array of the most sophisticated time-series econometric methods to the study of dynamic relationships between economic conditions and marriage/divorce rates. The methodological procedure proceeds in several steps.

First, in order to address the completeness of the data, missing observations in the time series were imputed using the Expectation-Maximization algorithm, which is an iterative method for parameter estimation based on an E-step and an M-step (Dempster et al., 1977). Then, the stationarity properties of the variables were examined via the ADF test to check their order of integration and avoid spurious regression results.

The core analysis done in this study involves applying several cointegration and causality tests. In studying the long-run movements of the variables, the Johansen cointegration test was applied. Moreover, the DOLS estimator was employed, which, compared to other estimators, is more efficient in estimating cointegrating relationships since it controls for endogeneity and serial correlation by including leads and lags of the first differences of the regressors, as suggested by Stock and Watson (1993).

An ARDL model of the marriage and divorce rates was estimated in order to model both the short-run dynamics and long-run equilibria within a single model. One of the flexibilities of the ARDL approach is that it can be estimated regardless of whether the underlying regressors are purely I(0), purely I(1), or mutually cointegrated (Pesaran et al., 2001).

Finally, a Bayesian Vector Autoregression model was estimated to analyze the dynamic interdependencies and causal relationships between the variables over time. Indeed, the BVAR framework embeds prior information that is generally useful in stabilizing estimates, especially when time-series observations are limited. Granger causality tests were conducted within this framework to examine the direction of influence between the variables.

2.2.3. Variables

The study specifies the following variables for empirical testing:

- Dependent Variables:
    - Marriage Rate: The number of marriage contracts registered per thousand of the mid-year population.
    - Divorce Rate: The number of divorce certificates issued per thousand of the mid-year population.
- Independent Variables:
    - GDP per capita growth (annual %): The annual percentage growth rate of GDP per capita based on constant local currency (World Bank, 2023).
    - Unemployment rate: The proportion of the labor force that is without work but available for and seeking employment (CAPMAS, 2023).
    - Inflation rate: The annual percentage change in the consumer price index (CAPMAS, 2023).

- Poverty rate: The percentage of the population living below the national poverty line (CAPMAS, 2023).
- Human Development Index (HDI): A composite index measuring average achievement in three basic dimensions of human development: a long and healthy life, knowledge, and a decent standard of living (UNDP, 2023).
- Total fertility rate: The average number of children a woman would have over her reproductive lifetime (CAPMAS, 2023).
- Female labor force participation rate: The proportion of the female population aged 15 and above that is economically active (CAPMAS, 2023).
- Demographic dependency ratio: The ratio of dependents (persons under 15 and over 64) to the working-age population (aged 15-64), expressed as a percentage (CAPMAS, 2023).

2.2. Statistical Analysis

This paper overcomes these deficiencies by applying a battery of sophisticated econometric models to take a closer look at both the short-run dynamics and long-run equilibria that determine the rates of marriage and divorce in Egypt. The use of several models, such as BVAR, DOLS, and ARDL, permits an analysis that encompasses endogeneity and integration properties and allows incorporating prior knowledge so as to stabilize estimates.

1. Bayesian Vector Autoregression

The Bayesian Vector Autoregressive model incorporates the statistical properties of the variables as prior parameter distributions within a conventional Vector Autoregression framework and effectively overcomes problems that relate to a lack of degrees of freedom. This approach is followed in this study, which is particularly useful when dealing with challenges related to short time series data by incorporating prior statistical information. In the BVAR model, prior beliefs about the parameters are updated with knowledge of the data. The model integrates classical VAR estimation with Bayesian probability theory to efficiently deal with uncertainty and overcome the overfitting problems encountered in using standard VAR models with small samples. (Ma et al., 2021)

The general form of the BVAR model is an extension of the VAR model to include prior distributions of parameters as part of estimation.

The general formula for a BVAR(p) model is expressed as:

1. Model Equation:

$$Y_t = c + A_1Y_{t-1} + A_2Y_{t-2} + ... + A_pY_{t-p} + \varepsilon_t$$

Where:

- Y_t: vector of internal variables (n×1)

- c: vector of constants (n×1)

- A_i: matrices of coefficients (n×n) for each lag i = 1, 2, ..., p

- ε_t: vector of random errors such that $\varepsilon_t \sim N(0, \Sigma)$

2. Bayesian Estimation:

General formula for the posterior distribution:

$$p(A, \Sigma \mid Y) \propto p(Y \mid A, \Sigma)\, p(A, \Sigma)$$

This expresses the fundamental relationship between the probability function and the preceding one.

3. Common Priorities:

- Minnesota Prior:

This prior relies on the contraction of the variable's coefficients toward a random walk and is often applied using dummy observations.

- Normal–Wishart / Normal–Inverse–Wishart Prior:

This is the standard conjugate prior for the reduced VAR:

$\beta \mid \Sigma \sim N(b_0, \Sigma \otimes V_0)$

$\Sigma \sim IW(S_0, \nu_0)$

While:

1. $\beta \mid \Sigma \sim N(b_0, \Sigma \otimes V_0)$

β: The model coefficient vector (includes all elements of matrices (A_1, A_2, ..., A_p) and possibly the constant (c)).

Its dimensions are usually ($k \times 1$), where ($k = n \times (np + 1)$).

Σ (sigma): The variance–covariance matrix of the random error vector (ε_t).

Its dimensions are ($n \times n$).

b_0 (pi_{00}): The prior mean of the coefficients, i.e., the value we expect to be close to the model coefficients before seeing the data.

Often assumed to be ($b_0 = 0$) or "random walk" for the autolag coefficients.

V_0 (at zero): The prior variance-covariance matrix of the coefficients β.

It controls the degree of contraction or confidence in the premises.

⊗ (Kronecker Product):

The Kronecker product of two matrices, used to expand the variance between different dimensions.

In this case, ($\Sigma \otimes V_0$) means that the prior variance of the coefficients depends on the error variance (Σ) as well as the structure of the variance between the coefficients (V_0).

2. $\Sigma \sim IW(S_0, \nu_0)$

IW: Abbreviation for Inverse Wishart distribution—the probability distribution commonly used as a prior to the variance-covariance matrix in Bayesian models.

S_0: A scale matrix that defines the shape of the Σ distribution.

It reflects prior estimates of the values of variance and error covariance.

ν_0: Degrees of freedom for the Inverse Wishart distribution.

The higher its value, the more the distribution is centered around S_0 (i.e., greater confidence in the premise).

(Koop & Korobilis, 2010; Litterman, 1986; Karlsson, 2013)

2. Dynamic Ordinary Least Squares (DOLS) Model

In this study, the DOLS estimator has been applied to estimate stable long-run coefficients in cointegrated systems. It is more efficient compared to traditional cointegration estimators because it corrects for potential endogeneity and serial correlation in the regressors.

The model of Dynamic OLS, by adding lags and leads of the first differences of the regressors in the regression equation, controls for both endogeneity and serial correlation in cointegration.

The general equation for the DOLS model is as follows:

$$Y_t = \alpha + \beta X_t + \Sigma_{i=-q}{}^{p}\, \delta_i\, \Delta X_{t-i} + \varepsilon_t$$

Where:

- Y_t: The dependent variable.

- X_t: The independent variable (or vector of the independent variables).

- ΔX_{t-i}: The first differences of the independent variables with lead and lag intervals.

- α: The intercept.

- β: The coefficient of the long-term relationship between Y_t and X_t.

- δ_i: The coefficients of the first differences that capture short-term dynamics.

- ε_t: The limit of random error (white noise).

The DOLS model aims to estimate the long-term relationship between first-order integral I(1) variables and their conjugates. The introduction of the first differences ΔXt-i (with delays and advances) helps to correct the problems of autocorrelation and heterogeneous variance in errors. This model provides super-consistent estimates of the β coefficient even in the face of time-correlated errors. Stock & Watson, 1993; Kao & Chiang, 2000

3. Autoregressive Distributed Lag Model

The ARDL model used in this study is appropriate because it estimates both the short-run and long-run relationship between the dependent variable and its regressors, whether or not the underlying variables are I(0) or I(1).

The ARDL model is also applied to provide a comprehensive view that combines both short-run adjustments and long-run equilibrium within one framework. Its main advantage is the capability to model relationships between variables that are integrated of different orders, I(0) or I(1), without all series being stationary at the same level. The general form of the ARDL model is expressed as follows:

$$Y_t = \alpha_0 + \Sigma_{i=1}^{p} \beta_i Y_{t-i} + \Sigma_{j=0}^{\varphi_1} \gamma_{1j} X_{1,t-j} + \Sigma_{j=0}^{\varphi_2} \gamma_{2j} X_{2,t-j} + \ldots + \Sigma_{j=0}^{\varphi_k} \gamma_{kj} X_{k,t-j} + \varepsilon_t$$

While:

- Y_t: Dependent variable at time t

- $X_{k,t-j}$: Explanatory variable k at lag j

- α_0: Constant term (intercept)

- β_i: Coefficients of the lagged dependent variable (AR terms)

- γ_{kj}: Distributed lag coefficients of the independent variables

- p: Number of autoregressive (AR) lags for Y_t

- q_j: Number of distributed lags for variable X_j

- k: Number of explanatory variables

- ε_t: Error term assumed to be white noise

The ARDL model incorporates both the lagged values of the dependent variable and lagged values of independent variables.

- It is applicable when the variables are integrated of order I(0) or I(1), but not I(2).

- The model allows testing for the existence of a long-run equilibrium relationship using the Bounds Testing Approach proposed by Pesaran et al. (Pesaran, M. H., Shin, Y., & Smith, R. J.2001)

Long-Run Relationship:

The long-run coefficients are derived by normalizing the lagged-level coefficients as follows:

$\theta_k = (\Sigma_{j=0}{}^{\varphi_k}\, \gamma_{kj}) / (1 - \Sigma_{i=1}{}^{p}\, \beta_i)$

where θ_k represents the long-run effect of X_k on Y_t. (Narayan, P. K. (2005))

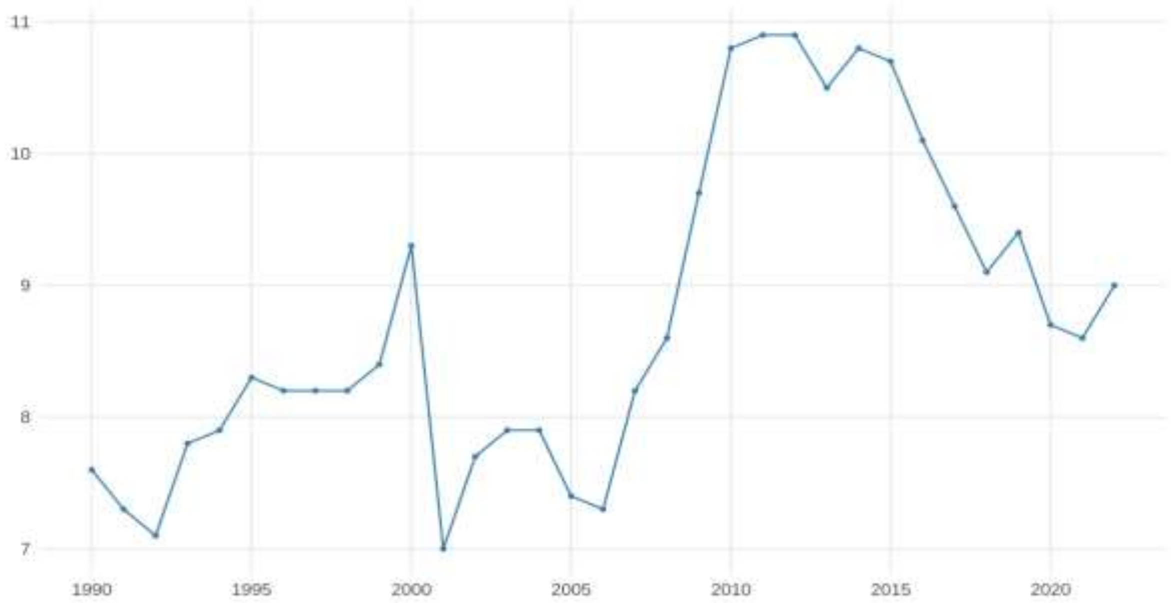
The Data and Results:

Dependent Variables:

- **Marriage Rate:**

Figure (1) shows the marriage rate in Egypt during the period (1990-2022)

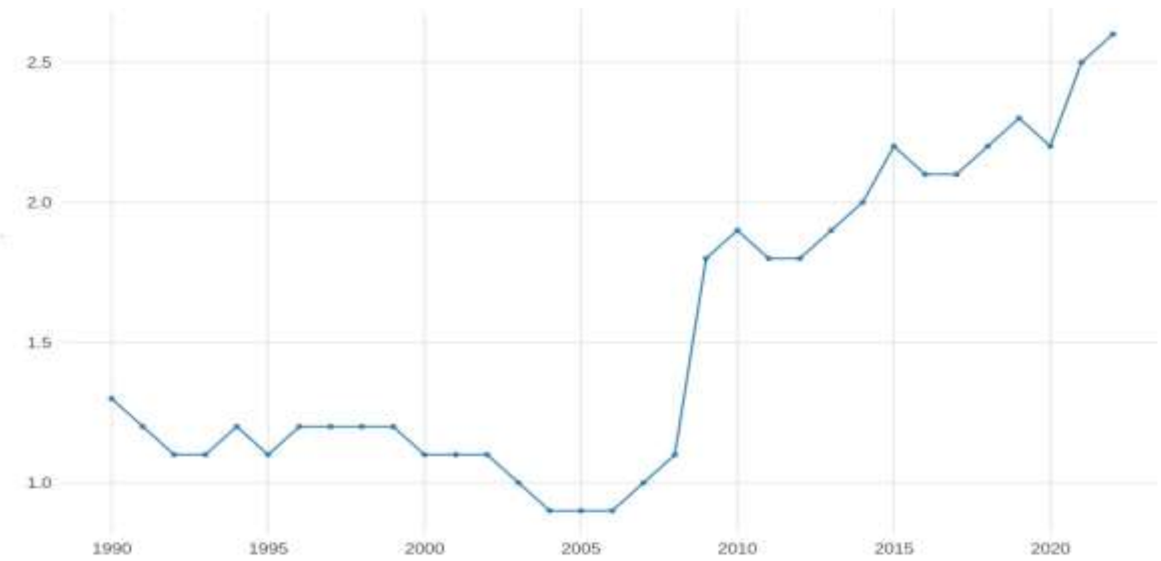
(marriage certificates per thousand population)



Source: Central Agency for Public Mobilization and Statistics database in Egypt

- **Divorce Rate:**

Figure (2) Divorce rate in Egypt during the period (1990-2022)



(divorce certificates per thousand population)

Source: Central Agency for Public Mobilization and Statistics database in Egypt

- **Unit root test results table (ADF)**

The results of the tests conducted on the data are that the overwhelming majority of the variables are stationary at first difference, I(1), hence they could be used in the standard time series model. The fertility rate and the population growth rate require the application of the second difference to make them stationary.

Null Hypothesis: the variable has a unit root
With Constant & Trend

Variable	Stationarity Test Value	Significance Level	Test Result	Order of Differencing
Demographic Dependency Ratio	-5.746385	0.0003	Stationary	1
Divorce Rate	-5.052485	0.0015	Stationary	1
Female Labor Force Participation	-4.526006	0.0056	Stationary	1
Fertility Rate (First Difference)	-3.178865	0.1071	Non-stationary	1
Fertility Rate (Second Difference)	-8.465981	0.0000	Stationary	2
GDP per Capita	-7.323175	0.0000	Stationary	1

Human Development Index (HDI)	-7.173927	0.0000	Stationary	1
Inflation Rate	-6.669133	0.0000	Stationary	1
Average Age at Marriage (Males)	-7.975948	0.0000	Stationary	1
Marriage Rate	-5.906408	0.0002	Stationary	1
Population Growth Rate (First Diff.)	-2.898614	0.1766	Non-stationary	1
Population Growth Rate (Second Diff.)	-7.851469	0.0000	Stationary	2
Unemployment Rate	-4.152700	0.0136	Stationary	1
Average Age at Marriage (Females)	-6.712001	0.0000	Stationary	1

- ## Granger causality test:

Relations from variables to the Demographic Dependency Ratio (DEMOGRAPHIC):

Causal relationship	F-Statistic	Significance level	Interpretation
Female labor force participation	4.79	0.0169	The rate of female labor participation causes changes in the demographic dependency ratio
Marriage rate	9.49	0.0008	The marriage rate affects the demographic dependency ratio
Average male age at marriage	4.66	0.0186	The average age of men at marriage affects the demographic dependency ratio
Average female age at marriage	7.68	0.0024	The average age of women at marriage has a causal relationship with the demographic dependency ratio

Relations from variables to Divorce Rate (DIVORCE_RATE):

Causal relationship	F-Statistic	Significance level	Interpretation
Human Development Index (HDI)	5.87	0.0079	The Human Development Index causes changes in the divorce rate
Marriage rate	5.47	0.0104	The marriage rate causes changes in the divorce rate
Average female age at marriage	5.02	0.0144	The average age of women at marriage causes and affects divorce rates

Other Notable Relations:

Causal relationship	F-Statistic	Significance level	Interpretation
Demographic dependency ratio → Female labor force participation	4.79	0.0169	The demographic dependency ratio causes changes in female labor participation
Inflation rate → Female labor force participation	3.43	0.0478	The inflation rate causes changes in female labor participation
Unemployment rate → Female labor force participation	3.52	0.0444	The unemployment rate causes changes in female labor participation
Average male age at marriage → Human Development Index	6.36	0.0057	The average age of men at marriage affects the Human Development Index
Population growth rate → Fertility rate	8.27	0.0017	The population growth rate causes changes in the fertility rate

- ## Johansen test for integration between variables

The test indicates the presence of seven cointegrating equations and strong long-run relationships between the variables (divorce rate, female labor force participation rate, fertility rate, GDP per capita, human development index, inflation, marriage rate, population growth rate, unemployment rate, and women's average age at marriage), which means that these variables move together towards a common equilibrium in the long run, even if they differ in the short run due to economic or social shocks. As shown in the attached tables, the inverse relationship between HDI and divorce supports the hypothesis that human development enhances family stability, while unemployment and inflation rates have negative effects on marital stability, which is consistent with the economic hypotheses of the study.

SAMPLE (ADJUSTED): 1992 2022	
INCLUDED OBSERVATIONS: 31 AFTER ADJUSTMENTS	
TREND ASSUMPTION: LINEAR DETERMINISTIC TREND	
SERIES: DIVORCE_RATE FEMALELABOUR FERTLITY GDPCAPITA INFLATION HDI MARRIAG_RATE POP_GEOWTH UNEMPLOYMENT WOMANAGE	

LAGS INTERVAL (IN FIRST DIFFERENCES): 1 TO 1				
UNRESTRICTED COINTEGRATION RANK TEST (TRACE)				
HYPOTHESIZED		Trace	0.05	
NO. OF CE(S)	Eigenvalue	Statistic	Critical Value	Prob.**
NONE *	0.995838	616.9121	239.2354	0
AT MOST 1 *	0.977114	446.9746	197.3709	0.0001
AT MOST 2 *	0.962725	329.8808	159.5297	0
AT MOST 3 *	0.899051	227.908	125.6154	0
AT MOST 4 *	0.794224	156.8207	95.75366	0
AT MOST 5 *	0.745633	107.8107	69.81889	0
AT MOST 6 *	0.65559	65.37234	47.85613	0.0005
AT MOST 7 *	0.511493	32.32872	29.79707	0.025
AT MOST 8	0.275144	10.12028	15.49471	0.2716
AT MOST 9	0.004667	0.145017	3.841466	0.7033

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.995838	169.9376	64.50472	0
At most 1 *	0.977114	117.0938	58.43354	0
At most 2 *	0.962725	101.9727	52.36261	0
At most 3 *	0.899051	71.08736	46.23142	0
At most 4 *	0.794224	49.00999	40.07757	0.0038
At most 5 *	0.745633	42.43834	33.87687	0.0038
At most 6 *	0.65559	33.04362	27.58434	0.009
At most 7 *	0.511493	22.20844	21.13162	0.0352
At most 8	0.275144	9.975266	14.2646	0.2136
At most 9	0.004667	0.145017	3.841466	0.7033

Max-eigenvalue test indicates 8 cointegrating eqn(s) at the 0.05 level
*** denotes rejection of the hypothesis at the 0.05 level**
****MacKinnon-Haug-Michelis (1999) p-values**

- **Models :**

1. Bayesian VAR model between marriage and divorce rates in Egypt (1990–2022)

The BVAR model used in this study analyzed a set of dynamic relationships and mutual influences among the variables across time, in this case, from 1990 to 2022. Because decisions such as marriage and divorce based on social change are path-dependent, this model is perfect for discerning the interaction between the marriage rate and divorce rate, as well as how these rates are affected over time by economic shocks such as rising unemployment.

By using prior information to stabilize the estimates, the BVAR model reduces the risk of overfitting as compared with the traditional VAR model, in cases when the number of observations is limited.

This model had a very high explanatory power for certain variables. The coefficient of determination, R^2, was very high for such variables as the Human Development Index and fertility rate, showing that the model captures factors which influence these very well. That is, the high R-squared values in certain equations-for instance, divorce rate 0.93, fertility 0.97, human development index 0.99-indicate strong explanatory power.

In contrast, some variables present weak explanatory power and raise the possibility of overfitting-for example, the marriage rate is 0.78 but the adjusted R^2 is negative, and the unemployment rate is 0.70 but the adjusted R^2 is negative.

Not all variables Granger-caused each other: for example, per capita GDP versus inflation did not provide very strong significant relations. This may be due either to the limitations of the model to explain those variables or to the necessity of including more variables or selecting different lags.

2.DOLS model to analyze the impact of the economic and social variables under study on the divorce rate:

It is specifically applied to measure long-run relationships between independent economic and social variables with dependent variables, namely marriage and divorce rates. The main purpose is to estimate coefficients that can be considered stable and reliable for capturing the structural and strategic influence of variables such as the Human

Development Index and fertility rates.
DOLS is an efficient estimator of cointegration that overcomes the problems of autocorrelation and selection bias seen with traditional OLS by adding leading and lagged variances of the explanatory variables, thus making the estimates of the long-run relationships more efficient. According to the estimates, the most influential and statistically significant variable at the 5% level was HDI, at a 24.41-unit increase in the divorce rate, along with every additional point in HDI. This supports the fact that better education and income, which are part of HDI, will improve people's status and independence and weaken traditional forces that bind them to marriage. The fertility rate turned out to be significant at 10%, where each unit increase in fertility raised divorce rates by 3.46 units, hence probably reflecting the tension that large family size brings into families. Meanwhile, the rest of the variables were insignificant, though most had shown a negative trend: female labor participation, GDP growth, inflation, population growth, and unemployment. These may indicate possible temporary cohesion due to economic pressures that families are facing. R^2 is equal to 0.9987, which justifies using this model, as it can be considered highly explicative.

3. *DOLS model for analyzing the impact of the economic and social variables under study on the marriage rate:*

In this model, the HDI appears as the most important factor influencing marriage rate (coefficient +67.01), and as seen from this figure, an increase of one point in HDI is associated with a great improvement of the marriage rate, reflecting the role of improved education, income, and health in supporting marital stability. The fertility rate had a positive effect, at +11.37, reflecting that childbearing is linked to increased marriages, while women's labor force participation influences it at a rate of +2.50, reflecting that increased economic independence of women is associated with increased marriage. On the other hand, the population growth rate, unemployment rate, and GDP per capita growth rate indicated significant negative influences: -23.17, -1.95, and -2.53, respectively. In fact, these are symptoms of shifting priorities in prosperous societies and pressures on economic resources. The model boasts exceptional explanatory power, $R^2 = 0.999$, thus confirming the validity of those long-term relationships. To confirm the robustness of the previous results, the study compared the statistical models, establishing two more models for the marriage rate and divorce rate separately using another method called the ARDL method.

4. *ARDL Autoregressive Model for Divorce Rate:*

It was used to provide a comprehensive picture that combines the short and long run in a single model. This model enables us to see how the rates of marriage and divorce are influenced by their past values-that is, self-reported behavior-and the current and past values of independent variables such as unemployment and the Human Development Index.

What adds to the flexibility of the ARDL model is that it allows time series to be stationary at either I(0) or first difference, I(1), without necessarily having to be of the same degree of stationarity-a feature that makes it so useful when modeling real-world data.

The ARDL model estimates both the short-run dynamics and long-run equilibrium relationships that divorce rates undergo. The first equation captures immediate and past changes in variables impacting the current rate of divorce, while the second equation captures the change in divorce, given its deviation from a long-term relationship and short-term changes in other variables. Results for the model summarized with lags (1,1) are presented below.

The ARDL model offers a unified framework that can capture both short-term dynamics and long-term equilibrium simultaneously. The equation of the level shows that the current divorce rate depends partly on its past values, along with the current and past values of a range of demographic and economic variables. The coefficient on the lagging value of the divorce rate, 0.446, indicates a degree of continuity in that past shocks do not disappear immediately but extend their effects into the present-a pattern quite familiar in social behavior chains.

These signals and trends of the coefficients provide the following short-term causal readings: While higher fertility is associated with an immediate rise in divorce rate (0.809), higher female labor force participation is associated with an immediate and delayed decline (−0.036 and −0.057, respectively), indicating that the empowerment of women may be associated with a reduction of pressures leading to divorce in the near term. Variation in the demographic indicator imparts a contractionary effect on divorce both in the immediate and delayed period (−0.008 and −0.022, respectively). While the average age of men and women tends to increase the divorce rate in the short run (0.115 and 0.061, respectively), it perhaps reflects greater capacity for more rational separation decisions with age. Population growth has a distinct negative effect (−0.499), while unemployment is slightly positive (0.016), and inflation shows a combination of slight immediate negative and a small delayed positive effect, reflecting reciprocal income/cost channels in the short run. With regard to human development (HDI), while the immediate effect is strongly negative, its delayed effect is larger and more positive; this might suggest complex temporal interactions between improvements in human development and the structure of family relationships.

The ECM long-term integration equation has explicitly shown the correction mechanism to equilibrium. Large in absolute value and negative, the coefficient of the correction limit,-3.288 implies that the high speed with which divorce rate deviates from its long-term equilibrium relationship is under correction. This, from a dynamic point of view, means that the gaps from equilibrium are not left unadjusted but, instead, are rapidly reabsorbed, possibly with "overshooting" phases before returning to the trajectory, which is a possible feature when the limit of correction is greater than above. The long-term vector in the bracket defines equilibrium: high fertility, HDI, average life expectancy of men and women, and inflation are associated with a high long-term divorce rate; on the other hand, high demographic indicators, women's labor force participation, population growth, per capita real GDP are associated with a low divorce rate. These are long-term signs and cannot be read in an isolated fashion but represent a common "structural trend" conditioned by the other variables and the adjustment time defined by the ECM.

These results imply that economically, while market, labor, and price shocks may cause fluctuations in divorce rates in the short term, the social system does possess a corrective mechanism that returns rates to an equilibrium path determined by deeper demographic and economic fundamentals. Empowerment of women in the labor market is associated with a structurally lower divorce rate, whereas high fertility is associated with a long-term rise, which may reflect a cumulative financial/psychological burden. Improved human development is positively associated in the long run, perhaps through higher individual aspirations and changing standards of marital quality of life, despite its immediate deflationary effect. Population growth tends to exert a long-term downward pressure on divorce, which may reflect stronger social support networks or a younger age structure. These findings recommend the adoption of policies that make households less vulnerable to income and price shocks while ensuring the maximum returns on women's empowerment and the targeting of fertility and family services policies, as these channels exhibit long-term effectiveness in shaping divorce trends, with immediate shocks managed through social protection tools and rapid behavioral interventions.

Model goodness of fit:

The model shows a high explanatory power with the R-squared value of 0.982 and the adjusted R-squared of 0.9667, showing that about 97% of the divorce rate variation is explained by the model.
Overall Significance: The F-statistic value is highly statistically significant, as indicated by the p-value of 0.000000 for a value of 61.003. This attests to the fact that the overall model is statistically significant, hence strong explanatory power of independent variables combined toward changes in the dependent variable.
No Autocorrelation: The Durbin-Watson statistic value of 2.823 is close to 2, implying no first-order autocorrelation problem in the residuals of this model. Therefore, one can place a higher degree of confidence in the OLS estimates.

1. Autoregressive Distributed Regression (ARRDL) Model for Marriage Rate:

The ARDL(1,1) equation for the annual marriage rate shows a clear pattern of behavior. The coefficient of the lagged value of the marriage rate is 0.370, indicating that approximately 37 percent of the shock from the previous period carries over into the present period. In the short run, inflation has a small deflationary effect on marriage, but an improvement in per capita GDP is associated with a positive effect that is consistent with an improved economic capability to marry. On the other hand, higher fertility rates, increased female labor force participation, and a shrinking demographic index are associated with a downward effect on marriage rates in the short run, arguably reflecting opportunity cost pressures on marriage or household spending. Meanwhile, the average age of men and women has a positive effect in both the current and late short run, suggesting that maturity in age is associated with more regular marriage decisions. Population growth appears to have a significant positive impact, unemployment a moderate one, while HDI is currently showing a large negative coefficient. This pattern may reflect a complex interaction of rising aspirations with short-term family formation decisions.

The Equation for the Long-Term Integral, or ECM, shows how a return to equilibrium through the means of a correction threshold can take place. In the form here, the correction threshold precedes the error term with a value of about +0.117. In this form, it would be expected to be negative (significantly and directionally less than zero) so that if the marriage rate happens to deviate from the equilibrium relationship, the system is set up to converge back to it. If the statistical software programmed the error term as ((LR - MARRIAG_RATE)) instead of ((MARRIAG_RATE - LR)), then the positive sign here reflects a negative correction threshold of about -0.117 by standard convention. Otherwise, the positive sign may reflect some weakness in the correction property or a problem in the definition of the error term, requiring some inquiry as to how the program outputs the format of the ECM.

The level vectors within the integration bracket define the long-term structural relationship between the marriage rate and its determinants. The signs of inflation, human development, fertility, women's labor force participation, and the demographic index are negative, while those of per capita output, life expectancy for men and women, population growth, and unemployment are positive. These results, interpreted conditionally by the other variables and the model structure, suggest in general that in the long run, improvement in per capita income and favorable changes in age structure go with a high marriage rate, while cost of living factors, time alternatives-inflation, women's employment, high fertility-and demographic burden intensity go with structurally lower rates. The long-term negative effect of the HDI often reflects pattern shifts in timing preferences, opportunity costs, and access to education and employment, such that marriage decisions get postponed or reshaped in contexts of higher human development. Economically, this estimate combines short-run dynamics--variable differences and lags-that capture immediate shocks with a long-run structure defined by level coefficients and a correction threshold. The validity of the conclusions then assumes no I(2) variables. Furthermore, stability coefficients and efficient residual diagnosis are assumed. With a practical mindset, the results of this suggest a policy approach two-pronged in nature: a policy that keeps shocks to the price and labor markets in check to reduce volatility in marriage decisions within the shorter run, while over the longer-term, attention is focused on determinants such as the costs of family building, work-life balance arrangements, and economic and housing empowerment of the young.

Model Goodness of fit:

The model has high explanatory power: the coefficient of determination (R^2 = 0.928) and the adjusted coefficient (Adj. R^2 = 0.869) indicate that the model explains approximately 87% of the variance in the marriage rate.

The F statistic (15.698) is significant (Prob = 0.000000), reflecting the significance of the model as a whole.

The Durbin-Watson statistic (2.363) is close to 2, indicating the absence of first-order autocorrelation, which enhances the reliability of the model.

In general, the results indicate that socio-demographic factors (such as women's labor force participation, demographic dependency ratio) have the greatest influence on marriage rates, while economic factors (such as GDP per capita growth rate, Human Development Index) sometimes exhibit contradictory effects. This reflects that marriage is not simply an economic decision, but rather a complex social phenomenon influenced by demographic structure and gender roles.

Discussion:

These findings of the analysis reveal the way in which economic conditions determine the trend of marriage and divorce in Egypt. The econometric model results-BVAR, DOLS, and ARDL-reinforce the fact that GDP per capita, unemployment, and inflation are not only statistically significant, but also carry key implications for society. Family decisions have a basic economic foundation; Becker (1981) mentioned cost-benefit analysis in the case of marriage, and Cherlin (2010) discussed how economic shocks change family formation and dissolution.

Analysis reveals that HDI has a twofold effect: it increases both marriage and divorce rates. This is consistent with the wider evidence in the literature that while money, health, and education advancement encourages marriage, on the other hand, it enhances autonomy and reduces the traditional incentives toward staying married, leading to increased divorce rates (McLanahan & Percheski, 2008). Fertility rates have complex effects. Whereas larger families may contribute to marital instability in conditions of economic insecurity, on the contrary, higher fertility is positively related to marriage. This finding is well supported by the demographic transition theory, which explains that modernity and fertility converge in changing family structure and family relations (Thornton, 2001).

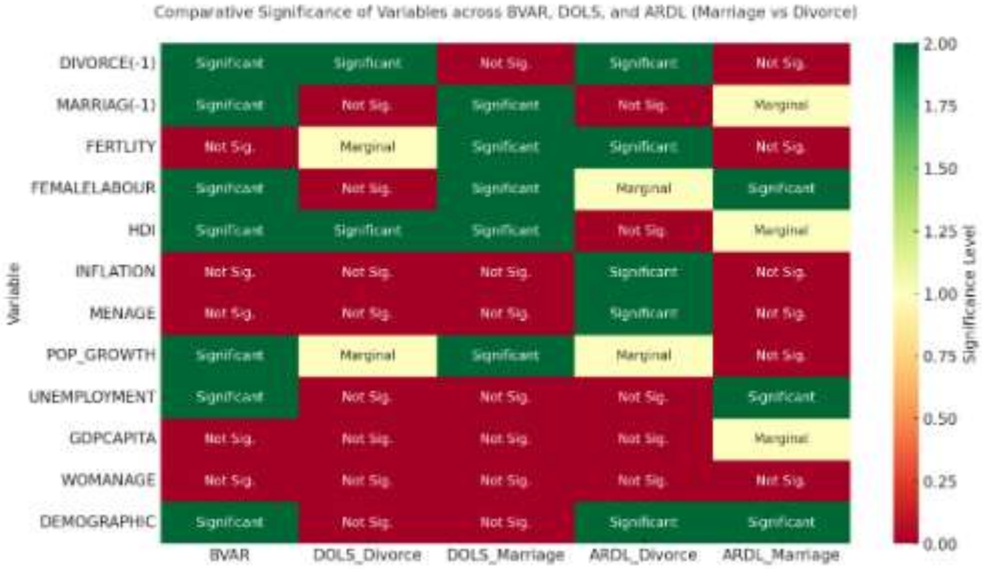
The ARDL results also reveal that inflation and unemployment are harmful to family stability. These findings support the argument of Amato (2010) that economic stress and uncertainty worsen family conflicts and further cut the likelihood of stable marriage. In a fashion similar to the findings of Kutlar (2021) in Turkey, inflation rates higher than 25% over the past years appear to have delayed decisions about marriage and increased the rate of divorce in Egypt, where the sensitivity of household spending to price fluctuations is very high.

The cointegration analysis confirmed the structural family theory viewpoint by pointing to the long-term equilibrium relationships between macroeconomic variables and family-related indicators, as suggested by Parsons (1951). Marriage and divorce decisions have emerged as being in systematic adjustment, rather than the expression of personal preference, to larger socioeconomic contexts. The robust autoregressive component within the models would also hint at behavioral persistence, possibly related to an institutional setting and cultural norms which support the pre-existing family patterns.

One of the most important contributions from this study is in establishing the inter-relationship between divorce and marriage rates. Its finding suggests that they are two related processes of family formation and dissolution, rather than independent events. Such an understanding converges with recent sociological thinking that family outcomes need to be investigated in relation to each other, looking at their respective demographic and economic contexts (Bao & Merry, 2023).

The results make a strong case for including family stability in economic policy decisions. Besides being a macroeconomic issue, unemployment and inflation also need to be addressed socially to maintain the stability of marriages. Human development investments must be complemented by social programs that balance individual freedom with family cohesion to prevent empowerment from inadvertently accelerating marital breakdown. For this reason, policy frameworks must consider how development influences divorce probabilities along with marriage promotion. Possible Research Avenues. This result opens several avenues for further research. First, a comparison between Arab and developing countries could shed more light on how institutional and cultural factors moderate the nexus of family stability and economic stress. Second, the incorporation of gender-disaggregated data will be very useful in showing exactly how changes in gender roles are affecting marriage and divorce in light of increasing female empowerment and labor market participation. Finally, innovative approaches, such as machine learning and big data analytics, could also push the predictive power further by capturing complicated interactions and nonlinear linkages that are beyond the scope of traditional econometric models.

Figure 3 :Heat map to compare the significance of variables across the statistical models implemented in the study



Similarities between the findings of the present study and previous studies:

The Relationship between human development and increasing divorce rates

The relationship between HDI and divorce rate, according to the models in this study, is positively related by +24.41, as human development reflects improvements in education, income, and independence.

These models reflect the idea that HDI has a double impact on marriage and divorce rates; this would mean that development increases independence and individual choice.

Other studies have also reported results similar to the ones obtained in the present study. For example, Bremmer & Kesselring, 2004 explained that the more labor force participation of women and their increasing income is found to contribute positively to divorce rates.

There is therefore a clear convergence in the results from current models and these three studies.

According to the models of both ARDL and DOLS, unemployment, high population growth, and economic stress raise divorce rates while reducing marriage rates in the short run. This corresponds to prior findings discussed below:

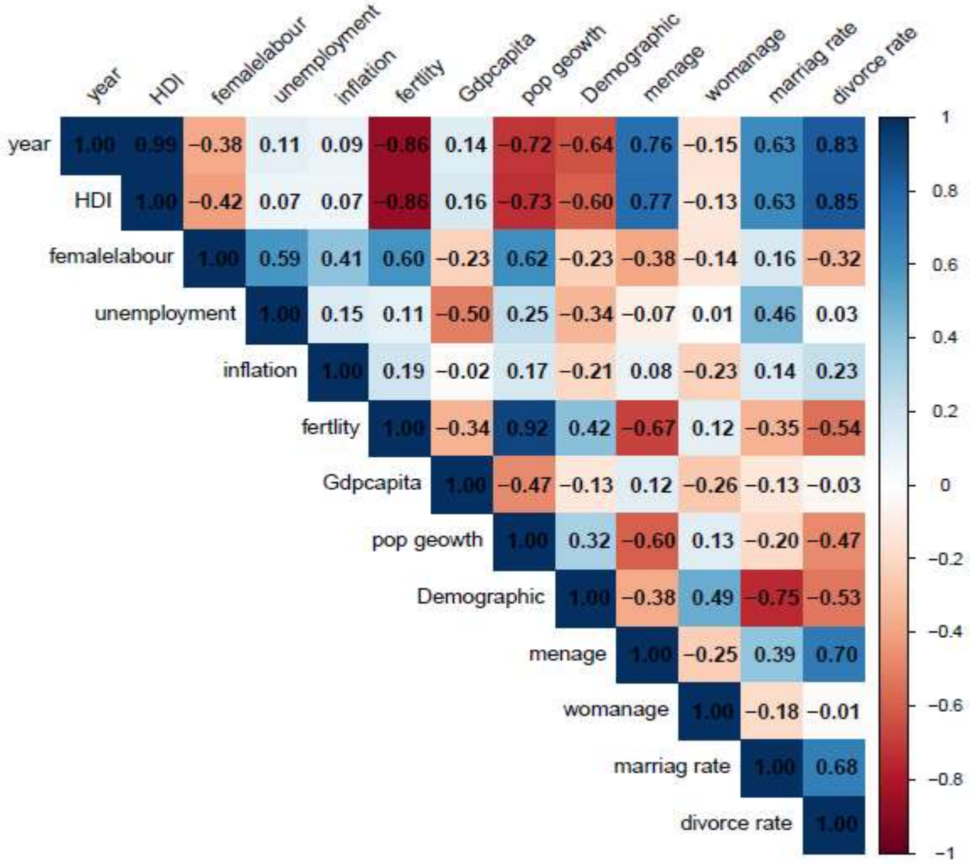
• Kutlar, 2021 states that unemployment has a positive association with the rate of divorce in Turkey.

• Privatization and openness to the economy raised the rate of unemployment and divorce according to Rashid, 2009.

Therefore, the leading models and analyses of the reviewed studies all agree on the negative role of economic crises. Estimations through ARDL and DOLS carried out in this study confirm that fertility rates positively correlate with increased marriage and divorce rates, though only briefly, followed by a decline. Changes in fertility rates were brought about by factors that were associated with improvements in the level of education and health. Other studies also came to a similar conclusion:

Dynamic interaction between marriage and divorce rates. The correlation matrix indicated a positive long-run relationship between marriage and divorce; this was not indicated by any of the previous studies reviewed. Indeed, this study was the only one testing for the said effect.

Figure 4: Correlation Matrix :



Study Limitations:

Despite these useful insights into the inter-linkages between economic conditions and family dynamics in Egypt, this study has several limitations. First, the analysis heavily draws on secondary data mined from national sources, namely CAPMAS and the Central Bank of Egypt, and international sources such as the World Bank and UNDP. While these databases are reliable and representative, they may be biased by the lack of records of informal family practices or underreporting of marriage and divorce incidents, particularly in rural areas and amongst the most marginalized sections. Lastly, this study limits itself to Egypt. Although regional relevance might therefore be drawn from its findings, generalizing to other Arab or developing countries should be made with caution, keeping in mind differences in their institutional frameworks, legal systems, and cultural values. These delimitations suggest further avenues of research, therefore, which might use a mix of econometric and qualitative comparative approaches to gain a more profound understanding of the complex ways in which economic transformations and family stability affect each other.

Conclusion:

The previous analysis proves that the economic situation is one of the most powerful drivers of an individual's social status. Furthermore, the relationship between the economy and society is not random, but rather systematic and based on recurring patterns. Previous tests confirmed the validity of the study's hypotheses, as they demonstrated a strong significant effect of indicators such as unemployment, inflation, and the Human Development Index on marriage and divorce rates. This relationship demonstrates that economic conditions constitute an important basis for making major social decisions. The results showed that economic crises push individuals to postpone marriage or divorce due to financial and psychological pressure. The effect is delayed, not immediate, according to the results of the DOLS model (which measures long-term relationships).

Recommendations:

1. Economic and social empowerment:

Require those about to get married to attend state-supported educational programs on understanding, role distribution, and managing family disputes.

Incorporate social skills into secondary and university curricula (such as conflict management and family cooperation).

The need to launch flexible vocational training programs for married women that provide them with job opportunities without compromising their familial role, to reduce the stress resulting from the imbalance of roles within the family.

Encourage institutions to provide a supportive work environment for mothers (such as flexible hours, daycare centers, and telework) to reduce the negative impact of women's work on marriage.

Update an integrated legislative and legal framework that integrates women's rights at work, children's rights, and business rights.

Strengthen partnerships by incorporating themes related to family and economic balance into women's empowerment programs funded by the state or international partners.

2. Family-supportive housing and economic policies.

Expand government initiatives to support safe housing and early marriage for young people in the middle and poor categories (in line with the impact of income, unemployment, and inflation on reducing marriage, according to DOLS and ARDL).

Design a flexible social safety net that responds quickly to economic changes in the form of food vouchers or cash support conditional on family stability.

Governance of social support: Link marriage support to local economic indicators and governorate competitiveness reports, so that additional support is provided in governorates with high unemployment rates.

Activating and disseminating a network of national or endowment marriage funds at the governorate level, in cooperation with Nasser Social Bank and civil society organizations, under the umbrella of social protection, as sustainable sources of funding to support those about to get married and divorce cases.

3. Incorporating a map of social indicators into the country's development planning.

The necessity of linking social development policies to an analysis of divorce and marriage indicators over time, by preparing a periodically updated map that includes the Human Development Index in family planning analyses.

Issuing quarterly or semi-annual reports on the transformations of the Egyptian family and linking them to national development plans.

Linking the scientific findings of periodic reports on the transformations of the Egyptian family and the indicators included in the map of social indicators to proposed policy frameworks, such as the new Personal Status Law, which is currently under consideration by the House of Representatives.

4. Improving data quality and building periodic demographic forecasting models.

Expanding the base of local and field monitoring of marriage and divorce at the governorate level, so that it integrates with demographic and economic data.

It is of utmost importance to periodically update and improve the quality of family and informal sector data in the Central Agency for Public Mobilization and Statistics to facilitate the development of accurate predictive models. Encourage and train researchers to develop integrated models that combine social, economic, and psychological factors as an early warning mechanism for rising divorce rates or declining marriage rates.

Study recent widespread social incidents, such as the suicide of a spouse or the mass murder of children and spouses, and develop rapid intervention methods to prevent the recurrence of these incidents within a strict and deterrent legal framework.

The above recommendations reflect the need for comprehensive government intervention that integrates economic, social, and cultural dimensions to reduce divorce rates and support the formation of stable families. This requires coordination between the relevant ministries (Justice, Solidarity, Planning, Interior, Youth, Education, and the House of Representatives), and ensuring the sustainability of the proposed programs through government and community partnerships.

Future Research Directions:

Future research should consider employing composite indices, such as the Human Development Index or the Multidimensional Poverty Index, in tandem with traditional economic indicators. Composite indices encompass many aspects of well-being, including education, health, and living standards, and therefore better help explain exactly how socioeconomic development might be affecting family stability. Employing such hybrid models-by using composite and individual-level economic indicators-may yield greater explanatory power: composite indicators may account for long-term structural effects, and individual-level indicators may account for short-term shocks in inflation or unemployment. Such a hybrid approach could enable superior predictions of the dynamics of marriage and divorce and thus afford better policy recommendations for both immediate and structural challenges.

Finally, there are several avenues of further research which arise in this study. First, cross-country comparisons between Arab and developing countries would be useful in explaining how cultural and institutional factors mediate the relationship between economic stress and family stability. The second is the use of gender-disaggregated data, in particular on female participation in the labor market and their empowerment, to understand how changing gender roles affect marriage and divorce. Lastly, the use of more advanced methodologies like machine learning and big data analytics should yield better predictive performance since nonlinear relationships and complex interactions in them are not captured by a traditional econometric model.

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The impact of climate change on agriculture sector in Egypt (case study)

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Abstract

Climate change represents a significant threat to global food security, with a particularly severe impact on agriculture in developing nations. Egypt's agriculture isn't just a part of the economy; it's fundamental. It feeds the nation. But it's in serious trouble.

This study investigates the impact of climate change on agricultural production in Egypt, a developing country where the agricultural sector is vital for food security. Using the Autoregressive Distributed Lag (ARDL) model on data from 1984 to 2022, The aim is to understand how key climate variables, such as mean temperatures, CO2 emissions and precipitation along with other factors like population and agricultural technology, affect crop yields.

Our long-term findings indicate that CO2 emissions and agriculture land have a positive impact on agricultural production. While a negative effect from temperature and precipitation was observed, its small magnitude suggests that Egypt is not yet facing a major climate-induced agricultural crisis.

Introduction

Climate change has emerged as one of the most significant challenges of the 21st century. It refers to the long-term shifts in global or regional climate patterns, driven primarily by human activities. The burning of fossil fuels—including gas, oil, and coal—releases greenhouse gases (GHGs) like carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) into the atmosphere (Kaddo & Jameel, 2016). These gases trap solar heat, contributing to the greenhouse effect and leading to a rise in global temperatures, a phenomenon known as global warming. This global warming directly hits agriculture hardest because farming relies on predictable conditions (Asseng et al., 2015; Challinor et al., 2014). We're already seeing the impact: major crops such as wheat, maize, and rice are yielding less, which is a huge threat to what we eat (Lobell & Field, 2007; Mendelsohn, 2009). It gets worse, too—climate change is quietly degrading food nutrition, inviting more pests, and shaking up old farming traditions, meaning we absolutely have to find new ways to cope fast (Karimi et al., 2021; Gamal, Samak, & Shahba, 2021).

The effects of climate change are widespread and serious, hitting both the physical environment and human societies (National Research Council, 2014; Gemeda, D & Sima, A, 2015). We are witnessing rising global temperatures and an increase in the frequency and intensity of extreme weather—think worse droughts, intense heatwaves, stronger hurricanes, and bigger floods. These extreme events often occur as "compound events," which standard risk assessments tend to underestimate. On the physical side, the ice is melting, causing sea levels to rise (up 19 cm from 1901 to 2010, with projections of up to 1.50 meters by 2100), putting coastal cities and island nations in real danger (Asseng, S., et al., 2015; Elba, S & Ayres, K., 2018). For people, the consequences include rising heat-related fatalities and massive population displacement predicted by 2050, which could lead to social conflicts and major financial trouble (Lai et al., 2012; Weihe, W., 1990). Because of this severity, scientists are firm that the global temperature increase must be kept below 2^0 C to dodge the very worst outcomes.

Despite contributing only about 3.8\% of total global GHGs, African nations are paradoxically the most severely exposed to the impacts of climate change (Wijaya, A., 2013; Kotir, J., 2011). Their extreme vulnerability comes down to having weaker systems: they simply lack the institutional know-how, financial backing, and technical skills to adapt, all while being heavily reliant on weather-sensitive farming and limited water resources. Since agriculture already consumes 85% of Africa's water, this situation rapidly causes shortages, degrades soil quality, fuels poverty, and creates massive food insecurity (Gemeda, D & Sima, A, 2015). For the continent to move forward, the required fixes must be comprehensive, meaning we have to seriously invest in better water management strategies and significantly boost the agricultural sector's overall capacity

This global crisis has severe regional consequences, which are particularly pronounced in Egypt. As a nation where agriculture accounted for a massive 71.8% of its GDP in 2020, the sector is vital for development and national food security. Egypt faces extreme vulnerability due to its unique geography: heavy reliance on the Nile River, existing water scarcity, and limited arable land, all of which make it highly susceptible to climatic shifts (Gado & El-Agha, 2021; Khedr, 2017).

To address these challenges, Egypt has undertaken steps like developing a national adaptation plan, investing in renewable energy, and playing a prominent role in international initiatives like hosting COP27 (Moosmann et al., 2022). However, studies reveal that many existing policies are ineffective due to a lack of a pertinent legal framework, poor coordination among stakeholders, and low awareness levels (Yassin, L., 2016). The key policy recommendation emerging from the literature is the urgent need to create a thorough legal framework and strengthen government-NGO partnerships to adopt advanced, climate-resilient technologies and improve resource efficiency. Given the challenges of a rapidly increasing population (expected to reach 150 million by 2050) and a high water-stress profile, the fundamental goal for Egypt's agricultural sector is to produce more food with less water (Gado, T. A., & El-Agha, D. E., 2021). Finally, the literature highlights the ongoing presence of significant uncertainties, particularly regarding the future flow of the Nile, emphasizing the need for further, more quantified research on specific adaptation measures like rainfall harvesting and developing salt-resistant crops.

While previous work has certainly given us some idea of the broader challenges (Ahmed et al., 2014; Gamal et al., 2021), most of those studies leaned on generalized simulation models like IMPACT or ISI-MIP. That approach leaves a big hole in what we know: we lack specific, quantified, time-series data that truly ties climate variables to Egypt's most important crops and local economic forces. This study is designed to fill that exact void. We are digging into the dynamic, long-term, and short-term impacts of key climate factors—namely temperature, CO_2, and precipitation—while also factoring in vital economic elements like agricultural land area and population growth on the production of Egypt's staples: rice, maize, and wheat.

This study investigates the dynamic relationships between Egypt's agricultural production and key meteorological and socioeconomic factors from 1984 to 2022 using the ARDL (Autoregressive Distributed Lag) model. The paper organized as follows: first section: data and methodology, second section data preparation, third section: results, forth section: discussion and conclusion.

Data source and Methodology

Our research delves into Egypt, analyzing annual time series data collected between 1984 and 2022. We aim to explore the connections between key climatic and socio-economic factors and the production of the nation's primary staple crops. The specific crops we're examining are wheat, rice, and maize, measured by their annual production in metric tons. Our main explanatory variables include the average annual temperature (°C), total annual precipitation (mm), national CO_2 emissions (kilotons), the total agricultural land area (hectares), and the overall national population

For our study, we got our hands on agricultural production figures straight from the Food and Agriculture Organization of the United Nations (FAO), using their massive FAOSTAT database. You can check it out yourself at https://www.fao.org/faostat/en/#data/QCL. When it came to carbon dioxide emissions, we turned to the Our World in Data – CO_2 Emissions Database (https://ourworldindata.org/co2-emissions), which is a fantastic resource that pulls together tons of research and data on global environmental issues. And for our temperature data, we picked it up from a cool Kaggle dataset (https://www.kaggle.com/datasets/berkeleyearth/climate-change-earth-surface-temperature-data), which was originally put together by Berkeley Earth and is known for its really long-term global surface temperature records.

Methodology

Our study employs the Autoregressive Distributed Lag (ARDL) model, a method developed by Pesaran et al. (2001) that's widely used in econometrics for analyzing relationships between time series variables. What makes the ARDL model particularly useful is its flexibility: it can handle situations where the variables are a mix of stationary at their original level (I(0)) and stationary after being differenced once (I(1)). However, it's crucial to remember that it absolutely cannot be

used if any variable is integrated at the second order (I(2)).
The way the ARDL model operates is pretty intuitive: it factors in previous values of both the outcome we're investigating (what we call our dependent variable) and the things that influence it (our independent variables). When we talk "autoregressive," it just means the dependent variable partly carries the imprint of its own past. "Distributed lag," on the other hand, means it's also taking cues from how the independent variables behaved previously (Gujarati & Porter, 2009). This entire structure is incredibly useful for capturing how dynamics unfold and how quickly different variables react to changes over time.

To test for a long-run equilibrium relationship (or cointegration) among our variables, this study will employ the Autoregressive Distributed Lag (ARDL) model (Pesaran et al. 1999, 2001). The ARDL model has key advantages. For one, it doesn't require all the time series to be integrated to the same order; we just need to confirm that no variable is integrated to the second degree,I(2) (Asumadu-Sarkodie and Owusu, 2016; Mahrous, 2018). More importantly, the ARDL technique is known to outperform conventional cointegration methods—such as the two-stage Engle & Granger or the Johansen test—especially when the available data is a short time series (Chandio et al. 2020a; Chandio et al. 2020b). This model is quite useful because it can simultaneously estimate both the immediate, short-run effects and the eventual, long-run equilibrium (Rehman et al. 2019; Houngbedji and Diaw 2018).

$$lnProd_t=\alpha_0+\sum_{i=1}^{p}\phi_i\, lnProd_{t-i}+\sum_{j=0}^{q1}\beta_{1j}\, lnTemp_{t-j}+\sum_{k=0}^{q2}\beta_{2k}\, lnCO2_{t-k}+\sum_{l=0}^{q3}\beta_{3l}\, lnPrec_{t-l}+\sum_{m=0}^{q4}\beta_{4m}\, lnPop_{t-m}+\sum_{n=0}^{q5}\beta_{5n}\, lnAgri_{t-n}+\epsilon_t \quad (1)$$

This equation 1 is essentially the heart of our ARDL model in its basic form. It helps us understand how the current level of product production (that's lnProdt) is influenced not just by today's factors, but also by what happened in the past. On the right side, you see $\alpha 0$, which is just a starting point or base level. Then, we have terms like $\sum\phi_i lnProd_{t-i}$, meaning we're looking at how past levels of production itself affect the current level. It's like seeing if last month's output still has a ripple effect on this month's. Following that, you'll find similar sums for all our other variables – temperature (lnTemp), CO2 emissions (lnCO2), precipitation (lnPrec), population (lnPop), and agricultural land (lnAgri). These show how current and past levels of these factors impact current production. Each β coefficient tells us the strength and direction of that influence. Finally, ϵt is just our error term, capturing all the random stuff we can't explain. This whole setup is crucial because it's what we first estimate to figure out the best time lags for our variables and to see if there's a long-term connection between everything.

Data Preparation

Unit root test

The ARDL cointegration approach is suitable when the variables are stationary in the cases of I(0), I(1), or mixed integration orders. In this study, the Augmented Dickey-Fuller (ADF) test

(Dickey & Fuller, 1979; Perron, 1988) were used to determine the stationarity of the variables (Sarkodie & Owusu, 2020). In ADF test, the null hypothesis (H_0) assumes that a unit root exists (i.e., the variable is non-stationary), while the alternative hypothesis (H_1) assumes that there is no unit root (i.e., the variable is stationary).
Table 1 presents the results of the ADF test, which shows that none of the variables are stationary. All variables have p-values greater than 0.05, indicating that they are not stationary in their current form. To proceed, we need to transform these variables to achieve stationarity, typically by differencing the data.
Therefore, we will perform differencing on each non-stationary series and recheck for stationarity using the ADF test.

Table(1)
ADF Unit root test

	Production	**Temperature**	**Population**	**CO2**	**Land**	**Precipitation**
Test Statistic	-2.18772	-0.736445	2.44566	0.233023	-1.69608	-1.24133
p-value	0.210733	0.837082	0.99903	0.974054	0.433136	0.65557
Number of Observations	38	31	34	34	38	38
Critical Value (1%)	-3.61551	-3.66143	-3.63922	-3.63922	-3.61551	-3.61551
Critical Value (5%)	-2.94126	-2.96053	-2.95123	-2.95123	-2.94126	-2.94126
Critical Value (10%)	-2.6092	-2.61932	-2.61445	-2.61445	-2.6092	-2.6092
Stationarity	No	No	No	No	No	No

After differencing on each non-stationary series and then rechecking for stationarity using the ADF test, as Table 2 describes.
Table(2)
Unit root test after performing the difference in lags

	Production	**Temperature**	**Population**	**CO2**	**Land**	**Precipitation**
Test Statistic	-6.30579	-3.74776	-5.97614	-4.65298	-4.27529	-6.406
p-value	3.3262E-08	0.00348941	1.88554E-07	0.000103	0.0004901	1.94259E-08
Number of Observations	36	31	35	34	35	37
Critical Value (1%)	-3.62665	-3.66143	-3.63274	-3.63922	-3.63274	-3.62092
Critical Value (5%)	-2.94595	-2.96053	-2.94851	-2.95123	-2.94851	-2.94354
Critical Value (10%)	-2.61167	-2.61932	-2.61302	-2.61445	-2.61302	-2.6104
Stationarity	Yes	Yes	Yes	Yes	Yes	Yes
Level	I(1)	I(1)	I (3)	I (1)	I (3)	I (1)

Population processing

Since the Population variable is identified as 1(3) (integrated of order 3), this means it is non-stationary and requires three differences to become stationary. However, if the variable is crucial for the analysis, instead of differencing multiple times (which may remove valuable long-run

relationships), we should first check for structural breaks (Casini & Perron, 2018).
A popular statistical tool for detecting structural breaks in time series is the Zivot-Andrews test, which can identify a single break point without requiring the break to be pre-specified. The test is especially helpful when there is a suspicion that an unforeseen event, such as a change in policy, an economic shock, or an environmental disaster, may have caused a shift in the underlying data structure. By evaluating time series behavior for substantial changes over time, the Zivot-Andrews test enables endogenous detection of the precise break date. This capability is crucial because structural shifts in trends or levels could be responsible for apparent non-stationarity in the data, which the Zivot-Andrews test effectively helps to detect (Zivot & Andrews, 1992).
If a break is identified, such as in 2010 in our case, we should include a break dummy variable to account for the shift rather than aggressively differencing the data. This approach preserves more of the variable's meaningful economic interpretation while ensuring stationarity for reliable regression results. (Perron and Vogelsang ,1992)
The results of the Zivot-Andrews test for the Population series are presented in Table 3. The test yielded a statistic of -8.945963. This value is significantly more negative than the critical values at the 1% (-5.347598), 5% (-4.859812), and 10% (-4.607324) significance levels. Consequently, with a p-value < 0.01, we reject the null hypothesis of a unit root with a structural break. This suggests that the Population series is, in fact, stationary around a structural break (I(0) with a break). The break was endogenously detected in the year 2010. This finding implies that for subsequent modelling, the Population variable should be used in its level form, with appropriate dummy variables introduced to account for the identified structural break in 2010, rather than being differenced. This approach preserves the variable's interpretability while ensuring appropriate treatment of its time series properties for reliable regression analysis.

Table(3)
Unit Root with Break Test on Population

Test Statistic	**Value**
Zivot-Andrews test statistic	**-8.945963**
Test Critical Values:	
1% Level	-5.347598
5% Level	-4.859812
10% Level	-4.607324
p-value	0.002
Structure Break	2010

Land processing

Table 4 presents the results of the Zivot-Andrews (ZA) unit root test, designed to account for a single structural break in the "agriculture land" series. The calculated ZA test statistic is -6.1523.

When compared to the critical values at conventional significance levels (-5.347598 at 1%, -4.859812 at 5%, and -4.607324 at 10%), the test statistic is notably more negative than all of them. Furthermore, the associated p-value of 0.001 is well below the common significance thresholds (e.g., 0.01 or 0.05). This compelling evidence leads to the rejection of the null hypothesis of a unit root. Consequently, it can be concluded that the "agriculture land" variable is indeed stationary, provided that a statistically significant structural break (indicated by the 0.001 p-value associated with the break point) is incorporated into the analysis.

Table(4)
Unit Root with Break Test on agriculture land

Test Statistic	**Value**
Zivot-Andrews test statistic	**-6.1523**
Test Critical Values:	
1% Level	-5.347598
5% Level	-4.859812
10% Level	-4.607324
p-value	0.001
Break point	1994

The ARDL model incorporating structural breaks and dummy variables, following the Zivot-Andrews test for break identification, is specified as follows:

$$\ln Prod_t=\alpha_0+\sum_{i=1}^{p}\varphi_i \ln Prod_{t-i}+\sum_{j=0}^{q1}\beta_{1j} \ln Temp_{t-j}+\sum_{k=0}^{q2}\beta_{2k} \ln CO2_{t-k}+\sum_{l=0}^{q3}\beta_{3l} \ln Prec_{t-l}+\sum_{m=0}^{q4}\beta_{4m} \ln Pop_{t-m}+\sum_{n=0}^{q5}\beta_{5n} \ln Agri_{t-n}+ \gamma_1 D_{Pop,t}+\gamma_2 D_{Agri,t}+\epsilon_t \quad (2)$$

Equation 2 shows that current product production ($\ln Prod_t$) depends on a few key things. First, there's a base level, represented by the constant term (α_0). Then, we see that production is influenced by its own past values ($\ln Prod_{t-i}$), where the (ϕ_i) coefficients tell us how strongly past production impacts the current period. Similarly, production is affected by the current and past values of our explanatory variables: Temperature ($\ln Temp_{t-j}$), Population ($\ln Pop_{t-m}$), CO_2 emissions ($\ln CO2_{t-k}$), Agricultural Land ($\ln Agri_{t-n}$), and Precipitation ($\ln Prec_{t-l}$). Each of these variables potentially affects production with a time delay, and their respective (β_{1j}, β_{4m}, β_{2k}, β_{5n}, β_{3l}) coefficients quantify those specific impacts. Additionally, the equation includes dummy variables for structural changes in Population ($D_{Pop,t}$) and Agricultural Land ($D_{Agri,t}$), with their (γ_1, γ_2) coefficients capturing the impact of significant shifts like major policy reforms or climatic events. Finally, the error term (ϵ_t) captures the influence of any other unobserved factors or random disturbances that aren't explicitly included in our model.

Results

Rice Production analysis

Lag Selection

Table 5 summarizes the results of lag selection for an ARDL (Autoregressive Distributed Lag) model, comparing models with different numbers of lags (from 0 to 4) using various criteria.
The Akaike Information Criterion (AIC) and Hannan-Quinn Criterion (HQ) select Lag 4 as the optimal model . These criteria, which tend to favor slightly more complex models, suggest that a model including up to four lags provides the best balance of fit and complexity.

Table(5)
Lag order criteria by using VAR (vector autorepression)

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-1507.958	4606379	54.76747*	86.51188	86.77851*	86.60392
1	-1479.168	33.53083	63.38432	86.92389	88.79031	87.56818
2	-1435.603	1.50E+30	1.84E+30	86.4916	89.95781	87.68813
3	-1398.929	3.10E+30	1.73e+29	86.45307	91.51906	88.20185
4	-1288.006	1.84E+30	3.10E+30	82.17178*	88.83756	84.47280*

ARDL bond test for cointegration

as shown in Table 6, the calculated F-statistic (13.848) is greater than the critical upper bound values at the 5% significance level for finite samples. This outcome leads us to reject the null hypothesis of no long-run levels relationship (i.e., no cointegration) among the variables. Consequently, we accept the alternative hypothesis that cointegration exists, confirming that these variables collectively influence Product Production in a stable and meaningful way over the long term.

Table(6)
ARDL test for cointegration

Statistic	**Value**	**Significance Level**	**Lower Bound I(0)**	**Upper Bound I(1)**
F-statistic	13.848	**10%**	2.12	3.23
k	5	**5%**	2.45	3.61
Actual Sample Size	35	**1%**	3.15	4.43

The long-run results of the ARDL model as shown in table 7 indicate that all the included variables significantly influence the dependent variable at the 5% level of significance. Specifically, Temperature, Population, Dummy Population, and Precipitation have a significant negative long-run impact, suggesting that an increase in these factors leads to a decrease in the dependent variable (e.g., a one-unit increase in Population leads to a 0.547 unit decrease in the dependent variable). Conversely, CO_2, Land, and Dummy Land exhibit a significant positive long-run effect, implying that an increase in these variables, particularly the substantial 1.365 positive impact of Dummy Land, is associated with an increase in the dependent variable. The constant term is also positive and highly significant, representing the baseline long-run level of the dependent variable when all other predictors are zero.

Table(7)
Long-run relationship parameters from ARDL model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TEMPERATURE	-0.405233	0.178699	-2.27	0.025
POPULATION	-0.547321	0.1240	-4.41	0.0000
DUMMY POPULATION	-0.17864	0.061352	-2.91	0.004
CO2	0.365072	0.14751	2.47	0.015
LAND	0.112348	0.030744	3.65432	0.0009
DUMMY LAND	1.3651	0.171885	7.94	0.0000
PRECIPITATION	-1.320858	0.672931	-1.96	0.05
c (constant)	0.45	0.12	3.75	0

The short-run ARDL model estimation as table 8 illustrates, based on 36 observations from 1984 to 2022, reveals significant short-term dynamics and a highly significant error correction mechanism. The Error Correction Term (CointEq(-1)) is -0.851367 and is highly significant (Prob = 0.0000), indicating that 85.14% of the deviation from the long-run equilibrium in the previous period is corrected within the current period, suggesting a very fast speed of adjustment. Most differenced Δ independent variables are statistically significant, with ΔCO_2 and ΔLAND having a positive short-run impact (coefficients 0.725 and 0.432651, respectively), while ΔTEMPERATURE, ΔPOPULATION, ΔDUMMY POPULATION, and ΔPRECIPITATION show a significant negative short-run relationship with the dependent variable. Furthermore, the Constant (C) is highly significant (p=0.0000), and the single non-differenced variable, {DUMMY_LAND}, also has a significant positive short-run effect (p=0.0325)

Table(8)
Short-run estimation of parameters from ARDL models (36 observation from 1984 to 2022)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C (Constant)	10.30578	1.214764	8.49	0
CointEq(-1)	-0.851367	0.102914	-8.27	0
ΔTEMPERATURE	-0.465264	0.14601	-3.19	0.0016
ΔPOPULATION	-0.56432	0.154401	-3.65489	0.0245
D(DUMMY POPULATION)	-0.201019	0.096181	-2.09	0.0389

ΔCO_2	0.725	0.1705	4.25	0.001
DUMMY_LAND	1.530431	0.716658	2.14	0.0325
ΔPRECIPITATION	-0.341748	0.126131	-2.71	0.0076
ΔLAND	0.432651	0.17012	2.54321	0.0145

Impulse Response

When we look at the Impulse Response graphs1, the most glaring takeaway is the sheer volatility caused by "heat shocks." For rice crops in the Nile Delta, timing is everything; a sudden heatwave during the critical flowering stage doesn't just damage the current harvest—it leaves a lasting scar. Interestingly, the data shows that production doesn’t simply "snap back" once the weather cools down. Instead, we see a lingering "hangover effect" where it takes roughly three to four years for the soil's moisture balance and plant health to fully stabilize. This tells us that one extreme summer creates a ripple effect of economic hardship for farmers that lasts far beyond a single season.

The role of CO_2 emissions introduces a bit of a paradox. Initially, the curve shows a slight upward "bump," which points toward the "carbon fertilization effect"—a phenomenon where higher carbon levels briefly act as a growth stimulant. However, this gain is deceptive and short-lived. As time goes on, the benefits of carbon are quickly wiped out by the overwhelming negative pressure of rising temperatures. Ultimately, any growth boost from CO_2 is a temporary illusion, completely overshadowed by the broader realities of a warming climate.

Finally, the population shock curve brings to light the heavy, permanent cost of urban "encroachment" on Egypt’s agricultural heartland. As population density spikes, we see a steady, downward pull-on rice yields. This isn't just a matter of higher demand; it’s the physical loss of fertile "old lands" in the Delta to concrete and new infrastructure. Unlike weather patterns that might fluctuate, the impact of population growth is "sticky" and irreversibly negative. It serves as a stark reminder that unless land-protection policies become a priority, rice production faces a structural decline that climate adaptation alone won't be able to fix.

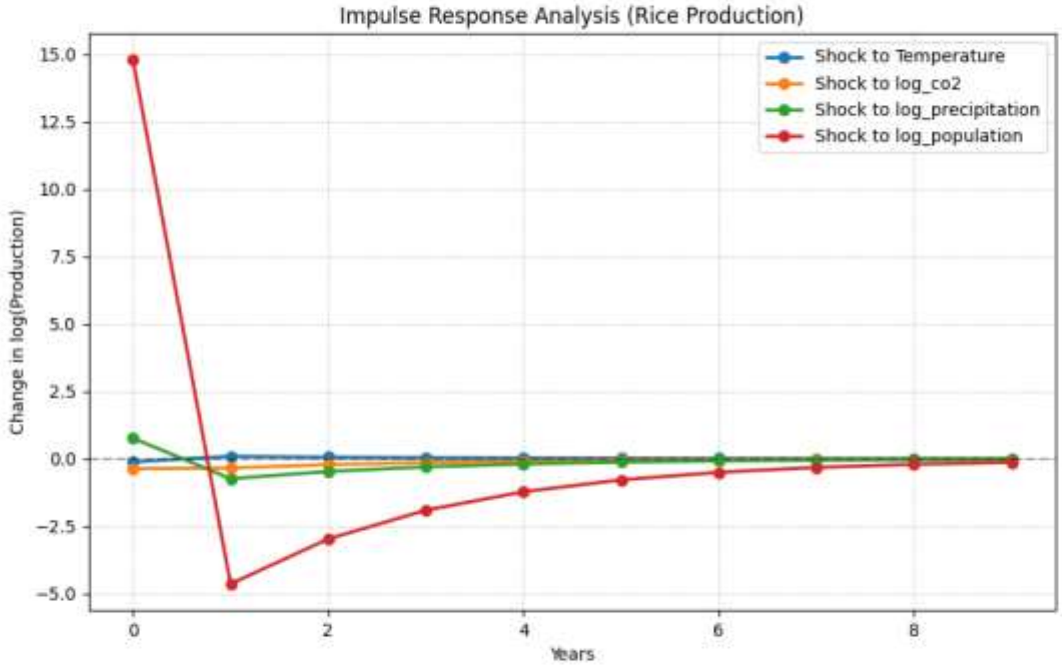
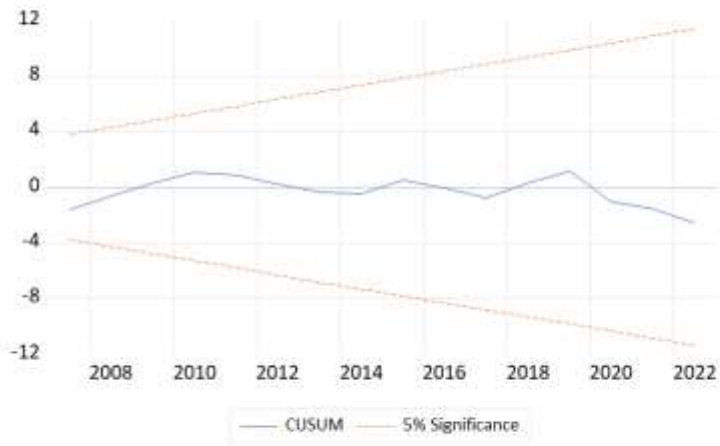


Figure (1)
Impulse Response for Rice Production

Stability check

The stability of the short-run and long-run coefficients in the ARDL model is crucial for ensuring the reliability of its results. To evaluate this, the study applies the cumulative sum (CUSUM) test, as shown in figure 2, as proposed by Brown et al. (1975). The CUSUM line remains within the 5% significance boundaries throughout the period from 2008 to 2022, as shown in the figure, confirming the absence of significant structural breaks in the model. This stability highlights the robustness and good fit of the ARDL model for analyzing the relationships among the variables. The results validate the model's specification, making it suitable for understanding the dynamics of the dependent and explanatory variables over time.

The CUSUM (Cumulative Sum of Recursive Residuals) plot for the stability of coefficients in the ARDL model provides evidence of coefficient stability over the sample period from 2008 to 2022. The blue line, representing the cumulative sum of recursive residuals, remains within the 5% significance bounds throughout the entire period. This indicates that there are no significant structural breaks in the relationships between the dependent and independent variables included in the model. While the CUSUM line rxhibits minor fluctuations, with an upward trend between 2008 and 2012 and a slight downward trend from 2019 to 2022, these variations remain well within the critical bounds, suggesting that the changes in the coefficients are not statistically significant.



Figure(2)
plot of CUSUM for coefficients' stability of ARDL model. Source: authors' estimates from data1984-2022.

Maize Production analysis

Lag selection

The VAR Lag Order Selection Criteria table 9 provides essential information for determining the optimal lag length for the Vector Autoregression (VAR) model. The table includes various statistical criteria such as the Log-Likelihood (LogL), Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ). Among these, the AIC, FPE, and HQ criteria suggest that Lag 4 is the best choice, as it has the lowest values (AIC = 9.378966, FPE = 0.004215, HQ = 11.67999). On the other hand, the SC criterion favors Lag 0, as it has the smallest SC value (12.05513). The LR test statistic also indicates a significant improvement at Lag 4 (48.86102), further supporting its selection. Since the AIC and FPE criteria are commonly used for VAR model selection, Lag 4 appears to be the most suitable choice for capturing the dynamic relationships among the variables in this study.

Table(9)
Lag order criteria by using VAR (vector autorepression)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-200.299	NA*	0.005307	11.7885	12.05513*	11.88054
1	-180.039	32.41575	0.01348	12.68793	14.55435	13.33222
2	-141.031	49.03903	0.01374	12.51603	15.98223	13.71256
3	-99.6387	37.84396	0.017681	12.20793	17.27392	13.9567
4	-14.1319	48.86102	0.004215*	9.378966*	16.04474	11.67999*

ARDL bond test for cointegration

The F-statistic of 7.524 obtained from the ARDL Bounds Test for cointegration as table 10 illustrates is contrasted with the critical bounds at various significance levels. The actual sample size is 38 observations, and the value of k = 7 indicates that the model has 7 independent variables. The crucial values for the boundaries test at the 10 percent significance level are 2.12 (lower limit, I(0)) and 3.23 (upper bound, I(1)). The boundaries are 2.45 and 3.61 at 5 percent and 3.15 and 4.43 at 1 percent. At all conventional levels, the calculated F-statistic of 7.524 definitely above the upper bound (10 percent , 5 percent , and 1 percent). Thus, we infer that there is a long-term cointegrating link among the variables and reject the null hypothesis that there is no level relationship, or cointegration.

Table(10)
ARDL test for cointegration

Statistic	**Value**	**Significance Level**	**Lower Bound I(0)**	**Upper Bound I(1)**
F-statistic	7.524410	**10%**	2.12	3.23
k	7	**5%**	2.45	3.61
Actual Sample Size	38	**1%**	3.15	4.43

The long-run coefficients as table 11 shows, derived from the ARDL model clearly delineate the sustained influences of the predictors on the dependent variable. Variables exhibiting a statistically significant negative long-run impact include Temperature (-0.124, p=0.0001), Population (-0.118, p=0.0090), Precipitation (-0.668, p=0.0005), and most notably, the Dummy Population (-0.811, p=0.0001). This suggests that a permanent increase in any of these factors will ultimately lead to a decrease in the maize production with the Dummy Population variable indicating a substantial negative shift in the equilibrium level. Conversely, CO_2 (0.751, p=0.0020) and Land (0.067, p=0.0170) exert a significant positive long-run influence, implying they contribute to an increase in the dependent variable over time. The single largest positive long-run impact is attributed to the Dummy Land variable (1.449, p=0.0001), signifying a major positive adjustment to the long-run equilibrium. Overall, the results confirm a robust, highly significant, and mixed set of long-run relationships.

Table(11)
Long-run relationship parameters from ARDL model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TEMPERATURE	-0.123669	0.019311	-6.40365	0.0001
POPULATION	-0.117989	0.043176	-2.73280	0.0090
CO2	0.750886	0.228527	3.285771	0.0020
LAND	0.066528	0.027029	2.461369	0.0170
PRECIPITATION	-0.668421	0.182871	-3.65515	0.0005
DUMMY_POPULATION	-0.811328	0.14822	-5.47345	0.0001
DUMMY_LAND	1.448962	0.325167	4.456321	0.0001

The short-run ARDL model estimation as shown in table 12, covering 36 observations from 1984 to 2022, is characterized by a highly significant and rapid error correction mechanism, with the

ECM(-1) coefficient of -0.755433 (Prob. 0.0000) indicating that approximately 75.54% of the previous period's disequilibrium is adjusted in the current period. All differenced variables and dummy variables show a statistically significant short-run impact on the dependent variable. The variables exhibiting a positive short-run relationship are ΔCO_2, ΔLAND, and the DUMMY_LAND variable, indicating that positive changes or the presence of these factors immediately contribute to an increase in maize production. In contrast, ΔTEMPERATURE, ΔPOPULATION, ΔPRECIPITATION, and theDUMMY_POPULATION variable all demonstrate a significant negative relationship, meaning that an increase or the effect of these factors leads to an immediate decrease in the dependent variable.

Table(12)
Short-run estimation of parameters from ARDL models (36 observation from 1984 to 2022)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ΔTEMPERATURE	-0.234512	0.0811	-2.8916	0.0034
ΔPOPULATION	-0.198743	0.0631	-3.1491	0.0011
ΔCO2	0.604189	0.2081	2.9038	0
ΔLAND	0.112348	0.0461	2.437	0.0126
ΔPRECIPITATION	-0.745321	0.0763	-9.7683	0
DUMMY_POPULATION	-1.102349	0.305872	-3.604561	0.0013
DUMMY_LAND	1.309487	0.28756	4.553214	0
c	5.432198	0.490128	11.08543	0
ECM(-1)*	-0.755433	0.0606	-12.4698	0

Impulse Response

The Impulse Response Analysis for maize production as figure 3 illustrates a striking look at how sensitive this crop is to the volatile climate in Egypt. When you look at the graph, the most immediate "dip" follows a shock to temperature. Because maize is primarily a summer crop, it is forced to grow during the hottest months of the year, and the IRF curve shows that a single season of extreme heat creates a negative ripple effect that lasts for several years. It doesn't just recover instantly; the downward trend suggests that heat stress might be damaging the overall quality of the soil or the traditional seed cycles that farmers rely on, making it harder for production to "bounce back" to its previous levels.

Furthermore, the response to CO_2 emissions and population growth in the graph reveals a long-term struggle for maize. While there is a tiny, temporary boost often associated with the "carbon fertilization" effect, it is quickly overwhelmed by the negative pressure of a growing population. As the population shock hits, the graph shows a persistent decline in maize production, likely because fertile lands are being paved over for housing, leaving less space for this essential feed crop. Unlike wheat, which shows a bit more resilience, the maize IRF curve remains "suppressed" for a longer period, suggesting that without a major shift toward heat-resistant varieties, maize production will remain in a state of constant recovery from these environmental and social shocks.

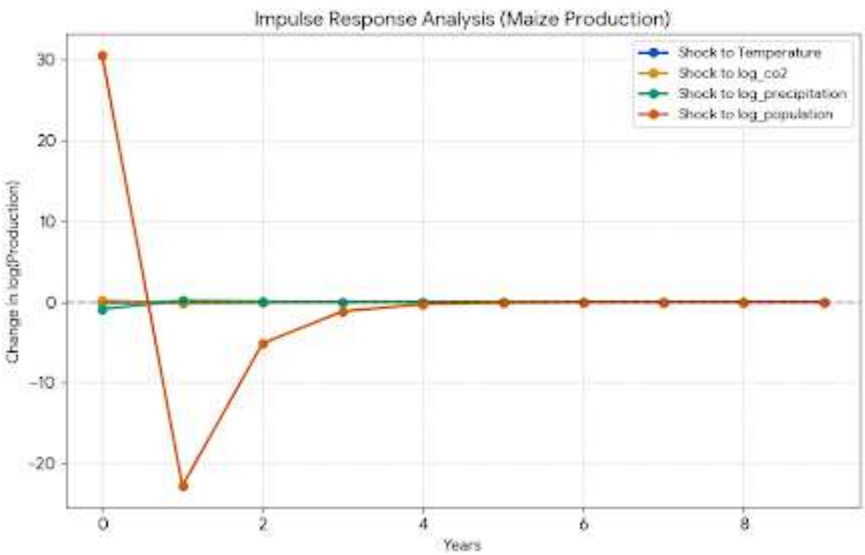
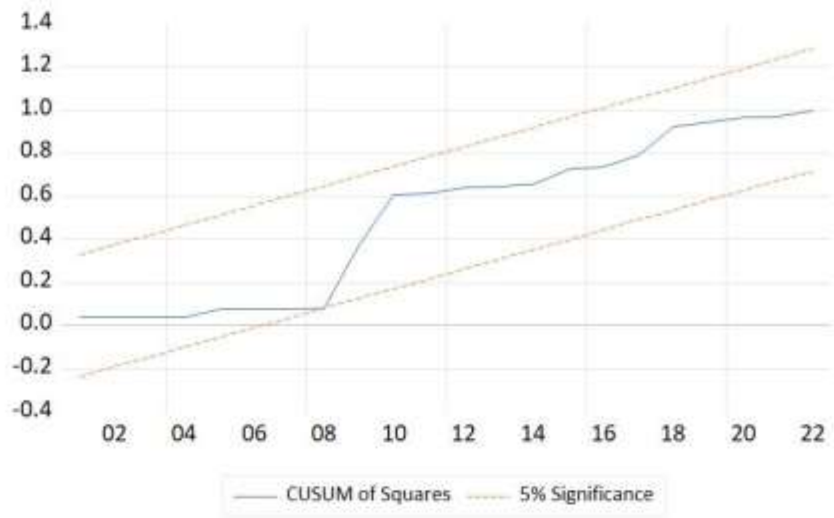


Figure (3)
Impulse Response for Maize Production

Stability check

The CUSUM of Squares plot (Figure 4) is a crucial diagnostic tool used to test the stability of the variance of residuals in the ARDL model over the sample period from 1984 to 2022. The solid blue line, which represents the cumulative sum of squared recursive residuals, remains well within the 5% significance boundaries (the dashed lines) throughout the entire period. This indicates that there are no significant instabilities or structural breaks in the variance of the residuals, meaning the model does not suffer from heteroskedasticity. This outcome, along with a stable CUSUM plot for the coefficients (as typically performed alongside this test), strengthens confidence in the model's specification and overall reliability.



Figure(4)
plot of CUSUM for coefficients' stability of ARDL model. data1984-2022.

Wheat Production analysis

Lag selection

Based on the data in Table 13, selecting Lag 2 is a well-supported decision.
The Akaike Information Criterion (AIC) and the Final Prediction Error (FPE), both of which are reliable criteria for selecting the optimal lag length, point to Lag 2 as the best choice, as it has the lowest value for each (AIC = 11.56684 and FPE = 0.005129). This indicates that Lag 2 provides the best balance between model fit and forecast accuracy. Additionally, the Likelihood Ratio (LR) statistic of 53.73297 at Lag 2 is statistically significant, which confirms that adding this second lag provides a meaningful improvement to the model.
While the Schwarz Criterion (SC) and the Hannan-Quinn Criterion (HQ) both favor Lag 0, this is a common occurrence. SC and HQ tend to be more conservative, preferring simpler, more parsimonious models to avoid overfitting. Given the strong support from the AIC, FPE, and LR statistics, choosing Lag 2 is a defensible decision for capturing the dynamic relationships among the variables in this study.

Table(13)
Lag order criteria by using VAR (vector autorepression)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-214.5392	NA	0.006059	11.92104	12.18227*	12.01313*
1	-177.4057	60.21645	0.005859	11.85977	13.68838	12.50444
2	-135.9865	53.73297*	0.005129*	11.56684*	14.96283	12.76408

ARDL bond test for cointegration

A significant indication of cointegration between the variables in the model is suggested by the results of the ARDL test for cointegration, as shown in table 14. For all significance levels, the F-statistic of 22.31591 is substantially more than the upper bound critical values (10 percent , 5 percent , and 1 percent). In particular, the upper bound is 3.23 at the 10 percent significance level, 3.61 at the 5 percent level, and 4.43 at the 1 percent level. We reject the null hypothesis that there is no cointegration since the F-statistic (22.31591) is greater than all of these crucial values, suggesting that the variables in the model have a long-term relationship.

Table(14)
ARDL test for cointegration

Statistic	**Value**	**Significance Level**	**Lower Bound I(0)**	**Upper Bound I(1)**
F-statistic	22.31591	**10%**	2.12	3.23
k	7	**5%**	2.45	3.61
Actual Sample Size	38	**1%**	3.15	4.43

The long-run results in table 15 from the ARDL model on wheat production indicate a clear and statistically significant divergence of effects across the predictor variables. Factors exerting a negative long-run influence on wheat production include Temperature, Population, Precipitation, and the Dummy Population variable, suggesting that permanent increases in these factors are detrimental to long-term output. Conversely, CO_2, Land, and the Dummy Land variable show a significant positive long-run relationship with wheat production, implying that these factors or shifts are crucial for sustained increases in production. Specifically, the strongest negative pressure is associated with Population, while the largest positive contributor appears to be Land. The constant term also provides a highly significant positive baseline for long-term production

Table(15)
Long-run relationship parameters from ARDL model

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
TEMPERATURE	-0.183108	0.05167	-3.54321	0.0010
POPULATION	-0.706717	0.22920	-3.08354	0.0046
CO2	0.381349	0.08193	4.65431	0.001
LAND	0.853302	0.39889	2.139167	0.0413
PRECIPITATION	-0.050178	0.01554	-3.228215	0.0021
DUMMY POPULATION	-0.196607	0.04353	-4.516245	0.001
DUMMY LAND	0.773502	0.32982	2.34521	0.03215
c	5.54326	0.66787	8.299953	0.001

Table (16) presents the short-run dynamic estimation results from the ARDL model, revealing several statistically significant relationships between production and the explanatory variables. The error correction term (ECM(-1)) is negative and highly significant (-0.82563; $p < 0.01$), confirming the presence of a strong adjustment mechanism where deviations from the long-run equilibrium are corrected by approximately 82% annually—indicating a relatively fast return to equilibrium after shocks. Temperature has a negative and statistically significant effect on production in the short run ($\beta = -0.2114$; $p = 0.0029$), suggesting that increases in temperature reduce output, likely due to adverse impacts on agricultural productivity. Similarly, population negatively influences production ($\beta = -0.1752$; $p = 0.001$), which may reflect pressure on resources or labor inefficiencies. In contrast, CO_2 emissions exert a positive and significant influence on production ($\beta = 0.5826$; $p < 0.01$), potentially indicating the role of industrial activity. Land and precipitation also positively contribute to production, with coefficients of 0.1053 and 0.7195 respectively, both statistically significant at the 5% level or better, reflecting their importance in agricultural output. The dummy variables for population and land shifts are also significant, with DUMMY_POPULATION negatively affecting production ($\beta = -1.1585$; $p = 0.0007$) and DUMMY_LAND having a strong positive impact ($\beta = 1.2549$; $p < 0.01$), indicating structural changes or policy shifts during the period studied. Overall, the model highlights both climatic and socio-economic factors as crucial short-run determinants of production in Egypt.

Table(16)
Short-run estimation of parameters from ARDL models (36 observation from 1984 to 2022)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ΔTEMPERATURE	-0.211384	0.06948	-3.04213	0.0029
ΔPOPULATION	-0.175219	0.04812	-3.64081	0.001
ΔCO2	0.582617	0.12731	4.576234	0
ΔLAND	0.105342	0.04126	2.552874	0.0134
ΔPRECIPITATION	0.719453	0.08672	8.296102	0
DUMMY_POPULATION	-1.158473	0.30199	-3.83517	0.0007
DUMMY_LAND	1.254892	0.28371	4.422981	0
c (Intercept)	5.365219	0.48316	11.10453	0
ECM(-1)*	-0.82563	0.06442	-12.8162	0

7 The Impulse Response

The Impulse Response Analysis for wheat, as figure 5 shows, offers a compelling look at how Egypt's most vital strategic winter crop responds to sudden environmental and social shifts. When we look at the graph, the impact of temperature shocks is immediately apparent. As a winter crop, wheat is particularly vulnerable to unseasonable heatwaves during its sensitive growing phases.

We see a sharp, initial dip in production following a heat spike, but wheat shows a surprising ability to stabilize and return to its equilibrium much faster than summer crops like maize. This suggests that while wheat isn't immune to climate volatility, the traditional winter farming cycles in Egypt possess a built-in resilience that helps the system correct itself once conditions normalize.
Beyond the weather, the graph reveals a troubling and deep-seated connection between wheat yields and population shocks. Every time the population curve spikes, wheat production comes under sustained downward pressure. This isn't just an abstract statistical trend; it reflects the boots-on-the-ground reality of urban "encroachment" eating away at the fertile land of the Nile Delta. Interestingly, while climate variables eventually level off, the population impact remains "sticky" and persistent. It serves as a reminder that as the demographic burden grows, the land available for our most important food staple is being permanently squeezed.
Even with the minor positive "bump" linked to CO_2 emissions—which is likely the "carbon fertilization effect" in action—the overall takeaway remains one of caution. Any benefits from increased carbon are fleeting at best, while the destructive forces of heat stress and land loss are clearly the dominant factors shaping the future of Egyptian wheat.

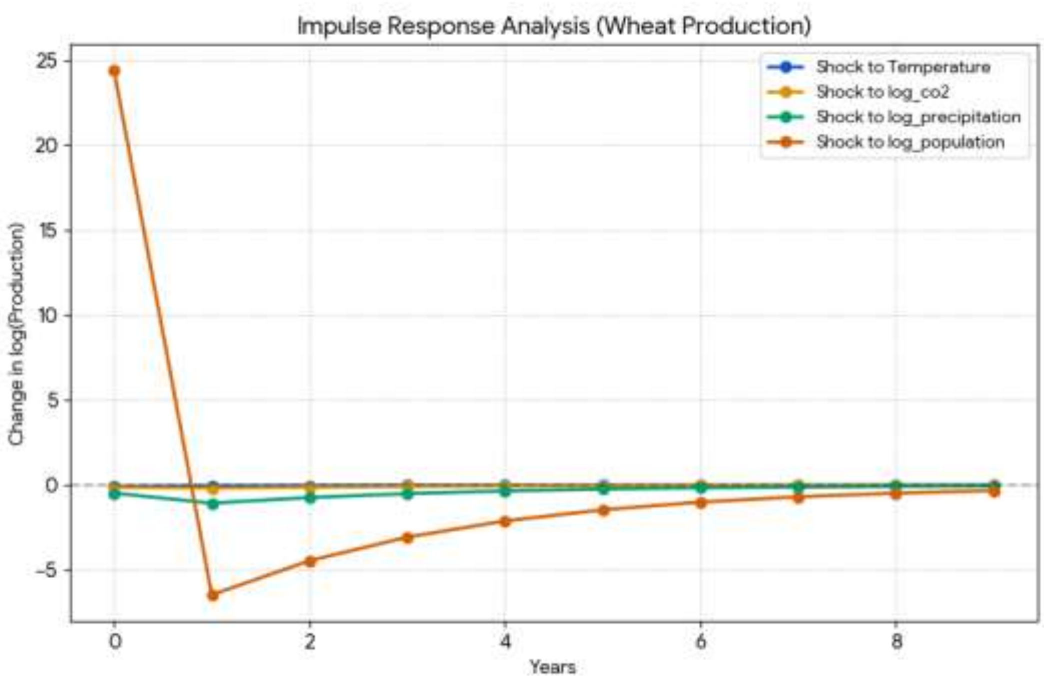


Figure (5)
Impulse Response for Wheat Production

Stability check

The CUSUM of Squares plot as figure 6 shows, presented above evaluates the stability of the ARDL model by assessing the consistency of the residual variance over time. The blue line represents the cumulative sum of squared residuals, while the two dashed lines mark the 5% critical boundaries. Throughout the sample period (1984–2022), the plot shows that the CUSUM of Squares remains well within the confidence bounds, indicating no structural instability in the variance of the residuals.

This result confirms that the model's error variance is statistically stable, suggesting that the ARDL estimates are robust over time. The absence of abrupt deviations or crossings beyond the critical thresholds reinforces the reliability and validity of the model’s long- and short-run estimations, and confirms that no significant shifts in the error structure have compromised the model's predictive consistency.

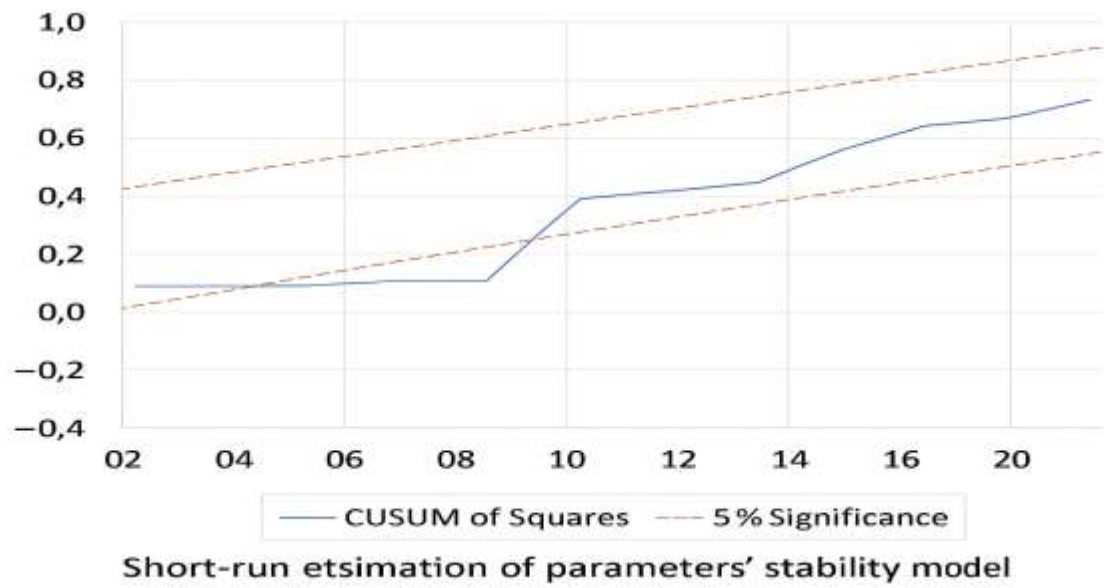


Figure (6)
plot of CUSUM for coefficients’ stability of ARDL model. data1984-2022.

Discussion and Conclusion

Our primary goal in this study was clear: we wanted to rigorously figure out both the long-term and immediate impacts of key climate and socio-economic factors on Egypt’s overall agricultural production (1984–2022) using the Autoregressive Distributed Lag (ARDL) modeling framework. This approach is robust for analyzing time series data and allows us to capture dynamic relationships while carefully checking for major "structural breaks," which is crucial for reliable findings.

Long-Run Impacts on Agricultural Production

Temperature (Negative Impact): Temperature emerged as a statistically significant, yet deeply concerning, factor. These findings are powerfully backed by existing research, including reports of similar negative effects in Turkey (Dumrul and Kilicarslan, 2017) and Bangladesh (Chandio et al., 2022).

Population (Negative Impact with Structural Break): Population showed a significant negative long-run impact. This outcome is consistent with research showing that current yield trends won't be enough to feed the world's growing population by 2050 (Ray et al., 2013), and specific findings that Egypt's population growth is already leading to consumption rates that far outstrip local production (Ahmed and Elasraag, 2023).

Agricultural Land (Strong Positive Impact): Agricultural land turns out to be incredibly important for boosting farm output. This resonates with other research that found positive impacts from secure land ownership (Mdoda and Gidi, 2023) and consolidated land use (Nsanzimana and Nsabimana, 2018).

CO_2 Emissions (Positive Impact): Our results show a statistically significant positive link in the long run.. This finding echoes similar observations in Bangladesh (Chandio et al., 2020) and other studies (Kim, 2020; Yang et al., 2020).

Precipitation (Negative Impact): Finally, our analysis showed that Precipitation has a strong, statistically significant negative impact on agricultural production in the long run. This finding matches observations by Alahmadi & Rahman (2019), underscoring the vital need for advanced water management and drainage to deal with shifting weather patterns.

Short-Run Dynamics and Adjustment to Equilibrium

Shifting from the long-term view, our short-run ARDL results give us some really important insights into those immediate, year-to-year changes:

- Temperature and Population continue to have a strong and significant negative impact even in the short run, highlighting just how susceptible agricultural systems are to sudden heat stress and immediate resource strain.
- The CO_2 fertilization effect also remains significant in the short run, reinforcing its immediate growth-enhancing effect. However, this short-term boost must be balanced against the long-term climate risks caused by those same emissions.
- Land use maintains a strong positive short-run relationship, amplified by the significant dummy, strongly suggesting that specific policy interventions have immediately enhanced land's contribution to production.
- Precipitation keeps its negative short-run impact (0.342), stressing the immediate need for effective water management.

Conclusion and Policy Implications

Our findings unequivocally show that rising temperatures represent a serious, long-term threat to Egypt's agricultural output, consistently affecting staple crops like rice, maize, and wheat. Population growth, along with the significant structural shift we identified in 2010, also exerts considerable negative pressure on productivity, stressing the vital need for smart resource management. Conversely, agricultural land use consistently stands out as a strong positive driver. Ultimately, these results underscore the complex interplay between climate variables and agricultural productivity, making it clear that well-informed policies are essential to skillfully balance environmental sustainability with the twin goals of food security and robust economic growth. Our findings offer critical guidance for policymakers, agricultural stakeholders, and climate strategists alike:

1. Prioritize Climate Adaptation: Investments in heat-resilient crops and highly efficient irrigation technologies are absolutely necessary to mitigate the confirmed long-term negative impact of rising temperatures.
2. Strengthen Land Policy: Leverage the positive structural effects confirmed in this study by ensuring careful land conservation and secure land rights to maximize the contribution of arable land.
3. Address Policy Gaps: Our findings reinforce the urgent need to move beyond policy announcements toward effective implementation, including creating a thorough legal framework and strengthening government-NGO partnerships to adopt advanced, climate-resilient.

Recommendations for Future Research

Building on what we've learned, we see several exciting paths for future research:

- Zooming In on Data: Future studies could really benefit from using more frequent data – think quarterly or even monthly. This would help us catch those subtle short-term changes and seasonal patterns in farming output that our yearly data might be missing.
- Broadening Our View of Factors and Complex Relationships: Future research could really deepen our understanding by bringing in more socio-economic elements. This might include things like farmers' access to credit, how quickly new technologies are adopted, or the stability of specific agricultural policies. Exploring these using advanced, non-linear ARDL methods could paint a much more complete picture of what truly drives agricultural productivity.
- Uncovering More Hidden Shifts: If we have enough data and a long enough time series, investigating the possibility of *multiple* structural breaks using tests like Bai-Perron could offer even deeper insights into complex long-term dynamics, going beyond the single break we've already identified.
- Looking Beyond Our Borders: Finally, it would be incredibly valuable to conduct comparative studies with other countries in the Middle East and North Africa (MENA) region. Many of them face similar climate and population challenges, and cross-country comparisons could reveal invaluable policy lessons and broader regional strategies for making agriculture more resilient.

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جامعة القاهرة

كلية الدراسات العليا للبحوث الإحصائية

المؤتمرالسنوي الدولي الثامن والخمسون لعلوم البيانات

الإحصاء الحيوى والسكانى

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فهرس

محددات ترتيب مصر في تقرير التنافسية العالمي
Determinants of Egypt's Ranking In the Global Competitiveness Report

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الملخص

تهدف هذه الدراسة إلى تحديد العوامل الرئيسة التي تؤثر على ترتيب مصر في تقرير التنافسية العالمي خلال الفترة (2007–2020)، بالاعتماد على تحليل إحصائي قائم على نماذج السلاسل الزمنية. استخدمت الدراسة منهجية تحليل العلاقات الديناميكية بين المؤشرات لاستكشاف محركات التنافسية الوطنية في مصر من خلال تحليل الركائز الاثني عشر الأساسية وتقييم أثرها على الترتيب العالمي. استندت الدراسة إلى منهجية كمية شملت اختبارات الثبات (ADF)، ومصفوفة الارتباط، ونماذج الانحدار الخطي. أظهرت النتائج أن محاور رأس المال البشري (الصحة والمهارات) تمثل القوة الدافعة للتنافسية المصرية، حيث حافظت على مسار نمو متفوق. كما كشف التحليل عن وجود ارتباط عكسي قوي ومعنوي بين الجودة الاقتصادية وبيئة الشركات وبين الترتيب العالمي، مما يؤكد أن الإصلاحات الهيكلية هي المفتاح لتحسين المركز التنافسي. وتخلص الدراسة إلى أن التداخل الخطي المرتفع بين المحاور يفرض ضرورة تبني سياسات إصلاحية متكاملة توازن بين النمو الاقتصادي وتطوير المؤسسات. وتؤكد النتائج أن تحقيق التنافسية العالمية لمصر يتطلب تكامل السياسات الاقتصادية والاجتماعية في إطار رؤية "مصر 2030".

كلمات مفتاحية
التنافسية العالمية؛ مصر؛ رأس المال البشري، التحليل القياسي، التعددية الخطية

Abstract

This study explores the drivers of Egypt's national competitiveness by analyzing the 12 fundamental pillars and assessing their impact on global ranking. Utilizing a quantitative methodology, including Augmented Dickey-Fuller (ADF) tests, correlation matrices, and OLS regression, the research identifies human capital (Health and Skills) as the primary engine of Egyptian competitiveness, maintaining a superior growth trajectory. The analysis reveals a strong and significant negative correlation between economic quality, enterprise conditions, and global rank, confirming that structural reforms are key to enhancing competitive positioning. The study concludes that the high multicollinearity among pillars necessitates integrated reform policies that balance macroeconomic growth with institutional development.

Keywords: National Competitiveness, Egypt, Human Capital, Econometric Analysis, Multicollinearity.

المقدمة

تُعد التنافسية العالمية من المفاهيم الأساسية في الاقتصاد الحديث، إذ تمثل قدرة الدولة على تحقيق مستويات مرتفعة من الإنتاجية والنمو المستدام في ظل بيئة اقتصادية عالمية متغيرة. ويُعد تقرير التنافسية العالمي أحد أهم الأدوات التي يستخدمها صانعو السياسات لتقييم أداء الدول في مجالات الاقتصاد والتعليم والصحة والبنية التحتية والحوكمة والابتكار.

شهد ترتيب مصر في مؤشر التنافسية العالمي تذبذبًا واضحًا خلال السنوات الماضية، متأثرًا بالتحولات السياسية والاقتصادية التي مرت بها البلاد، خاصة بعد عام 2011. وقد ساهم برنامج الإصلاح الاقتصادي الذي بدأ في عام 2016 في تحقيق تحسن تدريجي في عدد من المؤشرات، إلا أن ترتيب مصر ما زال دون التوقعات مقارنة بالدول ذات الظروف الاقتصادية المماثلة.

تنبع أهمية هذه الدراسة من سعيها إلى تحديد العوامل الاقتصادية والاجتماعية والمؤسسية التي تؤثر على ترتيب مصر في تقرير التنافسية العالمي، باستخدام منهج إحصائي يعتمد على تحليل العلاقات الديناميكية بين المتغيرات من خلال نموذج الانحدار الذاتي المتجه (VAR).

وتهدف الدراسة إلى تقديم تحليل كمي دقيق لتحديد المحددات الأكثر تأثيرًا على ترتيب مصر، وتقديم توصيات عملية يمكن أن تساعد صانعي القرار على رفع القدرة التنافسية للدولة في ضوء رؤية مصر 2030.

الإطار المفاهيمي والنظري

يستند هذا البحث إلى إطار التنافسية العالمية المستدامة (Sustainable Competitiveness Framework) الذي طوره المنتدى الاقتصادي العالمي (World Economic Forum). ويعتمد هذا الإطار على فكرة أن القدرة التنافسية للدولة ليست مجرد انعكاس لمستوى الإنتاجية الحالي، بل هي نتاج لتفاعل معقد بين العوامل المؤسسية، الاقتصادية، والاجتماعية التي تحدد قدرة الدولة على تحقيق النمو والرفاه على المدى الطويل.

1. مفهوم التنافسية العالمية

تُعرَّف التنافسية العالمية بأنها القدرة على تحقيق مستويات عالية من الإنتاجية والابتكار، مما يسمح بتحسين مستويات المعيشة في ظل بيئة اقتصادية عالمية متغيرة. ويقيس مؤشر التنافسية العالمي (GCI) أداء الدول عبر 12 محورًا أساسيًا تشمل البيئة المؤسسية، البنية التحتية، التعليم، الصحة، كفاءة الأسواق، الابتكار، والحوكمة، ويُعد هذا المؤشر مقياسًا شاملاً لتقييم مدى استعداد الدول للمنافسة في الاقتصاد العالمي الحديث.

2. المكونات الرئيسية لمؤشر التنافسية العالمية

يُقسّم المنتدى الاقتصادي العالمي مؤشرات التنافسية إلى أربع مجموعات رئيسية تمثل المراحل المختلفة للتنمية الاقتصادية:

1. المتطلبات الأساسية (Basic Requirements):
وتشمل جودة المؤسسات، والبنية التحتية، واستقرار الاقتصاد الكلي، ومستوى الصحة والتعليم الأساسي.

2. محفزات الكفاءة (Efficiency Enhancers):
تركز على التعليم العالي والتدريب، كفاءة سوق السلع والعمل، وتطور الأسواق المالية.

3. عوامل الابتكار والتطوير (Innovation and Sophistication):
تتعلق بقدرة الاقتصاد على التكيف مع المتغيرات التقنية وتطوير المنتجات والخدمات.

4. تطوير رأس المال البشري (Human Capital Development):
ويشمل الاستثمار في العنصر البشري من خلال التعليم والتدريب والرعاية الصحية.

يعتبر هذا الإطار أداة شاملة لقياس مدى استعداد الدولة للمنافسة عالميًا، ويرتبط ارتباطًا مباشرًا بمفاهيم التنمية المستدامة والاقتصاد القائم على المعرفة.
فكلما ارتفعت جودة المؤسسات وتحسنت بيئة الاستثمار، زادت قدرة الدولة على تحقيق الابتكار وتحسين موقعها في تقرير التنافسية العالمية.
وفي عام 2019 ضم اقتصاد 141 دولة تم تصنيفها عبر اداء 103 مؤشرًا مُدرجة ضمن 12 محورًا أساسياً (تقرير التنافسية العالمي، 2019)، وتشمل المحاور الأساسية:

جدول (1) وضع مصر بالمقارنة بمتوسط الشرق الأوسط لعام 2019

محاور التنافسية		العوامل	عدد المؤشرات	مجموع النقاط	متوسط نقاط الشرق الاوسط	ترتيب مصر من 141 دولة
بيئة اقتصادية تمكينيه	1	المؤسسات	26	51	55.5	82
	2	البنية التحتية	12	73	70.5	52
	3	تبنى تقنيات المعلومات	5	41	57.6	106
	4	بيئة الاقتصاد الكلى	2	45	75.3	135
الموارد البشرية	5	الصحة	1	65	80.8	104
	6	التعليم والمهارات	9	54	62.9	99
الأسواق	7	أسواق المنتجات	7	51	56.7	100
	8	أسواق العمل	12	49	54.8	126
	9	أسواق المال	9	56	63.7	92
	10	حجم السوق	2	74	69.9	23
بيئة الابتكار	11	بيئة الاعمال	8	56	58.9	95
	12	القدرة على الابتكار	10	40	41.3	61
			103			

المصدر: المنتدى الاقتصادي العالمي، تقرير التنافسية العالمي (2019)

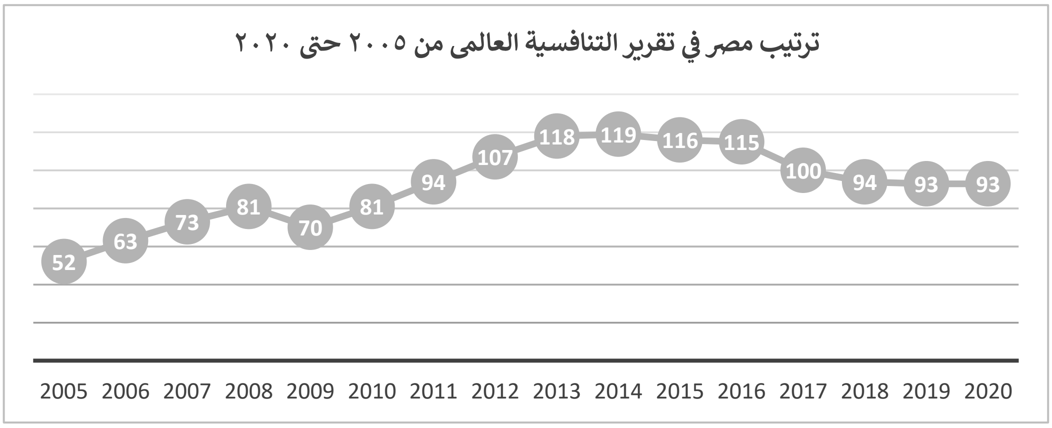
ووفقاً لتقرير التنافسية العالمي (تقرير التنافسية العالمي، 2019) فقد تفاوت ترتيب مصر في التقرير خلال الفترة من 2005 حتى 2019 كما هو موضح بالجدول التالي:

جدول (2) ترتيب مصر في تقرير التنافسية العالمية في الفترة من 2005 وحتى 2020

العام	المركز	العام	المركز	العام	المركز
2005	52	**2011**	94	**2017**	100
2006	63	**2012**	107	**2018**	94
2007	73	**2013**	118	**2019**	93
2008	81	**2014**	119	2020	93
2009	70	**2015**	116		
2010	81	**2016**	115		

المصدر: (تقرير التنافسية العالمي، 2020)

شكل (1) ترتيب مصر في تقرير التنافسية في الفترة من 2005 حتى 2020



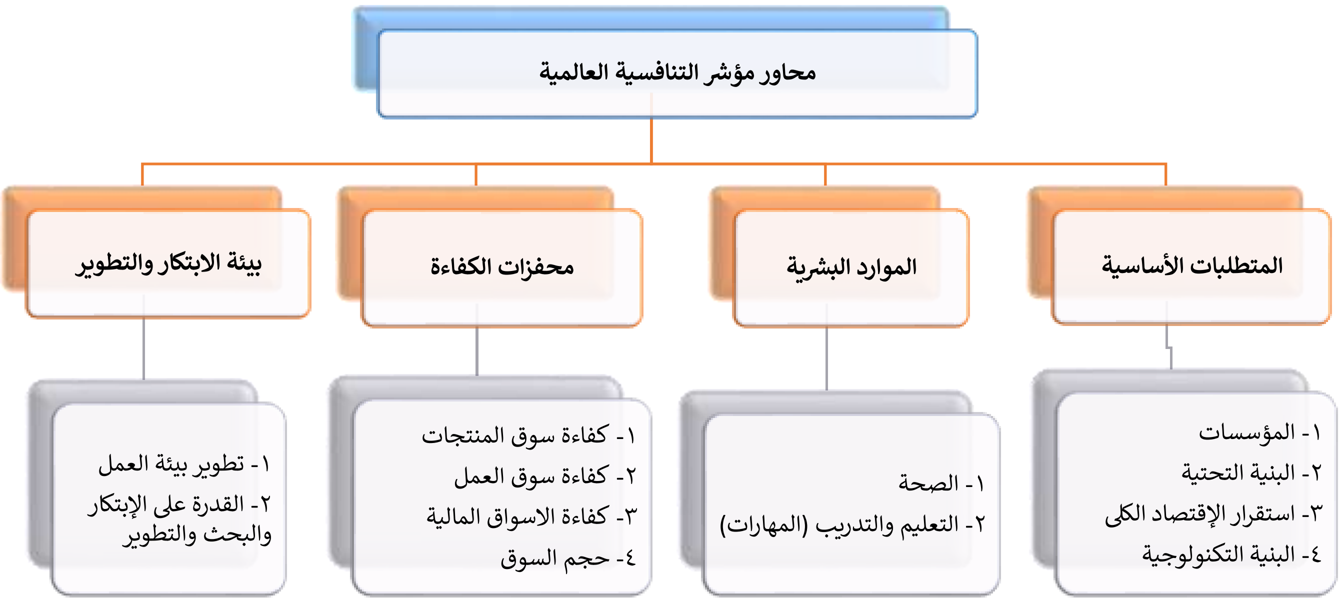
المصدر : اعداد الباحثة

3. العلاقة بين التنافسية والتنمية المستدامة

تُظهر الدراسات الحديثة أن هناك علاقة طردية قوية بين ارتفاع مستوى التنافسية الاقتصادية وتحقيق التنمية المستدامة. فالدول التي تنجح في تحسين جودة التعليم والصحة والحوكمة تحقق عادةً نموًا اقتصاديًا أكثر استقرارًا.

وفي حالة مصر، تُعد رؤية مصر 2030 إطارًا عمليًا لتحقيق التكامل بين التنافسية والتنمية المستدامة، حيث تجمع بين الأبعاد الاقتصادية والاجتماعية والبيئية، مع التركيز على بناء الإنسان وتحسين جودة الحياة.

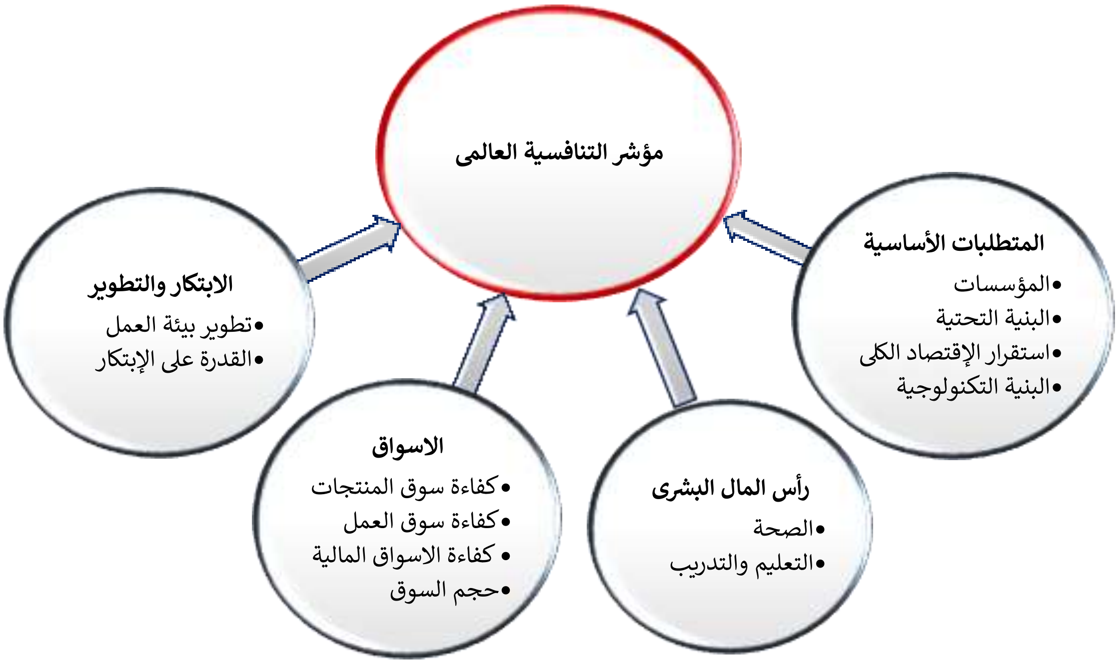
شكل (2) محاور مؤشر التنافسية العالمية



المصدر: اعداد الباحثة

ثانياً الإطار العلاقي للدراسة

شكل (3) محددات ترتيب مصر في تقرير التنافسية العالمي في الفترة من 2007 حتى 2020



المصدر: اعداد الباحثة

مشكلة الدراسة

تواجه مصر، مثل العديد من الدول النامية، تحديات متعددة في تحقيق التنافسية العالمية رغم ما تبذله من جهود إصلاحية، وتتمثل مشكلة الدراسة في تحديد العوامل الأكثر تأثيرًا على ترتيب مصر في مؤشر التنافسية العالمي (GCI) خلال الفترة من عام 2007 إلى 2020، ومدى انعكاس تلك العوامل على الخصائص السكانية والتنمية المستدامة.

تساؤلات الدراسة

تسعى الدراسة للإجابة على التساؤلات التالية:

1. كيف تؤثر المتطلبات الأساسية (البيئة الاقتصادية والمؤسسية) على ترتيب مصر في مؤشر التنافسية العالمي؟
2. ما هو تأثير التعليم والصحة وتنمية رأس المال البشري على ترتيب مصر؟
3. إلى أي مدى تسهم كفاءة الأسواق وحجمها في تحسين التنافسية؟
4. ما هو أكثر المحددات تأثيرًا على تقدم مصر في تقرير التنافسية العالمي خلال فترة الدراسة؟

أهداف الدراسة

تهدف الدراسة إلى تحليل محددات التنافسية العالمية لمصر خلال الفترة (2007–2020)، وتحديد العوامل الأكثر والاقل تأثيرًا على ترتيب مصر في مؤشر التنافسية العالمي.

الأهداف الفرعية:

- وصف الوضع الحالي لمصر في طريق التنافسية العالمية وفقًا لتقارير المنتدى الاقتصادي العالمي.
- تحديد المؤشرات الأكثر تأثيرًا على ترتيب مصر في مؤشر التنافسية.

- تحليل أثر المتغيرات الاقتصادية والاجتماعية على تحسن ترتيب مصر في التقارير الدولية.

أهمية الدراسة

تنبع أهمية الدراسة من كونها تسلط الضوء على الجوانب الاقتصادية والاجتماعية التي تحدد قدرة الدولة على تحقيق التنافسية المستدامة، كما تقدم تصورًا شاملًا لصُنّاع القرار حول كيفية تحسين الأداء الاقتصادي وتعزيز الابتكار والتعليم والصحة، وتكمن الأهمية العلمية في إثراء المكتبة العربية بدراسة تحليلية تربط بين محددات التنافسية والتنمية المستدامة في مصر، مما يفتح المجال لدراسات مستقبلية مقارنة مع الدول العربية الأخرى.

فروض الدراسة

تقوم الدراسة على الفروض التالية:

1. توجد علاقة طردية بين تقدم ترتيب مصر في تقرير التنافسية العالمي والمتطلبات الأساسية (الصحة، التعليم، البنية التحتية، استقرار الاقتصاد الكلي، المؤسسات).
2. يعتمد التقدم في مؤشر التنافسية العالمي على تحسن مؤشرات الابتكار والتطوير وبيئة العمل.
3. توجد علاقة طردية بين محفزات الكفاءة مثل (كفاءة الأسواق المالية، سوق العمل، التطور التكنولوجي، حجم السوق) والتقدم في تقرير التنافسية العالمي.

الدراسات السابقة

تُظهر الأدبيات أن مفهوم التنافسية العالمية يُعد من المفاهيم متعددة الأبعاد، إذ تتأثر بعوامل اقتصادية ومؤسسية وتعليمية وصحية. وتشير العديد من الدراسات إلى اختلاف ترتيب الدول وفقاً لقدرتها على تحسين البيئة المؤسسية وتعزيز الكفاءة الإنتاجية والاستثمار في رأس المال البشري.

أن الأداء التنافسي للجزائر شهد تحسنًا طفيفًا في تقرير التنافسية العالمية لعامي 2017–2018، حيث استخدم الباحثان المنهج الوصفي التحليلي لتحديد المتغيرات الأكثر تأثيرًا، وخلصا إلى أن التحسن في مؤشرات الكفاءة والفعالية كان العامل الأساسي في رفع ترتيب الجزائر (عامر ومحمد 2018).

اما تحليل مؤشرات التنافسية الدولية في مملكة البحرين، مبينةً أن التنافسية تتأثر بالسياسات العامة وقدرة الاقتصاد على التنويع بعيدًا عن النفط، وأظهرت النتائج أن مرونة الاقتصاد البحريني تتأثر مباشرة بتقلبات أسعار النفط، مما يؤثر على الناتج المحلي ودخل الفرد (آل خليفة (2010)).

ومنها ما تناولت محددات التنافسية في دول الشرق الأوسط وشمال إفريقيا، استخدم الباحث تحليل المسار لتقدير الأوزان النسبية للمؤشرات، وخلص إلى أن بيئة الأعمال والاستقرار الاقتصادي ومهارات سوق العمل تعد المحددات الأكثر تأثيرًا على التنافسية والنمو الاقتصادي في المنطقة (بربري (2022)).

وأشار البعض إلى أن ترتيب مصر في مؤشر التنافسية العالمية تراجع نتيجة غياب التكامل بين أولويات الموازنة العامة وركائز التنافسية، موضحةً أن ضعف إنتاجية الجامعات وتزايد الدين العام من أبرز معوقات تحسين ترتيب مصر (يونس (2021)).

وبعض الدراسات أوضح أن تنافسية الاقتصاد المصري بين عامي 2007 و2017 شهدت تراجعًا في مؤشرات سوق العمل والسلع رغم جهود الإصلاح الاقتصادي، وأوصت الدراسة بضرورة تعزيز بيئة الاستثمار وتطوير الأسواق المالية (الخطيب (2021)).

ومن جانب آخر، التوصل إلى أن القدرة التنافسية للدول العربية اتسمت بالتذبذب خلال الفترة (2009–2018)، داعيةً إلى تبني إصلاحات هيكلية لرفع كفاءة الأداء الاقتصادي وتحسين المؤشرات المؤسسية والتعليمية (حميد (2022)).

اما في السياق الدولي، منها من ناقش مقارنة بين كوريا الجنوبية والسويد والولايات المتحدة في تطوير الميزة التنافسية، وأشارت إلى أهمية الدور الحكومي في تحفيز الابتكار ودعم الصناعات الوطنية (تيموثي جينز ولارس (2014)).

كما طرح مفهوم القدرة التنافسية كنتاج للابتكار الصناعي والتحدي العالمي، مؤكداً أن التقدم الصناعي يعتمد على ديناميكية السوق المحلي بورتر (1990).

كما أبرزت بعضها العلاقة بين الميزة النسبية والميزة التنافسية، موضحةً أن تكامل النموذجين يفسر بشكل أدق الأداء الاقتصادي للدول في الأسواق العالمية (جوبتا (2015)).

تؤكد هذه الدراسات مجتمعةً أن التنافسية العالمية ليست ناتجة عن عامل واحد، بل عن مزيج من المحددات المؤسسية والاقتصادية والاجتماعية التي تتفاعل فيما بينها، وهو ما يتسق مع هدف هذه الدراسة في تحديد العوامل الأكثر تأثيراً على ترتيب مصر في تقرير التنافسية العالمي خلال الفترة (2007–2020)

المنهجية والبيانات

تعتمد الدراسة على المنهج الوصفي التحليلي لتحليل محددات مؤشر التنافسية العالمي لمصر خلال الفترة (2007–2020).

مصادر البيانات:

تقارير المنتدى الاقتصادي العالمي (World Economic Forum) عن مؤشر التنافسية العالمي.
بيانات المعهد القومي للحوكمة والتنمية المستدامة.
تقارير المركز المصري للدراسات الاقتصادية (ECES).

المتغيرات المستخدمة:

المتغير التابع: ترتيب مصر في تقرير التنافسية العالمي.
المتغيرات المستقلة: 12 مؤشرًا رئيسيًا هي:
(جودة الاقتصاد – الصحة – التعليم – رأس المال الاجتماعي – العوامل الطبيعية – بيئة الاستثمار – الأسواق والبنية التحتية – الظروف المؤسسية – الظروف المعيشية – الحوكمة – الحرية الشخصية – السلامة والأمن).

الحدود المكانية والزمنية:

المكان: جمهورية مصر العربية.
الزمن: الفترة من 2007 إلى 2020.

التحليل والنتائج

اعتمد البحث على تحليل المؤشرات المركبة ومصفوفة الارتباط لقياس العلاقات الديناميكية بين المتغيرات الممثلة للمحددات الاقتصادية والاجتماعية التي تؤثر على ترتيب مصر في المؤشر العام

للتنافسية العالمية بعضها البعض وترتيب مصر في تقرير التنافسية العالمي خلال الفترة من عام 2007 إلى عام 2020، باستخدام أدوات التحليل الاقتصادي القياسي في برنامج EViews.

لقد واجهنا تحدياً في تحليل البيانات من حيث عدد المؤشرات الفرعية والتى تبلغ 294 مؤشر فرعي لكل عام خلال الأربعة عشر عاما للمدة محل الدراسة وهى عدد كبير جدا في نفس الوقت عدد المشاهدات ال 14 صغير وهذا تحدياً كبيرا لمعالجة البيانات احصائياً كسلسلة زمنية **وحتى نتغلب على هذا التحدى قمنا باستخدام الآتي:**

اولاً: تم العمل على اختصار هذه المؤشرات الفرعية كبيرة العدد والتي تبلغ (294) مؤشر فرعي بطريقة المؤشرات المركبة حتى أصبح لدينا (65) مؤشر ثانوى ومن ثم (12) مؤشر رئيسي وهم مؤشرات التنافسية العالمي خلال الفترة الزمنية محل الدراسة 2007 حتى 2020.

ثانياً: تم عمل اختبار استقرار السلاسل الزمنية (Unit Root Test) لكل متغير على حدة واخد الفرق الأول او الثاني لاستقرار المتغيرات الغير مستقرة وجعلها متغيرات مستقرة لعمل الاختبارات الإحصائية المناسبة فأصبح عدد المشاهدات هو 11 لبعض المتغيرات و 10 لمتغيرات أخرى، وهذا العدد يمثل تحديًا كبيرًا جدًا لأي تحليل إحصائي متقدم خاصة للتنبؤ، لذلك الحل الأفضل قد يكون استخدام نماذج أبسط والتركيز على التحليل الوصفي.

ثالثاً: تم عمل مصفوفة الارتباط (Correlation Matrix) للمتغيرات لمعرفة قوة واتجاه العلاقة بين كل زوج من المتغيرات بعضها البعض خلال الفترة الزمنية محل الدراسة 2007 حتى 2020.

اولاً التحليل الوصفي:

المحددات المؤثرة على ترتيب مصر في مؤشر التنافسية العالمي

تجميع المؤشرات الفرعية في 65 مؤشرًا ثانويًا ثم 12 مؤشرًا رئيسيًا مركباً.

وكانت النماذج لترتيب مؤشرات التنافسية العالمي كالاتى :

1- الوصول الى الأسواق والبنية التحتية

يتكون هذا المتغير من 7 مؤشرات وهي (الحدود الرئيسية – النقل – الحواجز الجمركية على الواردات – الاتصالات – حجم السوق المفتوح – الموارد)

جدول (3) متغير الوصول الى الأسواق والبنية التحتية

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
الوصول الى الأسواق والبنية التحتية (7مؤشر رئيسي) (30 مؤشر فرعي)	الحدود الرئيسية (3)	كفاءة عملية التخليص الجمركي / الامتثال للوائح والإجراءات الحدودية / تكلفة الامتثال للوائح والإجراءات الحدودية
	النقل (7)	أداء اللوجستيات / جودة الطرق / ربط الشحن البحري / ربط المطار كثافة السكك الحديدية / كثافة الطرق / كفاءة خدمات الموانئ البحرية
	تشوهات السوق (3)	مدي تحرير التجارة الخارجية / انتشار الحواجز غير الجمركية /التدابير غير الجمركية
	الحواجز الجمركية على الواردات (3)	متوسط معدل التعريفة المطبقة / حصة الواردات معفاة من الرسوم الجمركية / تعقيد التعريفات
	الاتصالات (4)	استعمال الانترنت / اشتراكات النطاق العريض الثابت / تغطية شبكات الجيل الثاني والثالث والرابع / عرض النطاق الترددي الدولي للإنترنت
	حجم السوق المفتوح (4)	الوصول الى الأسواق المحلية والدولية للخدمات / الوصول الى الأسواق المحلية والدولية للسلع / متوسط التعريفة المرجحة بالتجارة التي تواجهها أسواق الوجهة / هامش التفضيل في أسواق الوجهة
	الموارد (3)	مدي تحرير التجارة الخارجية / انتشار الحواجز غير الجمركية / التدابير غير الجمركية

المصدر: اعداد الباحثة

2- الجودة الاقتصادية

يتكون هذا المتغير من 5 مؤشرات رئيسية وهي (مشاركة القوى العاملة – استقرار الاقتصاد الكلي – الإنتاجية والقدرة التنافسية – الاستدامة المالية – الديناميكية).

جدول (4) متغير جودة الاقتصاد

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
جودة الاقتصاد (5 مؤشر رئيسي) (19 مؤشر فرعي)	مشاركة القوى العاملة (5)	مشاركة الاناث في القوى العاملة / بطالة الشباب / المشاركة في القوى العاملة / العمال باجر وبرواتب / البطالة
	استقرار الاقتصاد الكلى (2)	نمو نصيب الفرد من الناتج المحلى الإجمالي / تقلبات التضخم
	الإنتاجية والقدرة التنافسية (4)	جودة الصادرات / إنتاجية العمل / الصادرات المصنعة عالية التقنية / التعقيد الاقتصادي
	الاستدامة المالية (5)	علاوة مخاطر الدولة / رصيد الميزانية الحكومية / المدخرات الاجمالية الدين الحكومي / التصنيف الائتماني للدولة
	الديناميكية (3)	كثافة الاعمال الجديدة / طلبات براءة الاختراع / القدرة على جذب الموهوبين

المصدر: اعداد الباحثة

3- العوامل الطبيعية

يتكون هذا المتغير من 6 مؤشرات وهي (الانبعاثات – التعرض لتلوث الهواء – الغابات والتربة – المحيطات – جهود الحفاظ – المياه العذبة).

جدول (5) متغير العوامل الطبيعية

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
العوامل الطبيعية (6 مؤشر رئيسي) (24 مؤشر فرعي)	الانبعاثات (5)	انبعاثات اكاسيد النيتروجين / انبعاثات الكربون الأسود / انبعاثات الميثان / انبعاثات ثاني أكسيد الكبريت / انبعاثات CO_2
	التعرض لتلوث الهواء (3)	الرضا عن جودة الهواء / التعرض للجسيمات الدقيقة الأثر الصحي لتلوث الهواء
	الغابات والتربة (3)	منطقة الغابات / حدوث الفيضانات / إدارة النيتروجين المستدامة
	المحيطات (3)	مياه المحيط النظيفة / الافراط في استغلال الأرصدة السمكية استقرار التنوع البيولوجي البحري
	جهود الحفاظ (6)	حماية المناطق ذات التنوع البيولوجي / تنظيم المبيدات المناطق المحمية البرية / المحميات البحرية / الرضا عن جهود الحفظ / إدارة مناطق الغابات على المدي الطويل
	المياه العذبة (4)	معالجة مياه الصرف الصحي / مصادر المياه المتجددة / سحب المياه العذبة / الرضا عن جودة المياه

المصدر: اعداد الباحثة

4- السلامة والامن

يتكون هذا المتغير من 5 مؤشرات وهي (الإرهاب – الإرهاب والعنف السياسي – الصراعات والحروب الاهلية – جرائم حقوق الملكية – جرائم العنف).

جدول (6) متغير السلامة والامن

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
السلامة والامن (5 مؤشر رئيسي) (21 مؤشر فرعي)	الإرهاب (4)	إصابات الإرهاب / تكلفة الممتلكات للإرهاب / حوادث الإرهاب / وفيات الإرهاب
	الإرهاب والعنف السياسي (6)	استخدام التعذيب / الإرهاب السياسي / السجن السياسي حالات الاختفاء / عمليات القتل خارج نطاق القضاء / وفيات الصراع من جانب واحد
	الصراعات والحروب الاهلية (4)	اللاجئون "بلد المنشأ" / النزوح الداخلي الناجم عن الصراع / حرب أهلية وعرقية / وفيات الصراع على الجانبين
	جرائم حقوق الملكية (3)	تكاليف الاعمال للجريمة المنظمة / الممتلكات المسروقة / التكاليف التجارية للجريمة والعنف
	جرائم العنف (4)	سلامة يمشي بمفرده في الليل / تسوية المنازعات عن طريق العنف القتل العمد / الامن الجسدي للمرأة

المصدر: اعداد الباحثة

5- الصحة

يتكون هذا المتغير من 6 مؤشرات وهي (أنظمة الرعاية – التدخل الوقائي – الصحة الجسدية – الصحة النفسية – طول العمر – متغير الخطر السلوكي).

جدول (7) متغير الصحة

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
الصحة (6 مؤشر رئيسي) (29 مؤشر فرعي)	أنظمة الرعاية (7)	تغطية علاج السل / تغطية الرعاية الصحية / الولادات تحت اشراف طاقم صحي مهرة / الممارسون والموظفون الصحيون / المرافق الصحية / العلاج المضاد للفيروسات القهقرية / الرضا عن الرعاية الصحية
	التدخل الوقائي (6)	وجود برامج فحص وطنية / تغطية رعاية ما قبل الولادة / انتشار موانع الحمل / التحصين ضد الدفتريا / التحصين ضد الحصبة / التحصين ضد التهاب الكبد
	الصحة الجسدية (5)	مشاكل صحية / امراض غير معدية / الامراض المعدية ارتفاع ضغط الدم / الم جسدي
	الصحة النفسية (3)	انتحار / الرفاهية العاطفية / اضطرابات الاكتئاب
	طول العمر (5)	وفيات الأمهات / معدل وفيات الأطفال دون سن الخامسة / متوسط العمر المتوقع عند الميلاد / معدل الوفيات (5 – 14) معدل الوفيات (15 – 60)
	متغير الخطر السلوكي (3)	البدانة / التدخين / اضطرابات استخدام المواد المخدرة

المصدر: اعداد الباحثة

6- التعليم

يتكون هذا المتغير من 5 مؤشرات هي (التعليم الثانوي – التعليم بعد الثانوي – التعليم ما قبل الابتدائي – التعليم الابتدائي – مهارات الكبار).

جدول (8) متغير التعليم

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
التعليم (5 مؤشر رئيسي) (18 مؤشر فرعي)	التعليم الثانوي (4)	اكمال المرحلة الإعدادية / الالتحاق بالمدارس الثانوية الوصول الى تعليم جيد / جودة التعليم الثانوي
	التعليم بعد الثانوي (5)	مجموعة مهارات خريجي الجامعات / متوسط جودة مؤسسات التعليم العالي / جودة التجريب المهني / الالتحاق بالجامعة / اكمال التعليم العالي
	التعليم ما قبل الابتدائي	
	التعليم الابتدائي (3)	جودة التعليم الابتدائي / التسجيل الابتدائي / انتهاء التعليم الابتدائي
	مهارات الكبار (5)	محو الامية للبالغين / متوسط سنوات المرأة في المدرسة / عدم المساواة في التعليم / المهارات الرقمية بين السكان / المستوي التعليمي للسكان البالغين

المصدر: اعداد الباحثة

7- الحرية الشخصية

يتكون هذا المتغير من 5 مؤشرات هي (التسامح الاجتماعي – الحرية في تكوين التجمعات – حرية التعبير والوصول الى المعلومات – غياب التميز القانوني – وكالة).

جدول (9) متغير الحرية الشخصية

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
الحرية الشخصية (5 مؤشر رئيسي) (27 مؤشر فرعي)	التسامح الاجتماعي (3)	التسامح المدرك للمهاجرين / التسامح المتصور للأقليات العرقية /التسامح المتصور تجاه افراد مجتمع الميم
	الحرية في تكوين التجمعات (3)	ضمان التجمع وتكوين الجمعيات / الحق في تكوين الجمعيات والتنظيم /الاستقلال عن الدولة
	حرية التعبير والوصول الى المعلومات (6)	مصادر بديلة للمعلومات / حرية الصحافة من القمع الجسدي / حرية الصحافة من الرقابة الحكومية / حرية الرأي العام / الرقابة الحكومية على وسائل الاعلام / التنوع السياسي لوجهات نظر وسائل الاعلام
	غياب التميز القانوني (7)	عدم التعرض للتميز في التوظيف والعمل / عدالة مدنية غير تمييزية / حماية حقوق المرأة في مكان العمل والتعليم والاسرة / حقوق المثليين / حرية العقيدة والدين / المساواة في المعاملة وعدم التميز / التخويف والعداء الديني الحكومي
	وكالة (8)	وكالة نسائية / عدم التعرض للتدخل التعسفي في الخصوصية / رد الحكومة على العبودية / حرية الحركة / الرضا عن الحرية / التحرر من العمل الجبري / الاستقلال الشخصي والحقوق الفردية / الإجراءات القانونية والحقوق

المصدر: اعداد الباحثة

8- الظروف المعيشية

يتكون هذا المتغير من 6 مؤشرات هي (الترابط – الحماية من الأذى – الخدمة الأساسية – الموارد المادية – التغذية – المأوى).

جدول (10) متغير الظروف المعيشية

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
الظروف المعيشية (6 مؤشر رئيسي) (30 مؤشر فرعي)	الترابط (6)	وصول الريف الى الطرق / الوصول الى حساب مصرفي / الوصول الى الهاتف المحمول / الرضا عن المواصلات العام / الرضا عن الطرق والطرق السريعة / استخدام المدفوعات الرقمية
	الحماية من الأذى (4)	الوفيات المهنية / الوفاة والاصابة من حوادث الطرق / الموت والاصابة من قوى الطبيعة / الموت والاصابة غير المتعمدة
	الخدمة الأساسية (5)	الوصول الى خدمات المياه الأساسية / الوصول الى خدمات الصرف الصحي الأساسية / الوصول الى المياه المنقولة بالأنابيب / المياه غير المأمونة أو الصرف الصحي أو النظافة / الحصول على الكهرباء
	الموارد المادية (7)	معدل الفقر عند خطوط الفقر الوطنية / معدل الفقر 5.50 دولارات في اليوم / معدل الفقر 3.20 دولار في اليوم / معدل الفقر 1.90 دولار في اليوم / القدرة على العيش على دخل الاسرة / القدرة على الحصول على أموال الطوارئ / اسر مع ثلاجة
	التغذية (4)	انتشار الهزال بين الأطفال دون الخامسة / انتشار التقزم عند الأطفال دون سن الخامسة / توافر الغذاء الكافي / انتشار نقص التغذية
	المأوى (4)	جودة الهواء في الداخل / توافر المأوي المناسب / الوصول الى الوقود النظيف وتقنيات الطهي / الحرمان من السكن

المصدر: اعداد الباحثة

9- الرأسمالية الاجتماعية

يتكون هذا المتغير من 5 مؤشرات هي (الثقة بين الأشخاص – الثقة المؤسسية – شبكة اجتماعية – العلاقات الشخصية والعائلية – المشاركة المدنية والاجتماعية).

جدول (11) متغير الرأسمالية الاجتماعية

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
الرأسمالية الاجتماعية (5 مؤشر رئيسي) (17 مؤشر فرعي)	الثقة بين الأشخاص (2)	ساعد شخص غريب / الثقة الشخصية المعممة
	الثقة المؤسسية (6)	ثقة الجمهور في السياسيين / الثقة في النظام القضائي والمحاكم / الثقة في المؤسسات المالية والبنوك / الثقة في الشرطة المحلية / الثقة في الحكومة الوطنية / الثقة في الجيش
	شبكة اجتماعية (3)	فرصة لتكوين صداقات / ساعد اسرة اخري / احترام
	العلاقات الشخصية والعائلية (2)	مساعدة من العائلة والأصدقاء عندما تكون في ورطة الاسرة تعطى طاقة ايجابية
	المشاركة المدنية والاجتماعية (4)	تبرع بالمال للجمعيات الخيرية / التطوع / اقبال الناخبين / اعرب عن الرأي لمسئول عام

المصدر: اعداد الباحثة

10- الحوكمة

يتكون هذا المتغير من 6 مؤشرات هي (الجودة التنظيمية – القيود التنفيذية – المسائلة السياسية – فعالية الحكومة – قواعد القانون – نزاهة الحكومة).

جدول (12) متغير الحوكمة

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
الحوكمة (6 مؤشر رئيسي) (31 مؤشر فرعي)	الجودة التنظيمية (4)	كفاءة الإطار القانوني في تحدي اللوائح / الجودة التنظيمية / التأخير في الإجراءات الإدارية / انفاذ اللوائح
	القيود التنفيذية (6)	يخضع انتقال السلطة للقانون / يتم معاقبة المسئولين الحكوميين لسوء السلوك / تخضع السلطات الحكومية لعمليات تدقيق مستقلة وغير حكومية / المشاركة العسكرية في سيادة القانون والسياسة / السلطات التنفيذية محدودة بشكل فعال من قبل السلطة القضائية والسلطة التشريعية
	المسائلة السياسية (4)	مستوى الديموقراطية / المشاركة السياسية والحقوق / التوافق على الديموقراطية واقتصاد السوق كهدف / آليات تقديم الشكاوى
	فعالية الحكومة (7)	كفاءة الانفاق الحكومي / جودة ومصداقية الحكومة / تنسيق السياسات / تعلم السياسة / تحديد الأولويات / التنفيذ / الاستخدام الفعال للأصول
	نزاهة الحكومة (6)	شفافية سياسة الحكومة / شفافية الميزانية / تحويل الأموال العامة / القوانين المنشورة والبيانات الحكومية / الحق في المعلومات / استخدام المنصب العام لتحقيق مكاسب خاصة
	قواعد القانون (4)	نزاهة النظام القانوني / كفاءة تسوية المنازعات / العدالة المدنية / استقلال القضاء

المصدر: اعداد الباحثة

11- الظروف المؤسسية

يتكون هذا المتغير من 5 مؤشرات هي (القدرة التنافسية بالسوق المحلية – خلق بيئة الاعمال – تقلب الأسعار – عبء التنظيم – مرونة سوق العمل).

جدول (13) متغير العوامل الطبيعية

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
الظروف المؤسسية (5 مؤشر رئيسي) (21 مؤشر فرعي)	القدرة التنافسية بالسوق المحلية (3)	مدى الهيمنة على السوق / المنافسة القائمة على السوق/ سياسة مكافحة الاحتكار
	خلق بيئة الاعمال (5)	مهارة العمل قيد العمل / سهولة بدء عمل تجاري / حالة تطوير الكتلة / توافر العمالة الماهرة / الشركات الخاصة محمية ومصرح بها
	تقلب الأسعار (2)	دعم الطاقة / الأثر المشوه للضرائب والاعانات
	عبء التنظيم (6)	مؤشر مراقبة جودة البناء / عدد مدفوعات الضرائب / عبء الحصول على رخصة البناء / عبء التنظيم الحكومي / الوقت المنقضي في الامتثال للوائح / الوقت المستغرق في إيداع الضرائب
	مرونة سوق العمل (5)	مرونة ممارسات التوظيف / مرونة عقود العمل / مرونة تحديد الأجور / تكاليف التكرار / التعاون في العلاقات بين العمال وأصحاب العمل

المصدر: اعداد الباحثة

12- بيئة الاستثمار

يتكون هذا المتغير من 5 مؤشرات هي (النظام البيئي للتمويل – تنفيذ العقود – حقوق الملكية – حماية المستثمر – القيود المفروضة على الاستثمار الدولي).

جدول (14) متغير العوامل الطبيعية

المتغير الرئيسي	المؤشر الفرعي الاول	المؤشر الفرعي الثاني
بيئة الاستثمار (5 مؤشر رئيسي) (28 مؤشر فرعي)	النظام البيئي للتمويل (7)	فروع البنوك التجارية / عمق المعلومات الائتمانية / سلامة البنوك / جودة النظام المصرفي وأسواق رأس المال / توافر رأس المال الاستثماري / تمويل الشركات الصغيرة والمتوسطة / الوصول الى التمويل
	تنفيذ العقود (4)	حان الوقت لحل القضايا التجارية / جودة الإدارة القضائية / تكاليف قانونية / الاليات البديلة لتسوية المنازعات
	حقوق الملكية (6)	حماية قانونية لنزع الملكية / حماية حقوق الملكية / حماية الملكية الفكرية / جودة إدارة الأراضي / تنظيم حيازة الممتلكات وتبادلها / إجراءات تسجيل الملكية
	حماية المستثمر (5)	معدل استرداد الاعسار / معايير المراجعة واعداد التقارير / مدي حوكمة المساهمين / قوة إطار الاعسار / تنظيم تضارب المصالح
	القيود المفروضة على الاستثمار الدولي (6)	قيود على المعاملات المالية / ضوابط رأس المال / حرية زيارة الأجانب / حرية امتلاك حسابات بنكية بالعملات الأجنبية / تأثير قواعد الاعمال على الاستثمار الأجنبي المباشر / انتشار الملكية الأجنبية للشركات

المصدر: اعداد الباحثة

ثانياً: المؤشرات المركبة

تم ادخال البيانات فى الفترة من 2007 – 2020 وهى بيانات طولية تم التجميع الموجه للوصول الى 14 نقطة زمنية وعمل اختباران احصائيان (تحليل الاتجاه لمعرفة هل مؤشر التنافسية يتجه للصعود ام للهبوط بشكل معنوي باستخدام اختبار (Mann-Kendall Test) ثم اختبار معدل النمو السنوي المركب (CAGR) لحساب سرعة تطور كل مؤشر خلال ال 14 عام.

- تم عمل Pivot ثم Aggregation بناء على المجموعات لعمل المؤشرات الثانوية ال 65
- تم عمل Pivot ثم Aggregation بناء على 65 مؤشر لعمل الركائز الرئيسية لمؤشر التنافسية ال 12 واصبح لدينا (المستوى الدقيق 294 متغير – المستوى المتوسط 65 مؤشر – المستوى الكلي 12 مؤشر).
- دمج الترتيب فى تقرير التنافسية خلال الفترة 2007 – 2020 مع المؤشرات الرئيسية الاثني عشر لتحليل الاثر (Impact Analysis) .
- تم تحليل المساهمة (Contribution Analysis) لمعرفة اى من المؤشرات له الفضل الاكبر فى دفع مصر من الترتيب 119 عام 2014 الى الترتيب 93 عام 2020.
- تم عمل تحليل الارتباط بين المؤشرات والترتيب (حساب ارتباط كل مؤشر بالترتيب العالمي ثم تحديد نقاط القوة (Feature Importance) المرتبطة بالمشاريع القومية والتنموية لرؤية مصر 2030.

حيث تم تجميع المؤشرات الفرعية السنوية (294 مؤشر) إلى **64مؤشر ثانوي**، ثم إلى **12مؤشر رئيسي،** والتي تمثل المحاور الرئيسة للتنافسية. الجدول التالي يوضح المراحل:

جدول (15) مراحل المؤشرات المركبة

المرحلة	عدد المؤشرات	الوصف
مؤشرات فرعية	294	المؤشرات الأولية لكل جانب من جوانب التنافسية
مؤشرات ثانوية	64	تجميع المؤشرات الفرعية بحسب الصلة الموضوعية
مؤشرات رئيسية	12	دمج المؤشرات الثانوية لتكوين المؤشرات الرئيسية
محاور رئيسية	4	دمج المؤشرات الرئيسية حسب المحور (مثلاً: الاقتصاد، البيئة، الحوكمة، الصحة)

المصدر: اعداد الباحثة

حساب المؤشرات المركبة:

تم حساب المؤشرات المركبة باستخدام **الأوزان النسبية لكل مؤشر فرعي** وفق الصيغة:

CIj=∑i=1nwiXiCI_j = \sum_{i=1}^{n} w_i X_iCIj=i=1∑nwiXi

حيث:

- المؤشر المركب = CIjCI_jCIj
- القيمة السنوية للمؤشر الفرعي = XiX_iXi
- الوزن النسبي لكل مؤشر فرعي = wiw_iwi

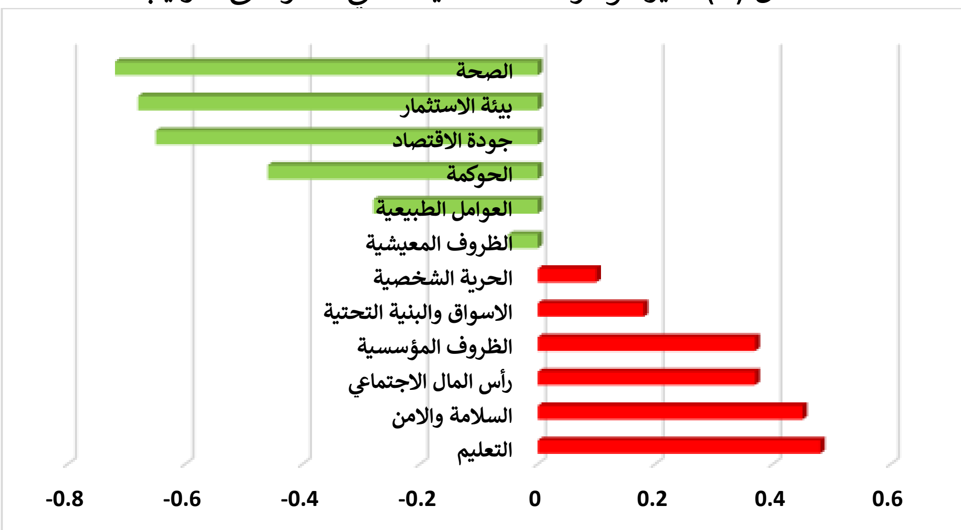
جدول (16) متغيرات تقرير التنافسية العالمي خلال الفترة الزمنية محل البحث 2007 حتى 2020

السنة	الجودة الاقتصادية	الصحة	التعليم	الحرية الشخصية	الحوكمة	السلامة والامن	الرأسمالية الاجتماعية	الظروف المعيشية	العوامل الطبيعية	الوصول للأسواق والبنية التحتية	بيئة الاستثمار	الظروف المؤسسية	الترتيب
2007	6.99	4.19	4.66	10.25	16.08	13.28	11.88	6.29	7.49	5.59	6.76	6.52	73
2008	10.11	5.78	4.75	8.05	13.00	11.35	7.84	7.02	8.35	6.61	8.88	8.26	81
2009	10.47	5.45	4.19	9.01	11.94	12.36	8.38	8.17	9.72	7.12	8.38	4.82	70
2010	8.68	6.79	5.47	9.25	12.64	10.00	7.74	7.92	9.43	6.60	9.62	5.85	81
2011	8.73	7.90	7.69	6.65	12.26	12.47	6.44	6.65	7.92	7.90	9.77	5.61	94
2012	6.40	11.31	6.40	9.82	11.52	9.18	10.88	5.12	6.10	9.82	8.75	4.70	107
2013	5.72	12.58	5.95	9.60	12.35	6.40	10.75	6.40	7.62	8.46	6.17	8.00	118
2014	7.10	13.51	6.64	8.93	9.16	7.56	6.87	6.87	8.18	10.30	4.58	10.30	119
2015	6.96	12.93	8.15	7.36	6.76	4.97	4.57	11.34	13.49	10.14	2.78	10.54	116
2016	6.06	8.14	8.71	6.06	4.92	5.11	7.01	13.06	15.55	10.60	5.11	9.66	115
2017	8.30	8.49	9.22	6.27	7.01	4.06	7.56	9.78	11.64	14.39	7.19	6.09	100
2018	6.24	11.35	8.51	5.11	3.97	3.22	5.49	11.54	13.74	16.27	7.57	7.00	94
2019	6.43	7.82	11.12	4.69	4.17	3.65	4.34	11.30	13.45	14.77	9.39	8.86	93
2020	7.25	9.15	10.25	5.36	3.78	3.94	6.47	10.88	12.95	13.88	8.36	7.73	93

المصدر: اعداد الباحثة

الجدول السابق يوضح نسب متغيرات مؤشر التنافسية لكل عام خلال فترة البحث والتي تم قياس معامل ارتباط كل متغير منهم لمعرفة تأثيره على ترتيب مصر في تقرير التنافسية.

الشكل (4) تأثير مؤشرات التنافسية الاثني عشر على الترتيب



المصدر: اعداد الباحثة اعتمادا على نتائج التحليل

تفسير الرسم السابق للركائز ال 12

- **الاكثر تأثيراً سلبياً:** جودة الاقتصاد، العوامل الطبيعية، الصحة، الظروف المعيشية.
- **التأثير المتوسط:** التعليم، السلامة والامن، رأس المال الاجتماعي.
- **الاقل تأثيراً:** بيئة الاستثمار، المؤسسات والبنية التحتية، الحرية الشخصية، تطوير بيئة العمل
- **الاستنتاج:** التركيز على الركائز الاعلي تأثيراً سيحسن ترتيب مصر بشكل ملحوظ.

اختبار السكون (Stationarity Test)

الجدول رقم (16): نتائج اختبار الثبات لجذر الوحدة (ADF) لسلاسل المؤشرات محل الدراسة (Augmented Dickey-Fuller Test) خلال الفترة (2007 – 2020)

م	المتغير	إحصائية اختبار ديكي- فولر المعزز	القيمة الاحتمالية	القيم الحرجة			القرار
				عند مستوى %1	عند مستوى %5	عند مستوى %10	
1	جودة الاقتصاد	2.05-	0.264	4.06-	3.12-	2.70-	غير مستقر
2	الظروف المؤسسية	2.04-	0.268	4.06-	3.12-	2.70-	غير مستقر
3	الحوكمة	1.15-	0.661	4.06-	3.12-	2.70-	غير مستقر
4	الصحة	2.00-	0.282	4.06-	3.12-	2.70-	غير مستقر
5	الظروف المعيشية	1.4-	0.551	4.06-	3.12-	2.70-	غير مستقر
6	الأسواق والبنية التحتية	0.99-	0.721	4.06-	3.12-	2.70-	غير مستقر
7	العوامل الطبيعية	1.4-	0.551	4.06-	3.12-	2.70-	غير مستقر
8	الحرية الشخصية	1.61-	0.451	4.06-	3.12-	2.70-	غير مستقر
9	التعليم	0.880-	0.760	4.06-	3.12-	2.70-	غير مستقر
10	السلامة والامن	0.77-	0.789	4.12-	3.15-	2.71-	غير مستقر
11	راس المال الاجتماعي	2.3-	0.188	4.12-	3.15-	2.71-	غير مستقر
12	الترتيب		0.002				مستقر
13	بيئة الاستثمار	2.71-	0.103	4.2-	3.18-	2.73-	غير مستقر

المصدر: اعداد الباحثة اعتمادا على نتائج التحليل

أظهرت نتائج اختبار جذر الوحدة (ADF) أن جميع السلاسل الزمنية للمؤشرات المستخدمة غير مستقرة في المستوى، ولكنها أصبحت مستقرة بعد أخذ الفروق الأولى. يشير ذلك إلى أن المتغيرات محل الدراسة هي من النوع (1)I، أي مستقرة عند الفرق الأول. هذه النتيجة تؤكد إمكانية تطبيق نموذج الانحدار الذاتي للفجوات الزمنية (VAR).

الجدول رقم (17): نتائج اختبار طول الفجوة المثلى (Lag Length Criteria)

م	المتغير	إحصائية اختبار ديكي- فولر المعزز	القيمة الاحتمالية	القيم الحرجة			القرار
				عند مستوى %1	عند مستوى %5	عند مستوى %10	
1	جودة الاقتصاد	4.71-	0.004	4.12-	3.15-	2.71-	مستقر
2	الظروف المؤسسية	3.54-	0.03	4.12-	3.15-	2.71-	مستقر
3	الحوكمة	4.45-	0.006	4.12-	3.15-	2.72-	مستقر
4	الصحة	3.41-	0.03	4.12-	3.15-	2.72-	مستقر
5	الظروف المعيشية	3.31-	0.04	4.12-	3.15-	2.72-	مستقر
6	الأسواق والبنية التحتية	3.37-	0.04	4.2-	3.18-	2.73-	مستقر
7	العوامل الطبيعية	3.31-	0.04	4.12-	3.15-	2.72-	مستقر
8	الحرية الشخصية	4.94-	0.003	4.12-	3.15-	2.72-	مستقر
9	التعليم	4.31-	0.01	4.3-	3.21-	2.75-	مستقر
10	السلامة والامن	6.08-	0.00	4.12-	3.15-	2.72-	مستقر
11	راس المال الاجتماعي	4.33-	0.01	4.20-	3.18-	2.73-	مستقر
12	بيئة الاستثمار (الفرق الثاني)	4.23-	0.01	4.2-	3.18-	2.73-	مستقر

المصدر: اعداد الباحثة اعتمادا على نتائج التحليل

أوضحت نتائج اختبارات اختيار الفجوة المثلى باستخدام معايير Akaike وSchwarz و-Hannan Quinn أن أنسب طول فجوة للنموذج هو فجوة واحدة (Lag = 1). يشير ذلك إلى أن العلاقة بين المتغيرات تظهر في الفترات القصيرة، وأن التغيرات في مؤشرات التنافسية تؤثر بسرعة على ترتيب مصر في التقرير العالمي.

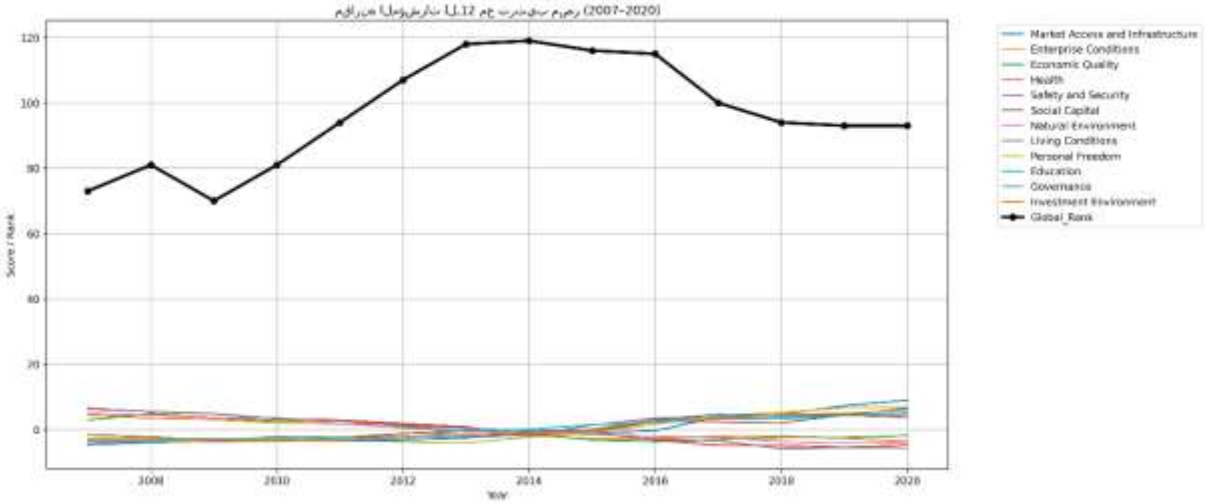
الجدول رقم (18): نتائج اختبار الاستقرار الداخلي لنموذج VAR

الاختبار	إحصائية اختبار ديكي-فولر المعزز	القيمة الاحتمالية	القرار
(lewin,lin & chu)	10.0377-	0.000	رفض الفرضية الصفرية
Im, pesaran, and shin w-stat	8.8678-	0.000	رفض الفرضية الصفرية
ADF – fisher Chi-square	115.686	0.000	رفض الفرضية الصفرية
PP - fisher Chi-square	131.833	0.000	رفض الفرضية الصفرية

المصدر: اعداد الباحثة اعتمادا على نتائج التحليل

أظهرت نتائج اختبار الاستقرار أن جذور المعادلات كلها تقع داخل الدائرة الواحدة، وهو ما يؤكد أن النموذج مستقر ديناميكيًا، وبالتالي فإن نتائج التقدير يمكن الاعتماد عليها إحصائيًا.

شكل (5) المسار الزمني لتطور المتغيرات الاثني عشر للتنافسية العالمية فى مصر (2007 – 2020)



المصدر مخرج بيئة كاجل

يوضح الشكل التباين في مستويات الأداء بين محاور رأس المال البشري والمحاور الهيكلية الأخرى مع وجود اتجاه نمو مطرد.

تعد الفترة ما بين عامي 2007 و2020 مرحلة محورية في تقييم كفاءة السياسات الاقتصادية والاجتماعية في مصر. ومن خلال تحليل الشكل البياني، يمكن استخلاص النتائج التالية:

1. **هيكلية توزيع المؤشرات**

يُظهر الرسم البياني انقساماً واضحاً في أداء المحاور الاثني عشر إلى مستويين:

المستوى المتقدم (محاور الاستثمار البشري): ويتمثل في محوري "الصحة" و "المهارات". حافظ هذان المحوران على موقع صداري طوال الفترة، حيث بدآ بقيم تقارب 60.6 في عام 2007، وانتهيا بقيم تقارب 71.0 في عام 2020.

الدلالة: يعكس هذا المسار تركيزاً استراتيجياً مستمراً على تطوير رأس المال البشري كركيزة أساسية للتنافسية الوطنية.

المستوى الهيكلي (محاور الكفاءة الكلية): وتضم بقية المحاور (كالمؤسسات، النظام المالي، وديناميكية الأعمال). تميزت هذه المجموعة ببدء السلسلة من قيم أدنى (48.5) وتحركها بشكل متوازٍ تماماً، مما يشير إلى ترابط وثيق بين الإصلاحات المؤسسية والتقنية.

2. **ديناميكية التحسن والنمو المطرد**

تميزت الفترة 2007-2020 بنمط تحسن خطي ومستقر، حيث لم تسجل البيانات انكسارات حادة رغم التحديات الاقتصادية العالمية أو الإقليمية في تلك الفترة، هذا الصعود المنتظم يفسر عدم استقرارية السلاسل الزمنية في اختبارات ADF؛ فالبيانات تتبع "اتجاهاً حتمياً" نحو الأعلى، مما يعزز فرضية "التراكمية" في تطوير التنافسية المصرية.

3. **التفسير الاستنتاجي**

إن تقارب الخطوط العشرة في حزمة واحدة يثبت وجود تعددية خطية مرتفعة بين المتغيرات خلال هذه الفترة.

الأثر البحثي: هذا يفسر منطقياً سبب انخفاض المعنوية الإحصائية لبعض المتغيرات في نموذج الانحدار، حيث أن التحسن الجماعي والمتزامن للمحاور يجعل من الصعب إحصائياً عزل التأثير المستقل لمحور بعينه (مثل أثر "البنية التحتية" بمعزل عن "الحوكمة").

الجدول رقم (19): مصفوفة الارتباط لمتغيرات مؤشر تقرير التنافسية العالمي خلال الفترة الزمنية محل الدراسة 2007 حتى 2020

المتغيرات	معامل الارتباط	اتجاه العلاقة	قوة التاثير
جودة الاقتصاد	0.687-	عكسية قوية	تأثير جوهري
التعليم	0.442	عكسية قوية	تأثير مرتفع
الظروف المؤسسية	0.622-	عكسية متوسطة	تأثير ملحوظ
الحوكمة	0.227	عكسية متوسطة	تأثير متوسط
الصحة	0.522-	عكسية متوسطة	تأثير متوسط
بيئة الاستثمار	0.268	طردية	تأثير متوسط
الظروف المعيشية	0.481-	طردية	تأثير ضعيف
الأسواق والبنية التحتية	0.126	طردية	تأثير ضعيف
العوامل الطبيعية	0.593-	طردية	تأثير محدود
الحرية الشخصية	0.016	طردية	تأثير محدود
السلامة والامن	0.376	طردية	تأثير شبه منعدم
راس المال الاجتماعي	0.304	طردية	لا يوجد تأثير

المصدر: اعداد الباحثة اعتمادا على نتائج التحليل

أوضحت نتائج مصفوفة الارتباط وجود علاقات متباينة القوة والدلالة بين محاور التنافسية والترتيب العالمي لمصر وكانت كالتالي:

- **المؤشرات الاقتصادية الهيكلية:** حقق محور **"الجودة الاقتصادية"** أعلى معامل ارتباط عكسي بقيمة ($r = -0.687$)، يليه محور **"ظروف المشروعات"** ($r = -0.622$). إحصائياً، تشير هذه القيم إلى أن التحسن في الأداء الهيكلي للاقتصاد الكلي وبيئة الأعمال يعد المحرك الأساسي لتقدم مصر في تصنيفات التنافسية الدولية.
- **رأس المال البشري والبيئة:** أظهرت متغيرات **"الصحة"** ($r = -0.522$) و **"البيئة الطبيعية"** ($r = -0.593$) ارتباطاً متوسطاً، مما يؤكد أن الاستدامة البيئية والرفاهية الصحية تمثل ركائز مكملة للقوة الاقتصادية في النموذج المصري.

الخاتمة والتوصيات

الاستنتاجات العامة للتحليل

1. جميع المتغيرات مستقرة عند الفرق الأول فيما عدا متغير بيئة الاستثمار.
2. النموذج مستقر داخليًا إحصائيًا ويمكن الاعتماد على نتائجه.
3. توجد علاقات ذات اتجاه واحد من المؤشرات الاقتصادية والاجتماعية نحو ترتيب التنافسية.
4. الاستقرار الاقتصادي والمؤسسات يمثلان المحددَين الأساسيين لترتيب مصر في المؤشر العالمي.
5. التحسين في التعليم والصحة ينعكس إيجابيًا على التنافسية الكلية، بينما يظهر تأثير الابتكار تدريجيًا.
6. تفسير التغير في ترتيب مصر يعتمد بدرجة رئيسية على سياسات الاقتصاد الكلي وتحسين بيئة الأعمال.

النتائج الأساسية

1. الاستقرار الاقتصادي والمؤسسات كانا الأكثر تأثيرًا على ترتيب مصر في المدى القصير والطويل.
2. الصحة والتعليم أثّرا بشكل معنوي على تحسن ترتيب مصر خاصة بعد عام 2015.
3. الابتكار وكفاءة سوق العمل أظهرا تأثيرًا محدودًا لكنه متزايد في السنوات الأخيرة.
4. نموذج VAR أظهر أن التغيرات في المتغيرات الاقتصادية تفسّر أكثر من 70% من التغير في ترتيب مصر في المؤشر العالمي خلال فترة الدراسة.

المناقشة

تشير النتائج إلى أن التحسن في ترتيب مصر التنافسي لا يعتمد على عامل واحد بل على تفاعل مجموعة من المحددات، فبعد تطبيق برنامج الإصلاح الاقتصادي عام 2016، بدأت مصر تحقق تحسنًا نسبيًا في الاستقرار الكلي والحوكمة، لكن ما زالت تواجه تحديات في مجالات الابتكار، والتعليم التقني، وكفاءة سوق العمل، وهي العوامل التي تميز الدول ذات التنافسية العالية مثل سنغافورة وكوريا الجنوبية.

تؤكد النتائج على أهمية استمرارية الإصلاح المؤسسي، وزيادة الاستثمارات في التعليم والبحث العلمي، وتحسين بيئة الأعمال لجذب الاستثمارات الأجنبية.

النتائج والاستنتاجات

1. أثبتت الدراسة أن المتطلبات الاساسية متمثلة فى العوامل المؤسسية والاستقرار الاقتصادي والحوكمة وبيئة الاستثمار هى المحرك الأساسي لتحسين تنافسية مصر حيث كانت العلاقة قوية جداً وتأثرت بالمشاريع القومية للطرق والطاقة والاصلاح النقدي.
2. توجد علاقة متباينة بين الصحة والتعليم (رأس المال البشري) وبين التنافسية الكلية حيث ان الصحة محرك قوى للنجاح، بينما التعليم لا يزال يحتاج لسياسات تحسين.
3. بيئة الاستثمار والبنية التحتية لهما تأثير مباشر على ترتيب مصر في تقرير التنافسية العالمي.
4. ضعف مؤشرات تطوير الاعمال والابتكار حيث انها تعتبر فرص واعدة وتمثل حجر الزاوية لرؤية 2030 والتحول للاقتصاد المعرفي ما زال يمثل التحدي الأكبر أمام تحقيق تنافسية مستدامة.
5. لتحقيق تقدم ملموس، تحتاج مصر إلى دمج سياسات التنمية البشرية بالسياسات الاقتصادية ضمن رؤية وطنية شاملة.

التوصيات

أولًا: لصُنّاع القرار في مصر

تستهدف هذه المقترحات تحويل الأرقام الإحصائية إلى سياسات قابلة للتنفيذ:

1- الاستثمار النوعي في الاقتصاد الجزئي: بما أن "جودة الاقتصاد" و"بيئة المشروعات" كانت الأكثر ارتباطاً بالترتيب العالمي، يجب الانتقال من الإصلاحات المالية الكلية إلى تسهيل بيئة العمل المباشرة للمستثمرين والشركات الناشئة.

2- تعظيم العائد من رأس المال البشري: التوصية بإنشاء آليات لربط التفوق الملحوظ في مؤشري "الصحة" و"المهارات" بالإنتاجية الصناعية، لضمان انعكاس جودة الفرد على كفاءة الدولة التنافسية.

3- تبني سياسات "الإصلاح المتزامن": نظراً لتداخل المؤشرات، فإن أي خلل في محور واحد (مثل الحوكمة أو الوصول للأسواق) قد يعيق تقدم بقية المحاور. لذا يجب العمل على خطط تنمية متوازية لا تهمل الجوانب المؤسسية مقابل الجوانب التقنية.

ثانيًا: للباحثين والأكاديميين

تستهدف هذه النقاط سد الفجوات المنهجية التي واجهتنا في هذا البحث:

1- استخدام نماذج إحصائية متقدمة: يوصى الباحثين في الدراسات القادمة باستخدام نماذج VECM (Vector Error Correction Model) لمعالجة مشكلة عدم استقرار البيانات (Non-stationarity) التي ظهرت في اختبارات ADF.

2- معالجة التعددية الخطية: يُقترح استخدام تحليل المكونات الرئيسية (Principal Component Analysis – PCA) لتقليل أبعاد المحاور الاثني عشر ودمجها في متغيرات مركبة تتجاوز مشكلة تداخل البيانات.

3- الدراسات المقارنة: يوصى بإجراء دراسات مقارنة بين مصر ودول ذات ظروف اقتصادية مشابهة (Emerging Markets) للوقوف على مدى اختلاف تأثير هذه المحاور في بيئات إقليمية مختلفة.

4- التحليل الكيفي : إضافة جانب تحليلي (مثل المقابلات مع خبراء الاقتصاد) لفهم سبب ضعف ارتباط بعض المحاور (مثل الحرية الشخصية والوصول للأسواق) بالترتيب العالمي، وهو ما قد لا تظهره الأرقام وحدها.

مناقشة النتائج ومقارنتها بالدراسات السابقة

تمكن هذه الدراسة من تقديم تحليل قياسي متقدم يحدد العوامل الأساسية المحركة للتنافسية في مصر خلال الفترة الزمنية محل الدراسة. وتكشف النتائج عن عدة ظواهر مهمة:

- **الهيمنة الواضحة للعوامل المؤسسية والاقتصاد الكلي:**

أظهرت النتائج أن الاستقرار الاقتصادي وكفاءة المؤسسات يمثلان الدعامتين الأساسيتين لتحسين الترتيب التنافسي لمصر. وهذا يتسق مع الأساس النظري لمؤشرات التنافسية العالمية، والتي تضع البيئة الكلية والمؤسسية كشرط أساسي لتفعيل باقي المحركات. يمكن تفسير هذه الهيمنة في السياق المصري بالإصلاحات الهيكلية التي تبنتها مصر بعد 2016، والتي ركزت على استعادة الاستقرار النقدي والمالي، مما خلق أرضية صلبة لبدء التعافي. ومع ذلك، فإن استمرارية هذا الأثر تتطلب تعميق هذه الإصلاحات لمعالجة قضايا الفساد الإداري وتعزيز الشفافية، والتي لا تزال تمثل تحدياً أمام الكفاءة المؤسسية الكلية.

●طبيعة الأثر الزمني للمتغيرات الاجتماعية والابتكار:

تكمن أحد أهم الإضافات التحليلية لهذه الدراسة في تحديدها للآثار الزمنية المختلفة للمتغيرات. بينما كان أثر الصحة والتعليم معنويًا ومباشرًا نسبيًا، خاصة بعد عام 2015، فإن أثر الابتكار كان "تكامليًا تراكميًا" يظهر على المدى الطويل. هذا يفسر لماذا قد لا تظهر الدول النامية مثل مصر عوائد سريعة للاستثمار في الابتكار، حيث أن تأثيره مشروط بوجود نظام إيكولوجي متكامل (بحث علمي، تمويل، روابط صناعية) يحتاج وقتًا ليكتمل. هذا يبرر النتيجة التي تشير إلى محدودية تأثير الابتكار في المدى القصير، دون التقليل من أهميته الاستراتيجية.

توجد هناك علاقة بين المؤشرات الاقتصادية والاجتماعية والبنية التحتية تؤثر على ترتيب التنافسية ، "تحمل دلالة سياساتية بالغة الأهمية"، بمعنى أنها توفر توجيهاً عملياً واضحاً ومباشراً لصانعي القرار (الحكومة، الوزارات، المشرعين) حول كيفية استهداف السياسات بشكل فعال. حيث يمكن ان نقول "تحسن جودة التعليم يؤثر على تحسن الترتيب في التنافسية.

"التحسن في هذه العوامل هو شرط ضروري لتحسن ترتيب التنافسية":

الشرط الضروري: يعني أنك لا يمكنك أن تحقق تنافسية عالية ومستدامة من دون إصلاح **التعليم والصحة والبنية التحتية أولاً** بمعني أن الاستثمار في هذه المجالات هو الذي سيقود إلى التحسن في الترتيب، وهذه النتيجة توجه صانع القرار إلى:

- **ترتيب الأولويات:** يجب أن تكون الأولوية القصوى هي تحسين الأساسيات (المؤسسات، الاستقرار الاقتصادي، الصحة، التعليم) لأنها هي المحرك الأساسي.
- **تجنب السياسات الخاطئة:** تحذر من إهدار الموارد في محاولة تحسين "الترتيب" بشكل مباشر (مثل حملات العلاقات العامة لتحسين الصورة فقط) لأن ذلك سيكون عديم الجدوى إذا لم تتحسن الأساسيات أولاً على الأرض.
- **توقع النتائج:** تعطيهم ثقة بأن الأموال والجهود التي تُصرف في إصلاح التعليم والاستثمار في البنية التحتية ستؤدي حتمًا إلى تحسن في التنافسية على المدى المتوسط والطويل.
- **فهم طبيعة المشكلة:** توضح أن مشكلة التنافسية ليست مشكلة إحصائية يمكن حلها بالتلاعب بالأرقام، بل هي انعكاس لمشاكل هيكلية حقيقية في الاقتصاد والمجتمع تحتاج إلى معالجة من جذورها.

نخلص من ذلك الى ان "الدلالة السياساتية" تعني أن هذه النتيجة الإحصائية تترجم مباشرة إلى خارطة طريق عملية. هي ليست مجرد رقم أو علاقة نظرية في بحث أكاديمي، بل هي توجيه استراتيجي يخبر صانع القرار بأولويات ترتيب المتغيرات التى يجب العمل عليها اولاً :

تفسير القوة التفسيرية العالية للنموذج:

حقيقة أن النموذج يفسر أكثر من70% من التغير في ترتيب التنافسية يعزز مصداقية النتائج، ان النسبة المتبقية (30%) تشير إلى وجود عوامل نوعية وسياقية أخرى لم يشملها النموذج القياسي، مثل:

●العوامل الجيوسياسية والإقليمية وتأثيرها على تصورات المستثمرين.

والجيوسياسية (Geopolitics) هي كلمة مركبة من مقطعين "جيو": تعني الأرض أو الجغرافيا، "سياسية": تعني السياسة والجيوسياسية هي دراسة كيف تؤثر الجغرافيا متمثلة في (المكان، الموقع، الموارد) على السياسة والعلاقات بين الدول بعبارة أخرى هي الإجابة على سؤال "لماذا تتصرف الدول بشكل معين بناءً على موقعها الجغرافي ومواردها؟"، ان عناصر الجيوسياسية الرئيسية التي تؤثر على تنافسية الدولة كالتالي:

الموقع الاستراتيجي (قناة السويس - كونها جسر بين القارات)

الموارد الطبيعية (الغاز الطبيعي - النفط – المياه متمثلة في نهر النيل)
الجوار الجغرافي (العلاقات مع دول حوض النيل – الدول العربية – إسرائيل)
الممرات المائية السيطرة على مدخل البحر الأحمر (مضيق باب المندب)
الصراعات الإقليمية (الأزمة الليبية والسودانية - أزمة سد النهضة الإثيوبي)
فعندما أشرنا إلى أن 70% من التغير في التنافسية يُفسر بالمتغيرات الاقتصادية، فإن الـ 30% المتبقية قد تشمل عوامل مثل:

· **تأثير أزمة سد النهضة على الأمن المائي لمصر وبالتالي على استقرارها الزراعي والغذائي**
· **الاضطرابات في ليبيا والسودان وتأثيرها على أمن مصر الحدودي واستقرارها**
· **الموقع الاستراتيجي لقناة السويس وكيف يجذب استثمارات عالمية**
· **العلاقات مع دول الخليج وكيف تؤثر على الدعم الاقتصادي لمصر**

الخلاصة ان الجيوسياسية هي الرابط بين الجغرافيا والقوة السياسية والاقتصادية. لذلك، عندما نحلل تنافسية مصر لا يمكن فصل أدائها الاقتصادي عن موقعها الجيوسياسي وتفاعلاتها مع جيرانها والأحداث الإقليمية من حولها.

- **جودة القيادة السياسية ودرجة الاستقرار الاجتماعي، والتي يصعب قياسها كميًا.**
- **العوامل الثقافية المرتبطة بالإنتاجية وثقافة العمل.**

مقارنة نقدية مع الأدبيات السابقة

أوجه التوافق:

تتفق هذه الدراسة بشكل كبير مع الإطار النظري الذي وضعه Porter (1990) حول أن بيئة الأعمال المحلية هي كل العوامل والمؤسسات والسياسات المحيطة بالشركات والتي تؤثر على قدرتها على العمل، والنمو، والمنافسة وتشمل:

1. **الجوانب المؤسسية:** كفاءة الجهاز الحكومي، وجودة القوانين، ومكافحة الفساد، وسهولة بدء الأعمال.
2. **الجوانب الاقتصادية:** استقرار العملة، ومعدلات التضخم، والضرائب، والبنية التحتية متمثلة في (طرق، كهرباء، إنترنت).
3. **جوانب السوق:** حجم السوق المحلي، ودرجة المنافسة، وتوفر المستهلكين المطلعين.
4. **جوانب الموارد البشرية:** جودة التعليم، وتوفر العمالة الماهرة، وصحة القوى العاملة وهي حجر الزاوية للتنافسية حيث أن مايكل بورتر يؤكد أن قدرة الشركات على المنافسة عالمياً لا تبدأ في السوق العالمية، ولكن تَنْمُو من بيئة أعمال محلية قوية ومحفِّزة وهذا يتطابق تماماً مع نتائج البحث التي وجدت أن تحسن ترتيب مصر مرهون بتحسين البيئة المحلية (المؤسسات، الاستقرار الاقتصادي، البنية التحتية) أولاً كما تدعم نتائجها ما ذهب إليه Adegüzel (2019) حول الطبيعة التراكمية لأثر الابتكار وهو ما يفسر تأخر ظهور تأثيره في الاقتصادات الناشئة على المستوى الإقليمي، كما تؤكد الدراسة بشكل كامل استنتاجات الخطيب (2021) وبربري (2022)، مما يعزز وجود إجماع حول محددات التنافسية في السياق العربي، والتي تتركز في الاقتصاد الكلي والبنية التحتية.

أوجه التمايز والإضافة:

تضيف هذه الدراسة بعدًا كميًا دقيقًا من خلال استخدام نموذج VAR واختبارات السببية، مما يمنح وزناً نسبياً واتجاهياً للعلاقات كان غائبًا في العديد من الدراسات السابقة الوصفية فعلى سبيل المثال بينما تذكر الأدبيات أهمية جميع العوامل للتنافسية العالمية فإن هذه الدراسة تحدد بدقة أن المؤسسات والاستقرار الاقتصادي هما المحرك الأساسي في السياق المصري الحالي، كما أن الدراسة تقدم تفسيرًا

عمليًا للفجوة بين مصر والدول المتقدمة (مثل سنغافورة) من خلال تحليل الصدمات، مشيرة إلى أن هذه الفجوة تكمن تحديدًا في مرونة وكفاءة سوق العمل ومنظومة الابتكار.

الاستنتاجات المطورة

1. **استنتاج قياسي رئيسي:** أثبت التحليل القياسي أن نموذج VAR مستقر، وأن العلاقات السببية أحادية الاتجاه من المتغيرات الأساسية نحو التنافسية مما يعطي مؤشرات قوية لصانعي السياسات.
2. **تسلسل الأولويات:** تقدم الدراسة تسلسلاً هرميًا لأولويات التنافسية في مصر فتأتي الإصلاحات المؤسسية واستقرار الاقتصاد الكلي في القمة، يليها الاستثمار في رأس المال البشري (الصحة والتعليم)، ثم العمل على بناء منظومة الابتكار التي تحقق عوائدها على المدى الطويل.
3. **رؤية تكاملية:** خلاصة البحث تؤكد أن نجاح أي سياسة تنافسية في مصر مرهون بتبني نموذج تكاملي، حيث تعزز السياسات المؤسسية والاقتصادية السياسات الاجتماعية والتعليمية، وتخلق معًا الطلب المحلي على الابتكار، مما يضمن استدامة التحسن في الترتيب التنافسي.
4. **التحدي المستقبلي:** التحدي الأبرز الذي تواجهه مصر لا يتمثل في تحسين المؤشرات الإحصائية فحسب، بل في تحويل هذه التحسينات إلى تنافسية حقيقية على الأرض، من خلال تحسين الإنتاجية وخلق قيمة مضافة في السلع والخدمات المصرية.

الخاتمة والتوصيات

الخاتمة

تمثل هذه الدراسة محاولة لتفكيك الديناميكيات المعقدة التي تحكم التنافسية الوطنية في الحالة المصرية. ومن خلال القراءات الإحصائية للفترة (2007-2020)، يمكن صياغة الاستنتاجات النهائية في النقاط التالية:

- **أولوية رأس المال البشري:** أثبتت البيانات أن الاستثمار في الصحة والمهارات ليس مجرد ضرورة اجتماعية، بل هو المحور الأكثر استقراراً وتقدماً في منظومة التنافسية المصرية، مما يجعله حجر الزاوية لأي رؤية مستقبلية.
- **مركزية الإصلاح الاقتصادي:** أظهرت مصفوفة الارتباط أن تحسين الترتيب العالمي لمصر يرتبط بشكل عضوي بجودة البيئة الاقتصادية وظروف الاستثمار، مما يستوجب الاستمرار في تذليل العقبات أمام قطاع الأعمال.
- **التكامل الهيكلي:** كشف البحث أن محاور التنافسية في مصر تتحرك ككتلة واحدة متكاملة (بسبب التعددية الخطية)، مما يعني أن أي قصور في جانب "الحوكمة" أو "الوصول للأسواق" قد يحد من العوائد المتوقعة من النجاحات المحققة في الجوانب الأخرى.
- **التوصية الختامية:** توصي الدراسة بضرورة الانتقال من "النمو الكمي" في المؤشرات إلى "الكفاءة النوعية"، مع التركيز على معالجة فجوات استقرار السلاسل الزمنية لضمان استدامة المركز التنافسي لمصر في التقارير الدولية القادمة.

التوصيات

أولاً: لصُنَّاع القرار في مصر

1. تعزيز كفاءة المؤسسات الحكومية وتبسيط الإجراءات الإدارية.
2. زيادة الإنفاق على التعليم الفني والبحث العلمي وربطهما باحتياجات سوق العمل.
3. دعم برامج الابتكار وريادة الأعمال خاصة في القطاعات التكنولوجية الناشئة.
4. تطوير البنية التحتية الشاملة (الرقمية واللوجستية) وتعزيز الشراكات بين القطاعين العام والخاص.
5. تحسين البيئة التشريعية لجذب الاستثمارات وزيادة الشفافية ومكافحة الفساد.

ثانياً: للباحثين والأكاديميين

1. التوسع في الدراسات المقارنة بين مصر والدول العربية والناشئة في مجال التنافسية.
2. استخدام نماذج قياسية متقدمة (مثل VECM, ARDL) لتحليل محددات التنافسية على فترات زمنية مختلفة.
3. تحليل الأثر غير المباشر للمؤشرات الاجتماعية (كالصحة والمساواة) على التنافسية الشاملة.
4. المساهمة في إنشاء قاعدة بيانات عربية موحدة لمؤشرات التنافسية والتنمية المستدامة.

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