

The impact of business cycles on economic growth in North African countries: dynamic panel data

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This study examines how business cycles impact economic growth in African countries using dynamic panel data analysis with the Generalized Method of Moments (GMM). The research utilizes comprehensive World Bank data spanning from 1990 to 2022, focusing on key economic factors such as inflation, foreign direct investment (FDI), exchange rates, and the far-reaching effects of the COVID-19 pandemic. The analysis reveals that both business cycles and economic growth have a positive influence on GDP per capita, though the impacts differ significantly across various regions of Africa. Inflation and COVID-19 emerge as significant variables contributing to economic fluctuations, emphasizing their disruptive effects on long-term growth patterns. Additionally, the study highlights how regional disparities and external shocks, including pandemics, have distinct consequences for economic resilience. The findings provide crucial insights for policymakers aiming to stabilize economies during periods of heightened volatility and uncertainty, promoting sustainable growth in the process. By deepening the understanding of how business cycles and economic growth are interconnected, governments across Africa can implement more effective strategies to mitigate the adverse effects of economic downturns while capitalizing on opportunities for growth. Ultimately, this research underlines the importance of considering external shocks in developing long-term economic policies.

Keywords: business cycles, economic growth, dynamic panel data, Africa.

JEL codes: O490, O550, E300.

Влияние бизнес-циклов на экономический рост в странах Северной Африки: динамика групповых данных

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В исследовании рассматривается влияние бизнес-циклов на экономический рост в африканских странах на основе анализа динамики групповых данных с использованием обобщенного метода моментов (GMM). В работе применяются данные Всемирного банка, охватывающие период с 1990 по 2022 г., акцентируясь на ключевых экономических факторах, таких как инфляция, прямые иностранные инвестиции (ПИИ), обменные курсы и долговременные последствия пандемии COVID-19. Анализ показывает, что как бизнес-циклы, так и экономический рост оказывают положительное влияние на ВВП на душу населения, хотя последствия значительно различаются в различных регионах Африки. Инфляция и COVID-19 становятся значимыми переменными, способствующими экономическим колебаниям, подчеркивая их разрушительное влияние на долгосрочные модели роста. Кроме того, в исследовании подчеркивается, что региональные различия и внешние шоки, включая пандемии, имеют определенные последствия для экономической устойчивости. Полученные результаты дают важные выводы для политиков, стремящихся стабилизировать экономику в периоды повышенной волатильности и неопределенности, способствуя устойчивому росту в этом процессе. Углубляя понимание того, как бизнес-циклы и экономический рост взаимосвязаны, правительства по всей Африке могут осуществлять более эффективные стратегии для смягчения негативных последствий экономических спадов, используя при этом возможности для роста. Как результат, исследование подчеркивает важность учета внешних потрясений при разработке долгосрочной экономической политики.

***Ключевые слова:** бизнес-циклы, экономический рост, динамика групповых данных, Африка.*

Introduction

The business cycle, characterized by fluctuations in economic activity, plays a significant role in economic growth and development [29, p. 45]. Understanding this relationship is particularly relevant for African countries, which face diverse economic conditions and are susceptible to external shocks, such as the COVID-19 pandemic [24]. This study seeks to explore how business cycles impact economic growth across African nations using a dynamic panel data approach, specifically the Generalized Method of Moments (GMM). The GMM methodology allows for capturing the complex interplay of

economic factors over time while controlling for reverse causality and omitted variable biases, providing a more accurate analysis of these relationships [8].

This research contributes to the literature by examining the influence of real shocks, especially technological innovations, on economic fluctuations in Africa. Insights from this study may inform policies aimed at enhancing economic resilience and promoting collaborative growth across the continent [20].

The *main objective of this study* is to analyze the relationship between business cycles and economic growth in African countries. The study examines how various phases of the business cycle correlate with growth and identifies key drivers, such as inflation and foreign direct investment (FDI), that impact economic performance. Additionally, it considers the influence of external shocks, particularly the COVID-19 pandemic, on economic fluctuations in the region.

Literature Review

Research underscores the existence of a global business cycle, with regional and developmental group cycles also playing an influential role [12]. Political strategies are highlighted as crucial in creating environments conducive to business model innovation, emphasizing the balance between sector-specific and broad economic policies [35]. Globalization has further intensified economic interdependence, increasing the likelihood of recessionary phase transmission as countries synchronize with the global economy [15].

In Africa, research points to a nuanced relationship between economic growth, unemployment, and poverty. Studies in South Africa reveal that while growth can reduce poverty in the long run, unemployment tends to exacerbate it [31]. The COVID-19 pandemic has also had profound impacts on corporate solvency and poverty, introducing unique challenges related to the scope and scale of economic adjustments [7].

Interest rates significantly influence economic fluctuations in Nigeria, exhibiting countercyclical behavior in comparison to trends seen in other emerging and developed

economies [10]. Studies also highlight the constraints that limited financial deepening imposes on monetary policy effectiveness in sub-Saharan Africa, advocating for policies that promote financial infrastructure development [32].

FDI and trade openness are recognized as contributors to long-term growth in various economies, although these benefits can be disrupted during financial crises [21]. Additionally, the relationship between oil prices, terms of trade, and economic cycles reveals that political and economic policies in African countries interact with global market trends in complex ways [6].

Monetary policy transmission mechanisms remain under-researched in Africa, with questions remaining about their efficacy in influencing key economic variables [23]. The role of external shocks on African economies, including the 2008 global financial crisis, the 2013 commodity price collapse, the COVID-19 pandemic, and the ongoing war in Ukraine, has highlighted the vulnerability of the continent to global economic conditions [22]. Despite resilience in some African nations, the uneven recovery from these shocks underscores the need for robust economic policies tailored to the African context.

A historical perspective on African economies reveals that sub-Saharan Africa has faced persistent economic challenges, often limited by episodes of negative growth despite improvements in GDP per capita [13]. Studies suggest that countries with aging populations tend to experience lower consumption and investment volatility, although output volatility may increase due to shifts in labor market dynamics [17].

In terms of macroeconomic policy, evidence suggests that supply-side models better explain economic changes in developing countries, contrasting with the approaches used in industrialized nations [33]. Moreover, the COVID-19 pandemic's impact on agricultural production and food insecurity in Africa has exacerbated vulnerabilities within the sector, particularly for poorer populations [9].

GDP is commonly used as an indicator of economic health, reflecting the value of goods and services produced within a country [38]. It includes components like

government consumption, investment, and net exports, all of which contribute to overall economic growth.

Exchange rates can influence GDP growth by affecting export competitiveness and economic stability. Studies indicate that in Nigeria, exchange rate volatility negatively impacts growth, underscoring the need for policies to stabilize currency fluctuations [10].

FDI plays a vital role in economic growth by supporting capital accumulation and technological advancement. However, its impact varies by country; in Nigeria and Morocco, factors like trade balance and the real exchange rate affect FDI's ability to drive growth [28].

Inflation has a nuanced relationship with growth. While moderate inflation can stimulate growth, high inflation generally hinders it. Studies suggest that inflation thresholds like 4% in South Africa can signal when inflation transitions from being growth-promoting to growth-reducing [14].

International reserves provide a buffer against external shocks, promoting exchange rate stability and supporting economic resilience. Research highlights the positive role of reserves in maintaining stability in countries like Algeria and Kenya [30].

Labor Force A skilled and growing labor force contributes to productivity and economic expansion. The composition and educational levels within the labor force are critical factors in South Africa and Nigeria's economic growth [34].

The COVID-19 pandemic disrupted African economies, affecting healthcare, food security, and overall economic resilience. Research stresses the importance of considering socio-economic factors like population density and healthcare infrastructure when analyzing the pandemic's impact [1].

The Ground Theory of Real Business cycle

The Real Business Cycle (RBC) theory, pioneered by Kydland and Prescott in 1982, posits that economic fluctuations are primarily driven by real shocks, especially technological changes that impact productivity. This theory assumes that individuals and

firms respond rationally to these shocks, making optimal decisions to maximize utility, even during economic downturns. RBC theory downplays the role of monetary factors, instead focusing on productivity growth as the principal driver of business cycles. The model typically excludes the government and external sectors, emphasizing the behaviors of households and firms as fundamental to understanding economic fluctuations [19, 25, 26]. Let's consider an economy with numerous identical firms and households, where firms accept prices as given. Production relies on two inputs: capital (K) and labor (L). Technology is considered exogenous and represented by A_t for each time period 't'. Additionally, let's assume the production function follows the Cobb-Douglas form.

Thus, output in period t is

$$Y_t = A_t F(K_t + L_t) = K_t^\alpha (A_t L_t)^{1-\alpha} \quad (2.1)$$

Where $0 < \alpha < 1$

It is recognized that the total output is allocated among consumption (C), investment (I), and government purchases (G). If δ represents the depreciation rate of capital in each period, the capital stock in period $(t + 1)$ can be expressed as:

$$K_{t+1} = K_t + I_t - \delta K_t = K_t + Y_t - C_t - G_t - \delta K_t \quad (2.2)$$

(since $C_t + I_t + G_t = Y_t$; we have $I_t = Y_t - C_t - G_t$)

Let's assume that labor and capital receive payments equivalent to their marginal products. Consequently, the real wage and the real interest rate in period 't' can be described as:

$$W_t = (1 - \alpha) A_t K_t^\alpha (A_t L_t)^{-\alpha} = (1 - \alpha) A_t (K_t / A_t L_t)^{-\alpha} \quad (2.3)$$

and

$$r_t = \alpha (A_t L_t / K_t)^{-\alpha} \quad (2.4)$$

(we can derive equation (2.3) and equation (2.4) from equation (2.1) by taking partial derivatives with respect to L and K respectively)

The representative household maximizes the expected value of the utility function. In the context of a hypothetical economy, a typical household aims to optimize its well-being by maximizing the utility function provided below:

$$U = \sum_{t=0}^{\infty} e^{-\rho t} u \left(C_t, 1 - l_t \right) \frac{N_t}{H} \quad (2.5)$$

The discount rate, denoted by ρ , reflects the preference for present utility over future utility. In this context, where $u(\bullet)$ represents the instantaneous utility function, N subscript t refers to the population, and H represents the number of households, the average household size can be calculated as N_t divided by H . Additionally, if the population experiences an exogenous growth rate of n , this implies that the population is increasing at a fixed rate over time.

$$\ln N_t = \bar{N} + nt, \quad (2.6)$$

Where $n < \rho$

Thus, the level of N_t is given by $N_t = e^{\bar{N} + nt}$

In equation (2.5), the utility function $u(\bullet)$ consists of two components: (i) the consumption per household member (C_t), and (ii) the leisure per household member (L_t). Leisure is defined as the disparity between the time allocated per member (normalized to 1 for convenience) and the individual's work hours. Given the homogeneity of all households, the total consumption C is divided equally among the population N , yielding $c = C/N$ and $l = L/N$

Before delving into other aspects, let's address the assumption regarding technology shocks. In order to account for trend growth, we adopt a specific functional form for technology, which is as follows:

$$\ln A_t = \bar{A} + gt \quad (2.7)$$

The specified technology in the previous form does not incorporate random fluctuations. To integrate random disturbances into technology, we propose the following modified functional form:

$$\ln A_t = \bar{A} + gt + \widetilde{A}_t \quad (2.8)$$

Where \bar{A} is the random disturbances. The term \widetilde{A}_t follows first- order autoregressive process. That is:

$$\widetilde{A}_t = \rho_A \widetilde{A}_{t-1} + \varepsilon_{A,t} \quad -1 < \rho_A < 1 \quad (2.9)$$

In this framework, $\varepsilon_{A,t}$ represents a stochastic error term (white noise). It means that $\varepsilon_{A,t}$ has zero mean and no correlation with other variables in the equation. Equation (2.9) illustrates that the random component \widetilde{A}_t comprises a portion ρ_A of the preceding period's value and a white noise error. Consequently, the impact of a technological shock diminishes gradually over time.

Government purchases follow a trend component with white noise, allowing for significant variations over time, potentially growing or shrinking relative to the overall economy.

$$\ln G_t = \bar{G} + (n + g)t + \widetilde{G}_t, \quad -1 < \rho_A < 1, \quad (2.10)$$

$$\widetilde{G}_t = \rho_G \overline{G}_{t-1} + \varepsilon_{G,t}, \quad -1 < \rho_A < 1, \quad (2.11)$$

Where the $\varepsilon_{G,t}$ is white noise. This completes the description of the RBC model.

Inter-Temporal Substitution in Labor Supply

As highlighted in the preceding section, significant distinctions between the Real Business Cycle (RBC) model and the Ramsey model encompass: (i) the incorporation of leisure within the utility function, and (ii) the incorporation of stochastic elements in technology and government expenditures, serving as the origins of macroeconomic aggregate fluctuations.

Let's narrow our attention to integrating leisure into the utility function. For simplicity, let's consider a scenario where the household exists for only one period and comprises a single member with no initial wealth. In this case, the household's objective function becomes $\ln(c) + b \ln(1 - l)$, while its budget constraint remains $c = wl$, where c denotes consumption, l represents leisure, and w stands for the wage rate. Thus, the Lagrangian maximization problem can be expressed as:

$$\zeta = \ln c + b \ln(1 - l) + \lambda(wl - c) \quad (2.12)$$

The first- order conditions for c and l are as follows:

$$\frac{1}{c} - \lambda = 0, \quad (2.13)$$

$$-\frac{b}{1-l} + \lambda w = 0, \quad (2.14)$$

From equations (2.13), we find that $\lambda = \frac{1}{c} = \frac{1}{wl}$ (since $c = wl$ as per the budget constraint).

Now, substituting the value of λ in equation (2.14), we obtain:

$$-\frac{b}{1-l} + \frac{1}{wl}w = 0$$

That is,

$$-\frac{b}{1-l} + \frac{1}{l} = 0 \quad (2.15)$$

In the scenario described, the labor supply determined by equation (2.15) remains unaffected by changes in the wage rate, as the wage rate is not explicitly included in the equation. The logarithmic utility in consumption and lack of initial wealth means that any income effect from wage changes is offset by the substitution effect, leading to a static outcome. Extending the household's lifespan to two periods allows wage rate changes to impact labor supply, assuming no uncertainty in future interest or wage rates.

The household's lifetime budget constraint is now:

$$c_1 + \frac{1}{1+r}c_2 = w_1l_1 = \frac{1}{1+r}w_2l_2 \quad (2.16)$$

Where r is the real interest rate. The lagrangian maximization problem is:

$$\zeta = lnc_1 + bln(1-l_1) + e^{-\rho}[lnc_2 + bln(1-l_2)] + \lambda \left[w_1l_1 + \frac{1}{1+r}w_2l_2 - c_1 - \frac{1}{1+r}c_2 \right] \quad (2.17)$$

In equation (2.17), the household's decision variables consist of consumption in period 1 (c_1), consumption in period 2 (c_2), leisure in period 1 (l_1), and leisure in period 2 (l_2). Our objective is to demonstrate how the relative labor supply responds to changes in the relative wage between the two periods. Therefore, we must derive the first-order conditions for l_1 and l_2 from equation (2.17). These conditions can be expressed as follows:

$$\frac{b}{1-l_1} = \lambda w_1 \quad (2.18)$$

$$\frac{e^{-\rho} b}{1 - l_2} = \frac{1}{1 + r} \lambda w_2 \quad (2.19)$$

In order to simplify the above two equations, we divide both sides of (2.18) by w_1 and both sides of (2.19) by $w_2/(1+r)$. Thus, we obtain:

$$\frac{b}{1 - l_1} \frac{1}{w_1} = \lambda \text{ and } \frac{e^{-\rho} b}{1 - l_2} \frac{1 + r}{w_2} = \lambda \quad (2.20)$$

$$\text{Now, } \frac{e^{-\rho} b}{1 - l_2} \frac{1 + r}{w_2} = \frac{b}{1 - l_1} \frac{1}{w_1}$$

The relative labor supply in the two periods is:

$$\frac{1 - l_1}{1 - l_2} = \frac{b}{e^{-\rho} b (1 - r)} \frac{w_2}{w_1} = \frac{1}{e^{-\rho(1-r)}} \frac{w_2}{w_1} \quad (2.21)$$

In the case of a two-period scenario, the wage rate becomes a factor in the labor supply function. Equation (2.21) establishes a relationship between the relative labor supply and the relative wage. It's important to note that $(1 - l_1)$ denotes the portion of leisure released by the household in the first period. If the wage rate in the first period (w_1) increases compared to the second period (w_2), then l_1 must increase or $(1 - l_1)$ must decrease to satisfy equation (2.21). This implies that when the wage rate rises in the first period relative to the second period, labor supply must increase in the first period relative to the second period, or leisure must decrease in the first period relative to the second period.

The elasticity of substitution between leisure in the two time periods is 1, owing to its logarithmic functional form. Now, considering a rise in the interest rate (r) in equation (2.21), it signifies an increase in labor supply in the first period relative to the second period. An increase in the interest rate in the first period heightens the incentive to work more (thus, earn more and save more) in the first period compared to the second period.

This observation underscores the significance of the interest rate's impact on fluctuations in employment within an economy. The effects of relative wage and interest rate on labor supply (or employment or leisure) are recognized as intertemporal substitution in labor supply.

Let's consider the impact of productivity shocks, also known as technology shocks, within our RBC model, as discussed previously. Assume there exists an exogenous and temporary favorable shock to technology in a particular time period (t). This is represented in our model by an increase in the A_t term, as described in equation (2.1). Let's denote the initial level of technology as A_{0t} , which rises to A_{1t} due to the shock. This increase in technology will lead to a rise in income Y_t at given levels of capital K_t and labor L_t .

Initially, at the technology level A_{0t} , the corresponding production function is given $K_t^\alpha (A_{1t} L_t)^{1-\alpha}$. Let's assume that L_0 represents the optimal amount of labor at this technology level, and the equilibrium output is Y_0 . The beneficial productivity shock shifts the production function upward to $K_t^\alpha (A_{1t} L_t)^{1-\alpha}$. Additionally, the shock is assumed to make the production function steeper for any level of labor input. In microeconomics, the slope of the production function represents the marginal product of labor. Therefore, the positive technology shock also increases marginal productivity. Consequently, at the same level of labor input (L_0), we observe higher output Y_1^i due to the increased productivity. This indicates that the favorable shock alters the production possibilities as well. If we increase the labor input to L_1 , the corresponding higher output is Y_1 due to the increased productivity.

A technology shock increases output, which can be distributed between consumption and savings. In cases of temporary shocks, it may be beneficial to save part of the increased output for future consumption. According to Equation (2.2), higher savings lead to increased investment, which subsequently raises the capital stock in future periods. In contrast, a permanent shock leads to sustained higher output, reducing the incentive to save and increasing consumption, with a more moderate rise in labor input. Although technology shocks yield persistent effects on output, capital, and employment,

Keynesian economists critique the Real Business Cycle (RBC) model for not fully explaining this persistence. However, RBC proponents argue that the dynamic responses of optimizing agents to changing economic conditions account for extended periods of high or low economic activity.

$$Y_t = A_t F(K_t, N_t, FDI_t, ER_t, IMP_t, EXP_t, INTR_t) \quad (2.22)$$

Where K_t represents capital at time t , N_t represents labour force at time t , FDI_t represents foreign direct investment at time t , ER_t represents exchange rate at time t , IMP_t represents imports at time t , EXP_t represents exports at time t , and RES_t represents international reserves at time t ,

In the given equation, A_t represents a stochastic productivity shock factor, which accounts for fluctuations in total output that cannot be attributed to the inputs utilized in the production process. On the other hand, X_t signifies the deterministic component of productivity, which experiences steady expansion at a constant rate over time.

$$X_{t-1} = \gamma X_t, \gamma > 1 \quad (2.23)$$

The capital stock K_t undergoes changes over time and experiences depreciation at a constant rate represented by δ . This depreciation rate signifies the portion of capital that diminishes over time due to wear and tear or obsolescence. It essentially reflects the definition of investment, as it accounts for the need to replace the depreciated capital to maintain or expand the productive capacity of the economy:

$$K_{t+1} = I_t(1 - \delta)K_t \quad (2.24)$$

The resource constraints ensure that the total output (GDP) is allocated between consumption (C) and investment (I). This means that the total output produced in the

economy can be utilized for either consumption (C_t) or investment (I_t) purposes. Therefore, the following resource constraint on the economy is expressed as:

$$Y_t = C_t + I_t \quad (2.25)$$

To achieve the desired steady-state transformation of the economy, it becomes necessary to introduce an assumption into the utility function. This assumption aims to ensure that the utility function aligns with the conditions required for stability. The utility function is then structured according to the formulation proposed by [30].

$$u(C_t, L_t) = \frac{1}{1 - \sigma} C_t^{1 - \sigma} V(L_t) \quad (2.26)$$

The provided equation accounts for both the income and substitutability effects resulting from changes in wages due to shifts in supply. This adjustment facilitates the economic transformation by ensuring that all variables are measured in efficiency units, achieved through scaling them with the initial level of the deterministic component. Consequently, the transformed utility function is expressed accordingly:

$$\sum_{i=0}^{\infty} (\beta^*)^i u(C_t, L_t) \quad (2.27)$$

The modified discount factor, $\beta^* = b\gamma^{1 - \sigma}$ is introduced to ensure compliance with the condition $0 < \beta < 1$. Subsequently, the transformed utility function is optimized while adhering to the given resource constraints.

$$\text{Labor: } N_t = 1 - L_t \quad (2.28)$$

$$\text{The production function: } Y_t = A_t F(K_t, N_t) \quad (2.29)$$

$$\text{The Resource constraint: } Y_t = C_t + I_t \quad (2.30)$$

$$\text{The law of Motion of capital: } \gamma K_{t-1} = I_t(1 - \delta)K_t \quad (2.31)$$

To derive the optimal paths for consumption, C_t , leisure, L_t , labor, and K_t , capital stock the transformed utility function is constrained accordingly. This process involves employing the Lagrangian multiplier approach to incorporate the relevant constraints.

$$L \sum_{t=0}^{\infty} (\beta^*)^t U(C_t, L_t) + \sum_{t=0}^{\infty} (\beta^*)^t \lambda_t (A_t F(K_t, N_t) + (1 - \delta)K_t - C_t - \gamma K_{t+1}) + \sum_{t=0}^{\infty} \beta^t \omega_t (1 - L_t - N_t) \quad (2.32)$$

First-Order Conditions: Derive first-order conditions that represent the optimal decisions of economic agents, taking into account the utility maximization and resource constraints.

$$C_t: D_1 U(C_t, L_t) = \lambda_t$$

$$L_t: D_2 U(C_t, L_t) = \omega_t$$

$$N_t: \lambda_t A_t D_2 F(K_t, N_t) = \omega_t$$

$$K_{t+1}: \beta \lambda_{t+1} [A_{t+1} D_1 F(K_{t+1}, N_{t+1}) + 1 - \delta] = \gamma \lambda_t$$

The notation $D_i U(C, L)$ represents the partial derivative of the function $U(C_t, L_t)$ with respect to the i^{th} term. Consumption, labor, and capital are treated as independent variables across different time periods, and the optimal decisions are made while accounting for the resource constraint of the economy.

$$Y_t = A_t F(K_t, N_t, FDI_t, ER_t, INF_t, INTR_t, LF_t, COVID_t) \quad (2.33)$$

$$Y_t = A_t F(K_t, N_t) X_t$$

$$Y_t = A_t F(K_t, N_t)$$

Where:

Y_t represents Gross Domestic Product (GDP).

A_t represents a measure of total factor productivity (TFP) or a productivity shock factor.

$F(K_t, N_t)$ represents the production function, indicating the relationship between capital (K) and labor (N) inputs.

K_t represents the capital stock.

N_t represents the labor force

X_t could represent any additional factors affecting productivity or output in the study model.

To incorporate independent variables:

Foreign Direct Investment (FDI) could influence the capital stock (K_t).

Exchange Rate (ER) might affect the productivity factor (N_t).

Inflation (INF) could influence both labor (by affecting real wages) and capital (by affecting investment decisions).

International Reserves (RES) might influence investment decisions and thus impact the capital stock (K_t).

Labor Force (LF) is directly incorporated as N_t .

COVID-19 Severity (COVID) may influence all aspects of economic activity and could be included as a shock factor (A_t).

Methodology

This study utilizes a dataset provided by the World Bank, covering five North African countries Algeria, Morocco, Egypt, Tunisia, and Libya over the period from 1990 to 2022.

A dynamic panel data analysis approach is employed, using the Generalized Method of Moments (GMM). GMM is well-suited for handling the endogeneity of variables and capturing the dynamic nature of economic growth over time [11]. The two-stage system GMM estimator was used after testing through OLS and LSDV estimation

procedures, which revealed biases. The Sargan test and Arellano-Bond test were applied to validate the model's robustness and ensure consistency.

Research

As show in the fig. 1 below as conceptual framework examines how labor forces, foreign direct investment (FDI), international reserves, and inflation rate influence the real GDP growth rate of African countries, while using the COVID-19 pandemic as a control variable to analyze its impact on economic performance.

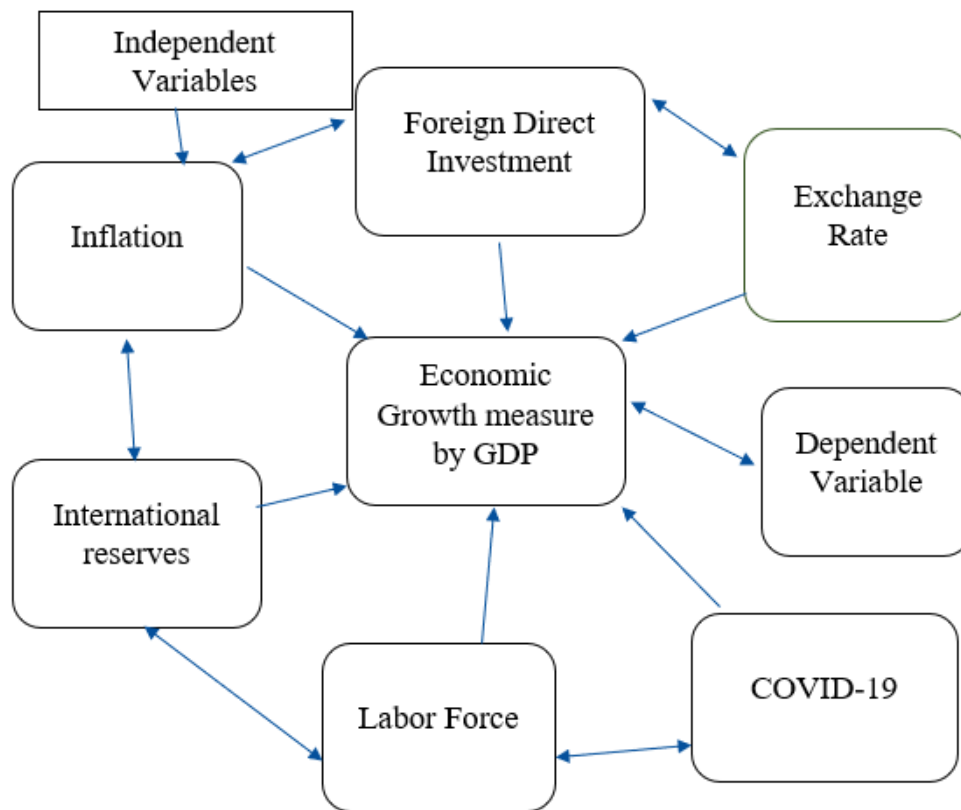


Fig. 1. Conceptual Framework.
 Source: compiled by the authors based on [18].

Analysis of North Africa Region

Table 1

Sargen Test for instrument validity of North Africa

Test Statistic: chi2(15)	14,87011
p-value: Prob > chi2	0,4608

Source: compiled by the authors based on [37].

As show in tab. 1, the results of the chi-squared test provide valuable insights into the overall fit of the model being evaluated. The test statistic of $\chi^2(15)=14,87011$ suggests that, while the model has a certain level of complexity with 15 degrees of freedom, the value of the test statistic is not significantly high. A p-value of more than 0,05 an indication that there is no adequate reason to infer that the model does not fit the data. This suggest that the indicated relations between the variables should provide a reasonably accurate account of the data patterns without much distortion. The results of the chi-squared tests indicate that the model is reasonably appropriate to the data collected and thus further investigation of its potential as a predictor and its potential theoretical applications should be pursued.

Table 2

Arellano–Bond test results for autocorrelation for North Africa

Order	Z	Prob > z
1	-1,7949	0,0727
2	-0,3795	0,7043

Source: compiled by the authors based on [37].

As show in tab. 2, the Arellano–Bond test results reveal potential first-order autocorrelation, with a z statistic of $-1,795$ and a p-value of 0,07, indicating a marginally significant issue that warrants further review. However, the second-order autocorrelation test, with a z statistic of $-0,38$ and a p-value of 0,704, suggests no significant autocorrelation at this level, supporting the model’s robustness at higher orders. Overall, while first-order autocorrelation may require attention, the model’s error structure appears reliable at second-order levels.

Table 3

Comparison of Fixed Effects, First-Differenced GMM, System GMM, and Pooled Least Squares Models for Log GDP Determinants

Variables	FEM	FDGMM	SYSGMM	PLS
GDP L1	0,82521272	0,82625986	0,92909724	0,9423215
Exchange rate	-1,681e+08	-1,795e+08	1756684,4	-254523,32
Foreign direct investment	1,4206548	1,4258215	2,483866	2,5357906
Inflation	-3,166e+08	-3,117e+08	-2,758e+08	2,445e+08
International Reserve	0,08664086	0,08565983	0,05272399	0,04382634
Labor force	4192,1566	4192,9527	1020,9731	566,11195
Covid	9,143e+09	9,303e+09	9,703e+09	7,136e+09
Constant (cons)	-2,330e+10	-2,316e+10	-4,698e+09	9,362e+08

Source: compiled by the authors based on [37].

As show in tab. 3, the study finds that GDP L1 demonstrates stability across all models, with significant positive coefficients in SYSGMM, FDGMM, FEM, and PLS. Foreign Direct Investment (FDI) shows similar stability, particularly in the FDGMM model, which aligns closely with FEM and PLS. Labor Force and COVID-19 exhibit consistent positive relationships across all models, with FEM and SYSGMM providing comparable estimates for Labor Force. In contrast, Exchange Rate and Inflation show more variability, with FDGMM yielding estimates that align well with FEM and PLS. Overall, FDGMM is favored as the preferred model for its closer alignment with benchmark models for key variables, providing unbiased estimates for Exchange Rate and Inflation, while SYSGMM is more robust for GDP L1 and Labor Force. Overall, the study emphasizes the importance of historical performance, capital inflows, and workforce

factors in understanding GDP dynamics, while highlighting the need for policies to mitigate COVID-19's economic impact.

Table 4

Adjusted Short Run Regression Model for North Africa

Variable	Coefficient	Robust Standard Error	Z-value	p-value
Lagged GDP (GDP L1)	0,929	0,044	21,26	0,000
Exchange Rate (ER)	1756684	4,05e+07	0,04	0,965
Foreign Direct Investment (FDI)	2,484	1,032	2,41	0,016
Inflation Rate (INF)	-2,76e+08	3,22e+08	-0,86	0,392
International reserves (INTR)	0,053	0,036	1,46	0,143
Labor Force (LF)	1020,973	389,192	2,62	0,009
COVID-19 Impact (COVID)	9,70e+09	7,34e+09	1,32	0,186
Constant (cons)	-4,70e+09	3,92e+09	-1,20	0,230

Source: compiled by the authors based on [37].

As show in tab. 4, the modified short-run regression model for North Africa identifies key economic drivers of GDP growth. Lagged GDP (GDP L1) shows a strong positive correlation with current GDP, with a coefficient of 0,929 and a highly significant p-value of 0,000, indicating that past economic success significantly influences current growth. Foreign direct investment also exhibits a significant positive relationship with GDP (p-value = 0,016), suggesting that increased investment fosters economic activity in the region. In contrast, inflation shows a negative association with GDP but lacks statistical significance (p-value = 0,392), implying minimal short-term impact. Similarly, international reserves have a positive coefficient with a non-significant p-value of 0,143. The labor force demonstrates a strong positive correlation with GDP (p-value = 0,009), highlighting the importance of human capital for economic growth. While the COVID-19 influence is positively associated with GDP, its low significance (p-value = 0,186) suggests that the pandemic's immediate effects may not be fully captured. Overall, the

model emphasizes the roles of past GDP performance, foreign direct investment, and labor availability in driving short-term economic growth in North Africa.

Table 5

Adjusted Long Run Regression Model for North Africa

Variable	Coefficient	Standard Error	Z-value	p-value
Exchange Rate (ER)	2,48e+07	5,82e+08	0,04	0,966
Foreign Direct Investment (FDI)	35,032	16,284	2,15	0,031
Inflation Rate (INF)	-3,89e+09	6,63e+09	-0,59	0,557
International reserves (INTR)	-3,89e+09	6,63e+09	-0,59	0,557
Labor Force (LF)	0,744	0,470	1,58	0,113
COVID-19 Impact (COVID)	14399,62	8825,416	1,63	0,103

Source: compiled by the authors based on [37].

As show in tab. 5, the adjusted long-run regression model for North Africa reveals insights into the long-term effects of various economic variables on GDP growth. The exchange rate shows a weak positive association with GDP, with a coefficient of 0,966 and a p-value indicating low statistical significance, suggesting minimal long-term impact. Foreign direct investment (FDI) emerges as a significant factor for long-term growth, with a positive coefficient and a p-value of 0,031, highlighting its role in enhancing industrial growth and employment. In contrast, inflation and interest rates exhibit negative coefficients and non-significant p-values of 0,557, indicating limited long-term influence on economic performance. The labor force shows a positive correlation with GDP, but its p-value of 0,113 suggests this relationship is not statistically significant. Similarly, the COVID-19 impact variable, although positive, lacks statistical significance (p-value = 0,103), indicating uncertain long-term economic implications. Overall, the model emphasizes the importance of FDI while suggesting that other variables may have less substantial long-term effects on GDP growth in North Africa.

Analysis of Short-run and Long-run Effects of Independent Variables on GDP

Growth

Variables	Short-run Effect P-value	Long –run Effect P-value	Significant level
Lag Dependent Variable: L1. GDP	0,000		
Independent Variables: er	0,965	0,966	Not significant
Independent Variables: fdi	0,016	0,031	Short-run Long-run
Independent Variables: inf	0,392	0,557	Not significant
Independent Variables: intr	0,143	0,557	Not significant
Independent Variables: lf	0,009	0,113	Short-run
Independent Variables: covid	0,186	0,103	Short-run

Source: compiled by the authors based on [37].

As show in tab. 6, the analysis of short-term and long-term effects on GDP reveals complex relationships among economic indicators. The lagged dependent variable shows a statistically significant short-term effect (p-value = 0,000), underscoring the influence of historical performance on current GDP. The exchange rate has no significant impact in either timeframe, with p-values of 0,965 and 0,966, suggesting that exchange rate fluctuations may not be crucial for economic outcomes. In contrast, foreign direct investment (FDI) significantly promotes GDP growth in both the short term (p-value = 0,016) and long term (p-value = 0,031), emphasizing its importance as a policy objective. Inflation shows no significant impact on GDP (short-run p-value = 0,392; long-run p-value = 0,557), indicating it may not substantially influence GDP dynamics. International reserves have negligible effects, while the labor force demonstrates a significant short-term effect (p-value = 0,009) but an insignificant long-term effect (p-value = 0,113). The COVID-19 variable shows short-term significance (p-value = 0,186), suggesting immediate economic changes, but its long-term influence on GDP remains uncertain, warranting further examination.

Convergence estimation in North Africa shows a slow alignment in growth rates, with a 7,35 % annual convergence rate, highlighting the need for greater economic integration and structural reforms. Foreign direct investment and trade policies play key roles in influencing this gradual convergence.

Discussion

The relationship between economic indicators and growth in African countries is complex, with certain factors playing a critical role in driving sustainable development. Foreign Direct Investment (FDI) and inflation emerge as crucial determinants of growth, with evidence suggesting that robust policy frameworks can enhance their positive impacts on economic performance [27]. Different phases of the business cycle exhibit distinct correlations with growth. For instance, expansion phases typically lead to higher growth rates, driven by increased investment and consumption, while contraction phases expose structural weaknesses within economies [5].

Labor force participation also plays a pivotal role in economic growth, underscoring the importance of responsive labour policies that can adjust to market demands and inflationary pressures [16]. External shocks, such as the COVID-19 pandemic, have further stressed African economies, particularly in North Africa, highlighting the critical need for resilience and emergency preparedness in economic planning [4].

Policy Implications

The policy implications of these findings are significant, especially for North African economies. Effective policies should foster a favourable environment for FDI by streamlining regulations and enhancing labour market flexibility. Controlling inflation is equally important to sustain a stable economic environment conducive to investment and growth. Additionally, governments in the region should establish contingency plans to mitigate the impact of external shocks, such as global pandemics and economic crises, which disproportionately affect economies that are heavily dependent on natural resources, tourism, and remittances [3].

For sustainable growth, North African countries must adopt tailored policies that address their unique economic structures and vulnerabilities. These policies should promote diversification to reduce reliance on volatile sectors, such as tourism and natural resources, thereby creating a more resilient economic foundation that can withstand external shocks and foster long-term growth [4].

Conclusion

This study offers valuable insights into the intricate relationship between business cycles and economic growth in African countries, focusing on macroeconomic variables such as inflation, foreign direct investment (FDI), exchange rates, labour force, and the effects of external shocks like the COVID-19 pandemic. Through dynamic panel data analysis using the Generalized Method of Moments (GMM), the findings reveal that interest rates and FDI have a positive influence on short-term GDP growth, while inflation and external shocks pose challenges to long-term economic stability. The research highlights the need for policymakers to consider these factors when formulating strategies to mitigate economic downturns and seize growth opportunities.

Future Research

Future studies should explore the sector-specific impacts of business cycles, focusing on how different industries such as agriculture, manufacturing, and services are affected. By adopting these policy recommendations, African countries can mitigate the negative effects of business cycles and external shocks, ensuring more stable and sustainable economic growth in the long term.

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