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From Policy Reforms to Pandemic Recovery: Quantile Analysis of Economic Growth Determinants in Egypt

من إصلاح السياسات إلى التعافي من الجائحة: التحليل الكمي لمحددات النمو الاقتصادي في مصر

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Abstract: This study examines the asymmetric distributional impact of key determinants on Egypt's economic growth from 1977 to 2023, focusing on total factor productivity (TFP), human capital, financial development, savings, governance, foreign direct investment (FDI), and inflation. Uniquely employing the quantile autoregressive distributed lag-error correction model (QARDL-ECM), the study captures heterogeneous effects across low, median and high growth phases, challenging traditional linear frameworks and providing deeper insights into growth dynamics. The analysis employs a comprehensive dataset and robust econometric techniques, including Huber-White robust standard errors, to ensure reliable results. Findings reveal that TFP drives growth during downturns but loses relevance in prosperous phases due to structural bottlenecks, while human capital consistently supports growth across all economic conditions. Savings hinder growth in downturns and median phases due to inefficient financial intermediation, while financial development is associated with slower long-run growth, driven by credit misallocation and systemic inefficiencies. FDI shows negligible effects due to structural and institutional barriers, and governance reforms exhibit nonlinear impacts, initially disrupting growth but potentially supporting it in high-growth phases. Inflation has a negligible long-run impact, except for a slight positive effect during high-growth phases. The study underscores the need for phase-specific interventions, including structural reforms, improved financial intermediation, and sustained governance enhancements. Policy recommendations prioritize TFP improvements and human capital investments during downturns, redirecting credit flows toward productive sectors, and targeting high-spillover FDI in renewable energy and technology. These measures aim to harmonize short-term stabilization with long-term structural transformation, addressing Egypt's growth asymmetries and unlocking its economic potential.

JEL classification : O40, C32, C51, O23

Keywords : Economic Growth, QARDL-ECM, Asymmetric Effects, Phase-Specific Interventions

الملخص: تهدف هذه الدراسة الى بحث التأثير التوزيعي غير المتماثل للعوامل الرئيسة المؤثرة على النمو الاقتصادي في مصر من 1977 إلى 2023، مع التركيز على إنتاجية الكلية لعناصر الانتاج، رأس المال البشري، التطور المالي، الادخار، الحوكمة، الاستثمار الأجنبي المباشر، ومعدل التضخم. تكمن أهمية الدراسة في تطبيقها لنموذج (QARDL-ECM) الذي يقيس التأثيرات غير المتجانسة للمتغيرات عبر مراحل النموالمختلفة (المنخفضة والمتوسطة والمرتفعة). تظهر النتائج أن الإنتاجية الكلية للعوامل تعزز النمو بشكل كبير خلال فترات الركود الاقتصادي، لكنها تفقد أهميتها خلال فترات الازدهار بسبب الاختناقات الهيكلية، بينما يدعم رأس المال البشري النمو بإستمرار في جميع الظروف الاقتصادية. أيضا، يعيق الادخار معدلات النمو في فترات الركود والمراحل المتوسطة بسبب عدم كفاءة الوساطة المالية. بينما يؤثر التطور المالي على تباطؤ النمو على المدى الطويل، نتيجة لسوء تخصيص الائتمان وعدم كفاءة الاسواق. كما للاستثمار الأجنبي المباشر تأثيرات غير معنوية بسبب العوائق الهيكلية والمؤسسية، بينما تظهر إصلاحات الحوكمة تأثيرات غير خطية، حيث تعرقل عملية النمو في البداية ولكنها قد تدعمه عند المراحل العليا. إضافة الى ذلك، للتضخم تأثير غير معنوى على المدى الطويل، باستثناء تأثير إيجابي طفيف خلال فترات النمو المرتفع. مما يستدعى الحاجة للتدخل بتطبيق سياسات محددة وفقاً لمراحل النمو، بما في ذلك الإصلاحات الهيكلية، تحسين الوساطة المالية، وتعزيزات مستدامة في الحوكمة، لتحقيق النمو المستدام والشامل. تتضمن التوصيات تحسين إنتاجية الكلية للعوامل والاستثمار في رأس المال البشري خلال فترات الركود، إعادة توجيه التدفقات الائتمانية نحو القطاعات الإنتاجية، وجذب الاستثمار الأجنبي المباشر القادر على خلق ترابطات رأسية وأفقية في قطاعات الطاقة المتجددة والتكنولوجيا. تهدف هذه الإجراءات إلى تحقيق التوازن بين الاستقرار قصير الأجل والتحول الهيكلي طويل الأجل، معالجة الاختلالات في النمو الاقتصادي وإطلاق الإمكانات الاقتصادية الكاملة للاقتصاد المصرى.

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1.Introduction

Economic growth, a key element of macroeconomic stability and development, has been extensively studied in academic and policy domains. It is often attributed to sustained increases in real per capita income (Kaldor, 1957), structural changes driven by technological and institutional advancements (Kuznets, 1959), or enhancements in productive capacity (Bousserelle, 2004). Its measurement typically relies on observable improvements in GDP and living standards (Abou El-Enein, 2003; Miloud, 2014). While classical growth theories emphasize capital accumulation, human capital, and technological progress as key drivers, empirical research often overlooks a critical dimension: the asymmetric effects of these determinants across different phases of economic growth.

In Egypt, extensive research on growth determinants—spanning savings, foreign direct investment (FDI), governance, and beyond—has predominantly relied on linear frameworks. These approaches fail to account for how these factors may exert distributional and asymmetric effects across periods of stagnation versus prosperity. This study addresses this critical gap by employing the Quantile Autoregressive Distributed Lag Error-Correction (QARDL-EC) model, which allows for a deeper analysis of growth determinants across different economic conditions. Specifically, the study seeks to answer the following research questions:

1. How do key determinants—such as TFP, savings, inflation, FDI, financial development, human capital, and governance—influence Egypt's economic growth differently across its growth distribution (low, moderate, and high-growth phases)?
2. What are the short- and long-run dynamics of these determinants, and how do their impacts shift between economic downturns and periods of prosperity?
3. How can policymakers adapt interventions to account for these asymmetries, ensuring growth strategies align with Egypt's phase-specific challenges?

The novelty of this study lies in its application of the QARDL-EC model to explore the heterogeneous short- and long-run impacts of growth determinants across Egypt's economic conditions from 1977 to 2023. The findings reveal striking asymmetries: while TFP and human capital drive growth in lower quantiles (economic downturns), financial development exerts a persistent negative effect, reflecting systemic credit misallocation to unproductive sectors like real estate. Savings similarly hinder growth in low-growth phases due to inefficiencies in mobilizing capital, while inflation and FDI show negligible impacts across quantiles.

Governance improvements, surprisingly, correlate weakly with slower growth in mid-range quantiles, likely due to short-term disruptions from anti-corruption reforms. This study employs distributional analysis to offer deeper insights into Egypt's growth constraints, challenging the applicability of uniform policy solutions and emphasizing the need for reforms tailored to specific economic phases.

The remainder of the paper is structured as follows: Section Two offers a brief background on the stages of contemporary economic development in Egypt and their implications. Section Three reviews the evolution of economic growth models and presents an empirical literature review. Section Four details the methodology and data sources. Section Five discusses the empirical results, and Section Six provides the conclusion, policy implications, and suggestions for future research.

2.Background

Egypt is an example of a transitional economy; its system has seen a shift from centralized government planning policies to reforms focusing on strengthening market mechanisms. In this context, the stages of contemporary economic development in Egypt can be divided into four phases, as widely recognized in economic literature (Hansen & Nashashibi, 1975; Ikram, 2006; World Bank, 1991): the central planning policy (1952-1973); the economic liberalization policy (1974-1990); the economic reform and structural adjustment program and the post-January 25th Revolution (2011 onwards) as follows:

The Central Planning Policy Phase, following the 1952 revolution, brought about significant changes in Egypt's economy. Land reforms and nationalization efforts led to initial industrial growth and equitable distribution but eventually resulted in inefficiencies and a decline in agricultural productivity. The implementation of the first five-year plan achieved substantial investments and GDP growth; however, the subsequent five-year plan was halted due to war, leading to economic deterioration. The period was marked by a dominant public sector, restrictive policies on the private sector, and eventual economic instability, highlighting the limitations of centralized economic planning and the need for balanced and sustainable policies moving forward(Hansen & Nashashibi,1975; Waterbury, 1983)

The Economic Liberalization Policy phase (1974-1990) aimed to open Egypt's economy to foreign investment and create a favorable environment for growth through tax exemptions, protection from nationalization, and unrestricted profit repatriation. This phase was driven by inefficiencies in the public sector, depletion of foreign reserves due to military conflicts, and the need for higher economic growth.

While the policy initially achieved high GDP growth rates and attracted private and foreign investments, it primarily benefited sectors like tourism, oil, and construction, rather than enhancing overall productivity. The reliance on external sources for growth led to increased foreign debt and economic imbalances. The late 1980s saw a decline in real growth rates and economic recession due to global economic slowdowns and structural weaknesses. This phase highlights the importance of strategic investment in productive sectors and balanced economic policies to ensure sustainable growth (Ikram, 2006; Richards & Waterbury,2008).

Economic Reform and Structural Adjustment Program (1991-2010)

The Economic Reform and Structural Adjustment Program (ERSAP), initiated in 1991, aimed to address Egypt's deteriorating economic conditions by reducing the state's role in the economy, increasing private sector participation, and improving the investment climate. The program's stabilization policies focused on restrictive monetary and fiscal measures, while structural adjustments liberalized investment, prices, and foreign trade. Although the 1990s saw relative economic stability and improved growth rates compared to the 1980s, the sources of growth were temporary and concentrated in private sector investments and stock market inflows. By the late 1990s, economic imbalances re-emerged due to factors such as the Luxor terrorist attack, falling oil prices, and external financial crises, leading to a recession characterized by declining GDP growth rates, reduced investments, and rising unemployment. Despite some improvement in the early 2000s, the economy continued to face challenges, including a high savings gap and limited social policies, which contributed to increased poverty and social disparities. This phase highlighted the need for a balanced approach to economic reforms that addresses both financial stability and social justice (World Bank ,1991).

The Post-Revolutionary Period (2011-2024)

The Post-Revolutionary Period (2011-2024) in Egypt has been characterized by significant economic fluctuations driven by political instability and subsequent reforms. The initial years following the 2011 revolution saw a sharp decline in economic activity, reduced private sector contributions, and decreased foreign investments, leading to low growth rates and high unemployment (El-Meehy, 2012). However, from 2014 onwards, gradual stabilization efforts, economic reforms, and infrastructure projects led to improved growth rates. Despite challenges such as inflation and external economic shocks like the COVID-19 pandemic, the economy showed signs of recovery, driven by government spending, foreign investments, and tourism.

Nevertheless, persistent structural challenges, a declining savings rate, and the need for more robust social policies underscore the importance of continuous reforms to achieve sustainable and inclusive growth. This phase highlighted the necessity of balancing economic recovery efforts with measures to address social justice and support the most vulnerable populations(African Development Bank, 2022; IMF (2023).

3.Literature Review

3.1 The Evolution of Economic Growth Models

Classical growth theories, including the views of Malthus, Smith (1776), Ricardo (1781), Ramsey (1928), and Schumpeter (1934), emphasize various factors influencing economic growth. Smith's "Wealth of Nations" identifies land as a source of wealth (Barro & Sala Martin, 1995) and advocates minimal state intervention, individual economic freedom, competition, and trade. He highlights labor productivity, the proportion of the labor force, specialization, and division of labor as crucial for enhancing productivity, skills, and innovation. Economic growth requires capital accumulation driven by savings and investment, which expands labor division and raises per capita income. However, population pressure and resource scarcity can hinder growth by reducing profits and leading to stagnation.

Modern exogenous growth theories are influenced by external factors like population growth, technological progress, and aggregate demand. The Harrod-Domar Model extends Keynesian ideas, emphasizing the impact of increased capital stock on productive capacity, assuming total output is determined by aggregate demand, with savings equating to investment. Stable growth and equilibrium require government intervention, as market forces alone are insufficient. Historical evidence of balanced growth without government intervention led to the neoclassical growth theory based on Solow's (1956) model. Disparities in capital formation and growth rates among countries led economists, such as Barro and Becker (1988), to question models based on external technological progress. New endogenous growth models have emerged, driven by internal economic factors. Mankiw and Weil (1995) highlighted human capital's role in Germany's post-World War II growth. Romer (1986, 1990) introduced endogenous growth theory, asserting that growth is driven by production activities and technological progress, supported by Lucas (1988), and traced back to Arrow (1962), Sheshinski (1967), and Uzawa (1965).

This theory posits that innovations result from economic incentives and profit motives, emphasizing the importance of a well-educated workforce and R&D advancement from profit-driven corporate investments. Romer posited that capital's marginal product in competitive markets can increase indefinitely due to rising investment rates, assuming increasing returns to scale and positive externalities from knowledge investment. Technological change is considered an endogenous variable influenced by manageable factors, with discoveries and technologies being non-rivalrous production factors. This theory contends that growth is more rapid in nations with abundant physical capital, well-educated labor, and a conducive environment for knowledge accumulation, contrasting Solow's theory. The neoclassical growth accounting model, introduced by Solow (1957), Kendrick (1961), and Denison (1962, 1967), is the most common method for identifying economic growth sources. Barro (1991), Elias (1992), Young (1995), Dowling (1998), Senhadji (1999), and Iwata et al. (2003) further expanded it. This model decomposes economic growth into contributions from capital and labor inputs and a residual component, initially called Solow's residual and now known as total factor productivity (TFP).

TFP includes all growth sources beyond capital and labor, such as technological advances, economic restructuring, social and political stability, and improved labor quality (Lee, 2011). It indicates changes in input efficiency and technological progress, encompassing resource use efficiency, innovation, institutional changes, omitted variables, and measurement errors. Growth accounting distinguishes between extensive growth (factor input-driven) and intensive growth (productivity-driven), which is crucial for assessing sustainability. Rapid capital-driven growth may be unsustainable, while TFP-driven growth is likely more sustainable (Iyoha, 2002).

3.2 Empirical Reviews

The literature identifies key determinants of economic growth, yet their asymmetric effects across growth phases remain underexplored, particularly in Egypt. This section synthesizes existing findings while highlighting critical gaps addressed by this study's Quantile ARDL-EC framework.

A. Total Factor Productivity

TFP's growth impact depends on governance, technology, and institutional quality. In advanced economies, financial openness and R&D sustain productivity (Kose et al., 2009; Kataryniuk & Martínez-Martín, 2018), but Egypt's structural barriers—corruption, low workforce skills, and weak FDI absorption—limit TFP gains (Ngo & Nguyen, 2020; Zardoub & Sboui, 2021).

Critically, traditional models ignore phase-dependent TFP dynamics, such as its role in economic recoveries versus booms (Danquah et al., 2014). The current paper attempts to capture the distributional asymmetric impact of the determinants of growth, including TFP, in Egypt using the QARDL model.

B.Savings

The literature emphasizes that savings' impact on economic growth is nonlinear and is influenced by institutional efficacy, financial system robustness, and regulatory frameworks. Moderate savings can fuel growth by financing investments in physical and human capital, thereby enhancing productivity and technological progress (Wollasa & Kumo, 2011; Opschoor, 2014; Jagadeesh, 2015), while excessive savings in inefficient systems, poor financial intermediation, governance failures, or saturated investment opportunities, fuel misallocation and yield diminishing returns or even adverse outcomes (Siaw et al.,2017; Bezemer et al., 2014; Samargandi et al., 2014). This duality necessitates asymmetric, phase-specific analysis, as aggregate models may hide critical distributional heterogeneities. For Egypt, with institutional gaps, a dominant informal sector, and uneven financial intermediation, the QARDL model can uncover how savings' growth effects diverge across economic conditions. This model quantifies thresholds where savings transition from growth-enabling to growth-constraining, offering insights for policymakers.

C.Human Capital

Human capital drives economic growth through education, health, institutional quality, technological progress and innovation (Ciccone & Peri, 2006; Barro, 2013; Hanushek & Woessmann, 2012). It also enhances the workforce productivity, facilitating technology adoption and bridging skill gaps, particularly in developing economies (Benhabib & Spiegel, 2010; Duflo, 2001; Hefnawi, 2020; Hefnawi & Ghoneim, 2020; Emam et al., 2021). However, effective governance is crucial; Henderson (2010) found insignificant effects as poor governance hinders growth despite education. Mixed findings highlight context dependency, necessitating analysis of how human capital interacts with growth phases. In Egypt, no study quantifies human capital's asymmetric effects across growth quantiles.

D.The Inflation Rate

Moderate inflation can positively affect economic growth by increasing demand, encouraging investment, optimizing resource allocation and promoting affordable borrowing and spending (Akinsola & Odhiambo, 2017; Saad, 2017; Khan & Hanif, 2018; Harris, 2010).

While high inflation adversely affects growth by causing instability, reducing financial market efficiency, increasing uncertainty, eroding purchasing power, increasing borrowing costs, restricting access to capital, misallocating resources and distorting relative prices (Yilmazkuday, 2021; Ekinci et al., 2020; Khan & Senhadji, 2000; Burdekin & Coe, 2004; Cuaresma & Silgoner, 2004; Omay & Kan, 2010; Blanchard & Gali, 2010; Harris, 2010). Ericsson et al. (2001) and Levine and Renelt (1992) indicate a negligible effect of inflation on economic development. Recent research by Nadabo and Maigari (2021) and Ekpeyong (2023) in Nigeria, underscores the unequal effects of inflation on economic growth. Recent studies, including Nadabo and Maigari (2021) and Ekpeyong (2023) in Nigeria, highlight the asymmetric impact of inflation on economic growth. Using the NARDL approach, they measured the asymmetric impacts of inflation in both the short-and long-term. These studies stress the significance of considering asymmetric effects when analyzing inflation's influence on economic growth. Although existing research extensively examines the linear and non-linear impact of inflation on growth, it often neglects the distributional asymmetry across different growth phases. Specifically, inflation's quantile-specific impacts in Egypt remains unexplored.

E. Financial Development

The impact of financial development on economic growth is debated in empirical literature. Foundational studies by Goldsmith (1969), and Shaw (1973) suggest financial systems boost growth by mobilizing savings, efficiently allocating capital, and reducing transaction costs, fostering entrepreneurship and innovation. This "finance-led growth" paradigm is supported by Lucas (1988) and Pietrovito (2000), who highlight the role of advanced financial intermediation in promoting productivity growth and technological diffusion, especially in emerging economies. Nguyen & Pham (2021) further corroborate these findings, noting that financial inclusion and credit access benefit underserved sectors, driving inclusive growth.

However, other studies suggest that financial development might follow rather than cause economic growth, questioning the assumed causality (Demetriades & Hussein, 1996). Poorly regulated financial markets can lead to speculative bubbles and economic damage (Levine & Zervos, 1998). Excessive financial liberalization without adequate regulation can cause financial instability and slower growth in transition economies (Rioja & Valev, 2004; Tichy, 2006). Additionally, an oversized financial system relative to the economy can hinder growth, as rapid financial development can destabilize economies, leading to financial crises and downturns (Bezemer et al., 2014; Samargandi et al., 2014).

In Egypt, credit misallocation to unproductive sectors (e.g., real estate) likely restrains growth, particularly in high-growth phases. However, no Egyptian study has examined financial development's asymmetric drag across quantiles.

F. Foreign Direct Investment

FDI is crucial for economic growth by introducing capital, technology, and managerial expertise (Ayanwale, 2007). However, institutional barriers like corruption and bureaucratic obstacles can limit FDI inflows and associated technological spillovers, leading to diverse growth outcomes (Choudhry, 2008; Hawkes, 2014). Recent studies indicate that the growth effects of FDI depend on the host economy's absorptive capacity, including infrastructure, education, and financial system development (Aghion et al., 2019; Hayat, 2019; Baiashvili & Gattini, 2020). Some studies identify negative or negligible impacts of FDI in economies with underdeveloped institutions (Bruno & Campos, 2013; Hayat, 2019; Zardoub & Sboui, 2021; Mwitta, 2022). Additionally, the asymmetric impact of FDI is noted, with positive FDI shocks yielding stronger growth effects, especially in higher economic quantiles (Hsu et al., 2011). In Egypt, empirical evidence on FDI's impact is mixed: some studies show positive impacts through technology transfer and job creation (Alaa &Marwa, 2019), while others highlight adverse effects due to weak institutions or sectoral misallocation (Ahmed & Abdallah, 2020). The asymmetric effects—positive in high quantiles, neutral in low—are untested. However, Egypt's phase-specific FDI impacts remain unresolved.

G. Governance

Empirical literature reveals both positive and negative impacts of governance on economic growth, with some findings showing negligible effects. Abdelbary (2018) highlights post-revolution governance improvements in Egypt that have stimulated economic growth, emphasizing inclusive governance and social stability. Zhang et al. (2021) and Mahran (2023) indicate that governance improvements can stimulate growth via transparency. Lopes et al. (2023) assert that high-quality governance promotes efficient resource allocation and reduces economic distortions in emerging and developed economies. Conversely, Emara & Chiu (2016) and Samarasinghe (2018) argue that poor governance impedes growth through corruption, inefficiency, and lack of transparency, leading to slower development and reduced productivity. Mixed results from Azam (2022) and Kaufmann & Kraay (2002) suggest that the impact of strong governance frameworks varies depending on specific contexts. In Egypt, Governance's quantile-specific impacts are unstudied.

To conclude, while prior studies assume linearity, this research employs the Quantile ARDL-EC model to reveal asymmetric effects of growth determinants across Egypt's economic phases in both short- and long-term dynamics. By providing phase-tailored policy insights for Egypt's stagnation, recovery, and prosperity phases, this study advances a dynamic understanding of growth drivers.

4.Methodology

This study employs theoretical and empirical analyses to examine the determinants of economic growth in Egypt from 1977 to 2023. It investigates the role of key variables, including the saving rate, governance indicators (government effectiveness and corruption perception), economic stability (measured by the inflation rate), financial development, FDI and TFP. The stationarity of the data is assessed using the augmented Dickey-Fuller (ADF) and Phillips–Perron (PP) tests. The methodology is structured into three main steps. First, the Gauss-Newton algorithm is used to estimate a nonlinear production function, obtaining the TFP series as the residual. This step is critical for capturing the contribution of productivity to economic growth. Second, the residual augmented least squares-Engle Granger (RALS-EG) cointegration test is applied to ensure long-run relationships among the variables. This test is chosen for its robustness in handling Egypt's volatile macroeconomic data, which includes structural breaks (e.g., post-2011 political changes) and non-normal residuals. Finally, the Quantile Autoregressive Distributed Lag Error Correction Model (QARDL-ECM) is employed to examine short- and long-term dynamics and capture the asymmetric effects of growth determinants across different quantiles. This model is preferred over traditional methods due to its ability to provide detailed insights into phase-specific relationships, such as crisis versus boom periods (Maki, 2012; Cho et al., 2015; Shahbaz et al., 2018). Finally, to ensure the reliability and validity of the model, several diagnostic tests are conducted. These include utilizing the Huber-White robust standard error to check for heteroskedasticity, the Ramsey RESET test to check for model misspecification, the correlogram Q-statistics autocorrelation test and to test whether the coefficients of the dependent and independent variables are consistent across different quantiles of the distribution. the Quantile Slope Equality Test (Wald test) is performed, where the null hypothesis assumes that the coefficients for similar quantiles are equal.

4.1 Model Specification

4.1.1 The Estimation of the Nonlinear Cobb-Douglas Production Function

The nonlinear Cobb-Douglas production function is estimated to derive TFP, following the approach of Mankiw, Romer, and Weil (1992) and Barro, Mankiw, and Sala-i-Martin (1995). The function is specified as:

$$Y = AK^{\alpha}(LxH)^{\beta} \quad (1)$$

Where:

Y: Output

A: Total factor productivity (TFP); the residual part of the basic equation "Solow residual"

K: Capital

H*L: Efficient labor; as L is the size of labor and H represents human capital index following Kraay (2018)'s methodology and is calculated by getting the geometric average of three components survival, school (quantity and quality of education).

β, α: the output elasticity with respect to capital and efficient labor respectively. In this study, the type of return to scale is left to the real data and econometric estimations.

4.1.2 The Estimation of QARDL-EC Model

Following Zhang et al. (2021), Ngo & Nguyen (2020), Nguyen& Pham (2021), Weerakoon (2017) and Opschoor (2014), the functional form of the proposed model can be written as follows:

$$EG_t = F(TFP_t, HCI_t, S_t, INF_t, FD_t, FDI_t, GOV_t)$$

Where, EG_t is the economic growth rate measured by the per capita income growth; TFP is the total factor productivity, HCI_t is the human capital index of Egypt, S_t the saving rate, INF_t is the inflation rate; and FD is financial development measured by the credit given to the private sector as a percent of GDP; FDI_t is the foreign direct investment inflows as a percent of GDP and GOV_t is the governance index proxied by the effectiveness of government and corruption perception index. Thus, the estimated equation in its stochastic form is:

$$EG_t = \alpha_0 + \alpha_1 TFP_t + \alpha_2 HCI_t + \alpha_3 S_t + \alpha_4 INF_t + \alpha_5 FD_t + \alpha_6 FDI_t + \alpha_7 Gov_t + u_t$$

Both Phillips–Perron and augmented Dickey–Fuller tests were used to ensure the stationarity of the variables and prevent spurious regression. The ARDL cointegration approach is valid if the integration order of the regressors is less than two. The QARDL-ECM model combines quantile regression with the autoregressive distributed lag (ARDL) framework.

The structural form of the QARDL-ECM framework, established by (Chao et al., 2015b), is:

$$QEG_t(\tau)=\beta_0(\tau)+\sum_{i=1}^{p}\beta i(\tau)\,\Delta EG_{t-i}+\sum_{i=1}^{q1}\alpha 1(\tau)\Delta TFP_{t-i}+\sum_{j=0}^{q2}\alpha 2(\tau)\Delta HCI_{t-j}+\sum_{j=0}^{q3}\alpha 3\,(\tau)\Delta S_{t-j}$$
$$+\sum_{j=0}^{q4}\alpha 4(\tau)\;\;\Delta INF_{t-j}+\sum_{j=0}^{q5}\alpha 5(\tau)\;\Delta FD_{t-j}+\sum_{j=0}^{q6}\alpha 6\,(\tau)\;\Delta FDI_{t-j}+\;+\sum_{j=0}^{q7}\alpha 7(\tau)\;\Delta GOV_{t-j}$$
$$+\lambda_{ECM}(EG_{t-1}-\gamma_0(\tau)-\sum_{k=0}^{m}\gamma k\,(\tau)\,X_{t-k}+\varepsilon t(\tau)$$

In this context,

QEGt(τ): represent the conditional quantile function of economic growth at quantile τ

β0(τ): is the intercept at quantile τ

βi(τ) and αj(τ) are short-term coefficients at quantile τ

γk(τ): refers to long-term coefficients at quantile τ

εt(τ):denotes error term at quantile τ

λECM signifies the error correction term or speed of adjustment to long-term equilibrium. It is assumed to be significant and having a negative sign to confirm proper adjustment to long-term equilibrium.

5. Data Sources and Empirical Results

5.1 Data Sources

The study uses secondary data to examine the determinants of economic growth in Egypt. data on GDP, capital, and saving rates were sourced from the Ministry of Planning and Economic Development, Egypt, as these variables are crucial for measuring economic output and capital accumulation. Employment data, vital for assessing labor input, was obtained from the Egyptian Central Agency for Public Mobilization and Statistics. Data on FDI inflows, credit to the private sector, inflation rate, corruption perception index, and Human Capital Index components were collected from the World Development Indicators database, reflecting their empirical relevance to external capital, financial development, macroeconomic stability, institutional quality, and human capital. Government effectiveness data was taken from Transparency International, a globally recognized source for governance metrics. All variables were adjusted to real terms to account for inflation, and missing values were estimated using linear regression imputation, following best practices for time-series analysis. The data sources were selected for their reliability, accuracy, and alignment with theoretical and empirical research on economic growth.

5.2. Empirical Results

5.2.1 Summary Statistics

Table (1) presents descriptive statistics for the variables. Economic growth (EG) averaged 2.40% (range: 1.46%–3.61%), with a right-skewed, near-normal distribution (skewness = 0.73, kurtosis = 2.28) and no significant deviation from normality (Jarque-Bera p = 0.073). TFP had a mean of 20.24 (range: -441.55 to 497.88) and a near-normal distribution (skewness = 0.18, kurtosis = 3.998), confirmed by a Jarque-Bera p-value of 0.33. The Human Capital Index (HCI) averaged 47.16 (range: 31.5–59.9), showing a platykurtic distribution (skewness = -0.21, kurtosis = 1.71) and no significant deviation from normality (J-Bp = 0.16). Savings averaged 13.32% (range: 10.2%–17.8%), with a platykurtic and slightly right-skewed distribution (skewness = 0.51, kurtosis = 2.00), and no significant deviation from normality (J-Bp = 0.13). Governance (GOV) had a mean of 58.04 (range: 51.45–65.43) and a near-normal distribution (skewness = 0.22, kurtosis = 2.28), confirmed by a Jarque-Bera p-value of 0.50. FDI averaged 2.4% (range: -0.2%–9.35%), with a leptokurtic and highly right-skewed distribution (skewness = 1.89, kurtosis = 6.61), significantly deviating from normality (J-Bp = 2.31e-12). The inflation rate (INF) averaged 12.11% (range: 0.87%–37.2%), also leptokurtic and right-skewed (skewness = 1.23, kurtosis = 4.74), with clear deviations from normality (J-Bp = 0.00014). Financial Development (FD) averaged 33.82% (range: 21.1%–54.93%), showing a near-normal distribution (skewness = 0.80, kurtosis = 2.39) with a slight deviation from normality (J-Bp = 0.057).

Table 1. Summary Statistics Results

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.
EG	2.40	2.25	3.61	1.46	0.62	0.73	2.28	5.22	0.073
FDI	2.41	2.10	9.35	-0.20	2.01	1.89	6.61	53.58	0.000
FD	33.82	31.15	54.93	21.10	10.53	0.80	2.39	5.71	0.057
GOV	58.04	57.50	65.43	51.45	3.65	0.22	2.28	1.39	0.499
HC	47.16	48.69	59.90	31.50	9.03	-0.21	1.71	3.61	0.165
INF	12.11	10.90	37.20	0.87	7.50	1.23	4.74	17.82	0.000
S	13.32	12.50	17.80	10.20	2.19	0.51	2.00	4.02	0.134
TFP	20.24	38.47	497.88	-441.55	186.77	0.18	4.00	2.22	0.330

Source: Author's calculation by using E-Views13 packages.

Table 2. The Correlation Results

Variable	EG	FD	FDI	Governance	HC	INF	TFP	S
EG	1	-0.065	-0.024	-0.010	**0.906***	0.204	-0.035	**-0.39**
		(0.664)	(0.874)	(0.945)	**(<0.001)**	(0.169)	(0.818)	**(0.006)**
FD	0.154	1	0.078	0.51*	0.294*	**-0.399**	-0.131	0.17
	(0.128)		(0.602)	(<0.001)	(0.045*)	**(0.005)**	(0.382)	(0.24)
FDI	-0.007	-0.119	1	0.039	0.046	0.130	-0.092	0.37
	(0.949)	(0.244)		(0.794)	(0.756)	(0.383)	(0.538)	(0.010)
Governance	0.196	**0.509***	-0.088	1	0.241	-0.267	-0.088	0.099
	(0.053)	**(<0.001)**	(0.389)		(0.103)	(0.070)	(0.557)	(0.50)
HC	**0.870***	0.242*	0.023	0.184	1	0.057	-0.225	-0.208
	(<0.001)	(0.017*)	(0.826)	(0.069)		(0.776)	(0.128)	(0.15)
INF	-0.043	**-0.264**	0.196	-0.178	0.030	1	0.016	0.06
	(0.673)	**(0.009)**	(0.053)	(0.080)	(0.703)		(0.915)	(0.675)
TFP	-0.142	-0.073	-0.044	-0.067	-0.268*	-0.149	1	-0.227
	(0.163)	(0.474)	(0.666)	(0.515)	(0.008)	(0.142)		(0.127)
S	**-0.261**	0.167	0.1649	0.0195	-0.209	0.1209	-0.184	1
	(0.0099)	(0.1005)	(0.106)	(0.85)	(0.03)	(0.236)	(0.0707)	

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Note(s): The upper triangle exhibits Spearman rank order 's Coefficients, while the lower triangle demonstrates Kendall's Tau-b's Coefficients. p-values are written in parentheses.

Source: Author's calculation by using E-Views13 packages.

Table (2)'s Kendall's tau correlation analysis reveals Economic Growth (EG) has no significant relationship with FDI (-0.007, p=0.949), Financial Development (FD) (0.154, p=0.128), Inflation (INF) (-0.043, p=0.673), and TFP (-0.142, p=0.163). Governance (GOV) shows a nearly significant positive correlation with EG (0.196, p=0.053). A strong significant positive relationship exists between EG and Human Capital (HC) (0.870, p=7.22e-18), emphasizing education, skills, and health improvements' crucial role in promoting Egypt's economic growth. Savings has a moderate, significant negative correlation with EG (-0.261, p=0.009), possibly due to limited investment opportunities or financial sector inefficiencies. The findings suggest Human Capital is a key economic growth driver, while FDI, FD, GOV, INF, and TFP are either underdeveloped or not effectively contributing to Egypt's economic growth during the observed period.

5.2.2 Unit Root and RALS-Cointegration Tests

The stationary test results in Table (3) indicate that the variables (TFP, S, INF &FDI) are integrated of order 0, while (EG, FD, HCI&GOV) are integrated of order 1, d (1), at the 1% and 5% significance levels. To ensure a long-run equilibrium relationship between variables, the RALS-EG methodology suggested by Engle and Granger (1987) was utilized in two steps. First, the order of integration of the variables is determined. Second, we estimate the OLS regression equation and perform the ADF unit root test on the residual of the equation.

Table 3: Results of PP Unit Root and RALS-EG Cointegration Tests

Variable	PP Test		ADF Test		Cointegration Degree
	Level	1st Diff	Level	1st Diff	
EG	0.26	-5.1***	0.46	-2.4**	d(1)
TFP	-3.9***	-5.5***	-4.5***	-6.9***	d(0)
HCI	-1.4	-4.36***	-1.4	-1.5	d(1)
S	-3.5***	-11.3***	-3.4**	-10.9***	d(0)
INF	-4.26***	-13.5***	-1.9	-2.7***	d(0)
FD	-1.6	-4.4***	-1.6	-4.4***	d(1)
FDI	-3.3**	-6.8***	-3.4**	-6.3***	d(0)
GOV	-2.2	-5.4***	-2.5	-5.4***	d(1)
RALS-EG Cointegration Test Results					
Test Statistic		Probability		Cointegration Degree	
-2.97		0.04		d(0)	

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Notes: Significance Levels: ***1%, **5%, *10%.

Source: Author's calculation by using E-Views13 packages.

5.2.3 The QARDL-EC Model Results and Discussion

The empirical results of the cumulative and quantile autoregressive distributed lag (QARDL) model are depicted in Tables (4:7) and Figure (1&2).

Table (4) shows that TFP advancements exert a minor but statistically significant long-run impact on economic growth at the 5% significance level. This aligns with Solow (1956) and Romer (1990), who emphasize the role of technological change and productivity improvements in driving growth. However, the quantile-specific analysis (Figure 1 and Table 5) reveals an asymmetric impact: TFP significantly boosts growth during lower quantiles (τ = 0.1–0.5), with coefficients decreasing from 0.0005 to 0.0003. This suggests that TFP is most effective during economic downturns, where inefficiencies (e.g., outdated practices, poor resource allocation) create room for productivity gains, as argued by Hsieh & Klenow (2009) and Bloom et al. (2012). In contrast, TFP's impact diminishes at higher quantiles (τ = 0.8–0.9), becoming negligible and statistically insignificant.

This reflects saturation effects in advanced growth phases, where sectors operate closer to their efficiency limits, leaving little room for further productivity gains. This finding aligns with Tang & Zhao (2023), who highlight diminishing TFP returns in advanced economies due to innovation saturation.

Contrary to Jagadeesh (2015) and Opschoor (2014), savings negatively impact growth during downturns (τ = 0.1–0.5) and median phases (τ = 0.5). This paradox is attributed to inefficient financial intermediation (Gurley & Shaw, 1955), inflationary erosion of savings, and a dominant informal sector that diverts savings from productive use, as noted by Samargandi et al. (2014). The negative impact weakens during stable periods (τ = 0.9), where savings have an insignificant effect, consistent with Siaw et al. (2017). These results underscore the importance of addressing structural inefficiencies in Egypt's financial system to unlock the growth potential of savings.

Furthermore, human capital has a significant positive impact on long-term growth across all quantiles, consistent with Mankiw, Romer, and Weil (1992), Benhabib & Spiegel (2010). Duflo, 2001; Hefnawi (2020) and Emam et al. (2021) Education, health and skills development enhance workforce productivity and innovation, driving sustainable growth. However, the impact is strongest during lower quantiles, highlighting the critical role of human capital in recovery phases. Moreover, inflation has an insignificant long-run impact across most quantiles, aligning with Ericsson et al. (2001) and Levine & Renelt (1992). However, a slight positive effect is observed at the 9th quantile, suggesting that inflation may stimulate growth during high-growth phases through demand-pull effects, as noted by Barro (1993), Harris (2010), Akinsola and Odhiambo (2017), Saad (2017) and Khan and Hanif (2018).

Financial development exerts negative impacts on long-run growth, contrasting with conventional expectations. This is attributed to three key challenges: (1) credit misallocation to unproductive sectors, Egypt's banking sector has channeled credits disproportionately among large connected firms and sectors with low productivity in the real estate speculation instead of small and medium enterprises or innovation-driven industries. This misallocation limits inclusive growth and job creation. (2) excessive private-sector debt (60% of GDP in 2022), this raises concerns about repayment capacity and overall stability in the financial system because excessive borrowing would crowd out productive investment and (3) systemic inefficiencies (e.g., weak credit assessment frameworks, outdated collateral laws, and inadequate bankruptcy procedures) undermine the effectiveness of financial intermediation.

These findings align with the "finance curse" hypothesis (Bezemer et al., 2014), where financial sector growth paradoxically impedes economic development in emerging markets. The negative impact intensifies at higher quantiles (τ = 0.5–0.8), reflecting elite capture of credit during stable periods.

Table 4. Long-Run QARDL Estimates with Robust Standard Errors (Huber-White) for Egypt's Economic Growth

Long-Term Dynamics			
Variable	**Coefficient**	**Robust Std. Error**	**t-Statistic**
TFP	0.0003**	0.00014**	2.17
HCI	0.07***	0.0025***	27.8
S	-0.03***	0.012***	0.01
INF	0.002	0.0034	0.77
FD	-0.016***	0.0029***	-6.3
FDI	-0.003	0.0096	0.73
GOV	0.001	0.0042	0.76
Constant (C)	0.41	0.395	0.31
Diagnostics: *Pseudo* R^2=0.85, Ramsey RESET Test: p=0.12			

Note(s): Significance levels: ***1%, **5%, *10%.
Source: Author's calculations using EViews 13.

Table 5: Long-Run Estimates of the Quantile ARDL-EC Model

Quantile (τ)	Constant (α*)	ECM (δ*)	βTFP	βHCI	βS	βINF	βFD	βFDI	βGOV
0.1	0.11	-0.28*	0.0005***	0.068***	-0.027**	0.003	-0.012***	0.0018	-0.005
	(0.29)	(-1.2)	(3.8)	(23.6)	(-2.08)	(0.9)	(-4.3)	(0.23)	(-0.87)
0.2	0.39	-0.39	0.0005***	0.07***	-0.028*	0.0017	-0.014***	0.004	-0.009*
	(1.36)	(-1.3)	(4.6)	(30.02)	(-1.97)	(0.57)	(-4.9)	(0.44)	(-1.84)
0.3	0.31	-0.27	0.00047***	0.071***	-0.026*	0.002	-0.014***	-0.0005	-0.008
	(0.93)	(-1.5)	(3.7)	(28.9)	(-1.86)	(0.66)	(-5.4)	(-0.05)	(-1.46)
0.4	0.49	-0.34**	0.0004***	0.07***	-0.025*	0.0022	-0.015***	-0.002	-0.01*
	(1.34)	(-2.2)	(2.9)	(27.2)	(-1.88)	(0.69)	(-4.9)	(-0.19)	(-1.6)
0.5	0.41	-0.42***	0.0003**	0.069***	-0.036***	0.002	-0.016***	-0.003	-0.005
	(1.03)	(-2.6)	(2.3)	(23.8)	(-2.75)	(0.72)	(-5.3)	(-0.34)	(-0.68)
0.6	0.70*	-0.40***	0.00042**	0.067***	-0.031**	0.009	-0.016***	-0.004	-0.009
	(1.8)	(-2.5)	(2.4)	(24.3)	(-2.2)	(0.32)	(-5.6)	(-0.45)	(-1.25)
0.7	0.51	-0.38**	0.00034**	0.066***	-0.042**	0.0008	-0.017***	0.003	-0.0008
	(1.3)	(-2.1)	(2.39)	(17.7)	(-2.3)	(0.32)	(-7.4)	(0.23)	(-1.06)
0.8	0.42	-0.44***	0.0003***	0.064***	-0.043***	0.0015	-0.019***	0.0043	0.002
	(1.1)	(-2.4)	(2.57)	(20.04)	(-2.5)	(0.63)	(-8.9)	(0.40)	(0.38)
0.9	0.66	-0.17	0.00015	0.06***	-0.022	0.005	-0.018***	-0.02	-0.004
	(0.82)	(-0.6)	(0.9)	(15.4)	(-0.9)	(1.46)	(-6.5)	(-0.99)	(-0.32)

Note(s): Coefficients are reported with t-statistics in parentheses, Significance levels: ***1%, **5%, *10%.
Source: Author's calculations using EViews 13.

Despite the government's efforts to attract foreign investors through initiatives such as the Suez Canal Economic Zone and tax incentives, FDI shows negligible long-run effect on Egypt's growth consistent with Bruno and Campos (2013), Hayat (2019), Zardoub and Sboui (2021) and Mwitta, (2022). This reflects structural and institutional barriers that hinder the effectiveness of FDI in promoting economic growth. For instance, FDI in Egypt has historically been concentrated in extractive industries like oil, gas, and real estate, which have limited connections to domestic value chains or technology spillovers. Additionally, gaps in absorptive capacity, such as weak human capital and inadequate R&D infrastructure, limit Egypt's ability to utilize FDI for productivity improvements. An example of this is FDI in manufacturing, which often involves low-skilled assembly work. Bureaucratic hurdles, including corruption, further deter high-value FDI. These challenges lead investors to prioritize short-term gains over long-term commitments, thus impeding the potential growth benefits of FDI.

Moreover, a nonlinearity of governance impacts in Egypt is realized. Marginal governance improvements have unexpected negative impact on economic growth during moderate economic phases (quantiles $\tau = 0.2–0.5$), aligning with findings by Emara & Chiu (2016) and Samarasinghe (2018). This is attributable to three key factors: First, Anti-corruption reforms since 2013 disrupted old informal networks, causing delays in investments and projects. Second, the military's control over institutions created rigid, overregulated systems that hindered private-sector innovation. Lastly, it was hard to measure the real impact of governance improvements because Egypt's corruption perception was still low (ranked 130/180 in 2023), and governance improvements were uneven between sectors. which conceal the real impact on growth. In high-growth phases (at $\tau = 0.8$), these governance improvements showed a slight positive impact, although not statistically significant suggesting that sustained reforms in high-growth environments could eventually support growth. The overall cumulative impact is insignificant on long-term growth as Benefits of reforms take time to materialize, leading to short- to medium-term insignificance. Moreover, reforms need to be paired with infrastructure, technology, and human capital improvements to drive growth. Furthermore, factors like political stability, social cohesion, and external conditions influence the effectiveness of reforms. The model's goodness of fit, indicated by a Pseudo R^2 value of 0.85, suggesting that approximately 85% of the variation in the dependent variable is explained by the independent variables in the model.

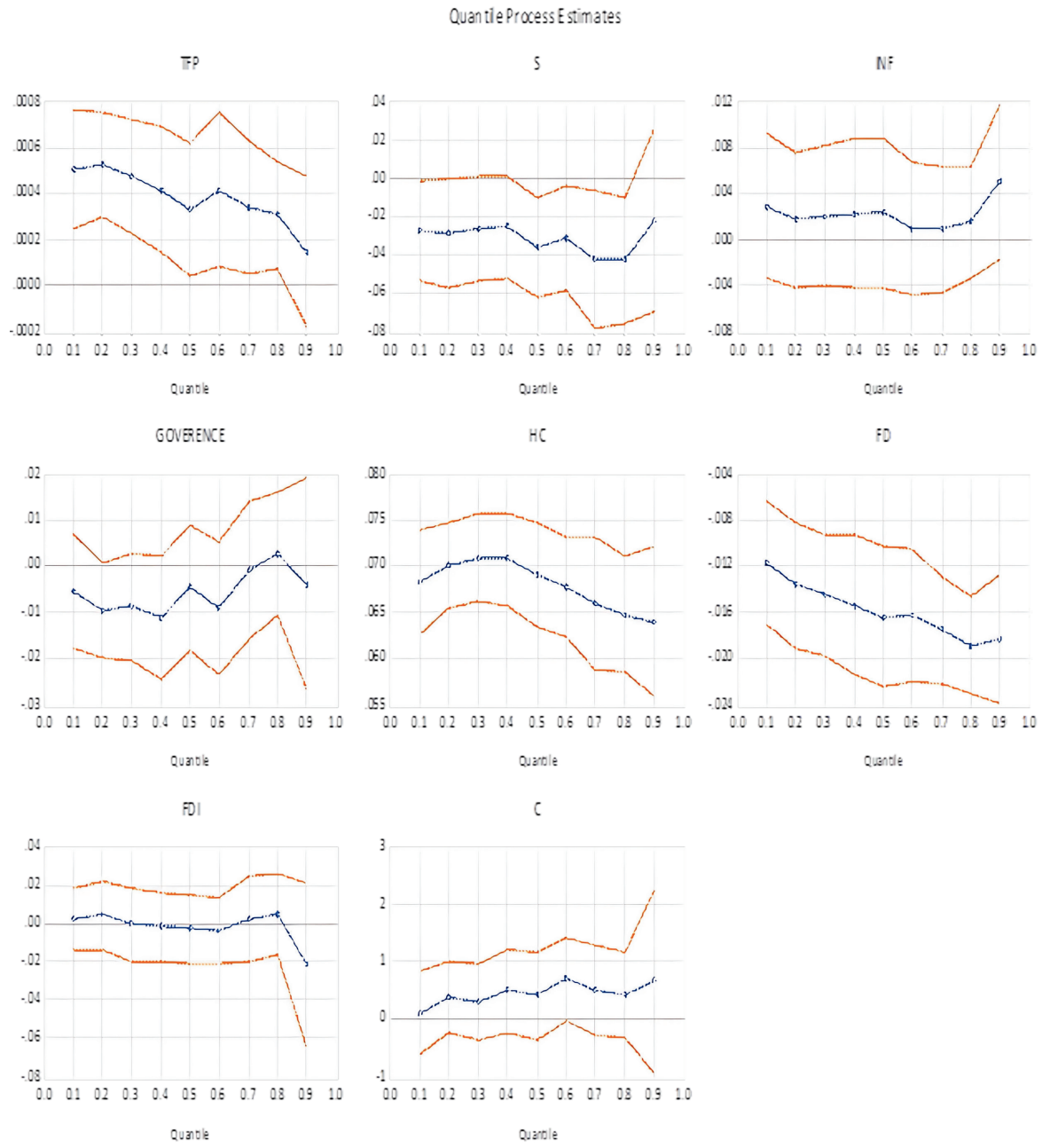

Figure 1. Long-run Quantile Process Estimates

Notes: This figure shows the long-run quantile process estimates for key determinants of Egypt's economic growth, using the QARDL-ECM model. The x-axis represents quantiles (0.1 to 0.9), reflecting growth phases like stagnation, recovery, and prosperity. The y-axis displays the estimated coefficients of independent variables. The solid line indicates point estimates, and the shaded area represents the 95% confidence intervals, showing the precision of the estimates.

As shown in Table (6), the speed of adjustment coefficient (λ) is negative and statistically significant across all quantiles, ranging from -0.17 (τ = 0.9) to its highest value at τ = 0.8. The negative sign of λ indicates convergence toward long-run equilibrium, with deviations corrected over time. The cumulative error correction term (-0.368) suggests that approximately 37% of deviations from equilibrium are corrected annually, implying it would take about 2.7 periods for economic growth to fully return to equilibrium.

Table 6: Short-Term QARDL Estimates with Robust Standard Errors (Huber-White) for Egypt's Economic Growth

***Method**: Quantile ARDL (Median)*

Variable	Coefficient	Robust Std. Error	t-Statistic
Δ(TFP)	0.0002	0.00016	1.48
Δ(TFP(-1))	-0.00004	0.000119	-0.43
Δ(S)	-0.01	0.010257	-0.91
Δ(INF)	0.0003	0.003309	0.12
Δ(INF(-1))	0.002	0.004652	0.60
Δ(GOV)	-0.004	0.006909	-0.50
Δ(GOV(-1))	-0.0017	0.008071	-0.19
Δ(HCI)	0.036	0.041689	1.05
Δ(HCI(-1))	-0.014	0.063641	-0.34
Δ(FD)	-0.012*	0.008537	-1.6
Δ(FD(-1))	0.009	0.010781	1.1
Δ(FDI)	0.004	0.014538	0.22
Constant (C)	0.037	0.068	1.1
ECM (-1)	-0.368**	0.169	-2.22

Diagnostics: *Pseudo* R^2=0.236, Ramsey RESET Test: p=0.06

Note(s): Significance levels: ***1%, **5%, *10%.
Source: Author's calculations using EViews 13.

Table (7) and Figure (2) present the short-run dynamics of the (QARDL-EC) model. Findings reveal that TFP has a modest significant positive effect on Egypt's economic growth during downturns (τ = 0.1–0.7), with its impact declining from 0.0004 (τ = 0.1) to 0.0002 (τ = 0.7). This suggests that TFP advancements are most effective during economic weakness, as underperforming sectors benefit more from productivity improvements (Hsieh & Klenow, 2009; Bloom et al., 2012). However, diminishing returns at higher quantiles (τ > 0.7) indicate that sectors near productivity frontiers experience saturation, limiting further gains. The transient nature of TFP's short-run effects is highlighted by insignificant coefficients for the lagged TFP term, reflecting structural constraints such as skills shortages and an inefficient financial market, which hinder the sustainability of productivity-driven growth.

Furthermore, Changes in the savings rate have an insignificant impact on Egypt's short-term economic growth across all quantiles, likely due to inadequate investment of savings or the offsetting effects of reduced consumption. In contrast, improvements in human capital positively impact growth, with stronger effects during lower and recovery phases (τ = 0.1–0.6), emphasizing the role of education and skills. However, this impact diminishes at higher growth stages (τ = 0.8–0.9), and lagged human capital shows negative coefficients at lower quantiles, suggesting skill mismatches during downturns.

Additionally, inflation has a weak positive effect on growth at the first quantile but is insignificant elsewhere, indicating that moderate inflation may stimulate demand during downturns but becomes neutral in high-growth phases.

Table 7: Short-Run Estimates of the Quantile ARDL-EC Model

Quantile (τ)	dTFP	$dTFP_{(-1)}$	dS	dHC	$dHC_{(-1)}$	dINF	$dINF_{(-1)}$	d(FD)	$dFD_{(-1)}$	dFDI	dGOV	$dGOV_{(-1)}$
0.1	0.0004***	-0.0001	-0.01	0.05*	-0.06	0.003*	0.003	-0.18*	0.006	-0.004	-0.008	-0.005
	[3.1]	[-0.9]	(-0.4)	[1.9]	[-1.5]	[1.95]	[1.02]	[-2.0]	[0.65]	[-0.33]	[-1.1]	[-0.45]
0.2	0.0004***	-0.0001	-0.01	0.05**	-0.05	0.003*	0.001	-0.017*	0.006	-0.002	-0.002	-0.003
	[3.2]	[-0.7]	(-0.4)	[2.3]	[-1.3]	[1.75]	[0.57]	[-1.9]	[0.69]	[-0.15]	[-0.29]	[-0.3]
0.3	0.0004***	-0.00007	-0.01	0.07***	-0.02	0.003	0.001	-0.02***	0.008	0.009	-0.003	0.005
	[3.3]	[-0.5]	(-1.1)	[2.8]	[-0.7]	[1.2]	[0.5]	[-2.9]	[1.2]	[0.79]	[-0.52]	[0.6]
0.4	0.0003***	-0.00006	-0.12	0.06**	-0.004	0.002	0.001	-0.02***	0.006	0.01	-0.002	0.002
	[3.1]	[-0.65]	(-1.2)	[2.4]	[-0.17]	[1.3]	[0.45]	[-3.0]	[1.03]	[0.84]	[-0.29]	[0.3]
0.5	0.00028**	-0.00004	-0.13	0.06**	0.015	0.002	0.003	-0.015**	0.007	-0.002	-0.006	0.001
	[2.16]	[-0.45]	(-0.82)	[2.2]	[0.49]	[1.02]	[0.57]	[-2.3]	[1.07]	[-0.14]	[-0.95]	[0.14]
0.6	0.0003**	-0.00004	-0.01	0.06**	0.015	0.002	0.003	-0.016**	0.006	-0.004	-0.006	0.0003
	[2.3]	[-0.45]	(-0.7)	[2.3]	[0.52]	[1.1]	[0.79]	[-2.6]	[1.07]	[-0.2]	[-0.94]	[0.04]
0.7	0.0002*	-0.00002	-0.004	0.16	-0.03	0.0026	0.001	-0.015*	-0.001	0.005	0.000	0.003
	[1.8]	[-0.45]	(-0.3)	[1.2]	[-0.37]	[1.5]	[-0.38]	[-1.95]	[-0.14]	[0.44]	[0.01]	[0.3]
0.8	0.0002*	-0.0001	-0.001	1.9*	-0.045	0.001	-0.001	-0.02**	-0.004	0.007	0.004	0.009
	[1.9]	[0.65]	(-0.1)	[1.9]	[-0.6]	[1.02]	[-0.69]	[-2.5]	[-0.49]	[0.61]	[0.64]	[0.76]
0.9	0.00018	-0.0003	0.002	0.21	0.03	0.002	0.003	-0.03	-0.001	0.009	-0.001	0.014
	[1.3]	[0.68]	(0.86)	[1.3]	[0.27]	[0.82]	[0.78]	[-1.5]	[-0.66]	[0.58]	[-0.06]	[0.68]

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Note(s): Coefficients are reported with t-statistics in brackets [ ] and significance levels: ***1%, **5%, *10%.
Source: Author's calculations using EViews 13.

Moreover, financial development has negative significant on Egypt's economic growth across nearly all quantiles in the short-run. The adverse effect is strongest during low-growth phases (τ = 0.1) but persists, though weaker, in higher-growth phases. Immediate credit misallocation –favoring unproductive sectors like real estate over SMEs or innovation–drives this growth drag. During downturns (τ = 0.1), inefficient credit distribution exacerbates vulnerabilities, while in high-growth phases (τ = 0.8), the persistent negative effect likely reflects elite capture, with politically connected actors prioritizing low-risk, non-transformative investments (e.g., luxury housing). These findings highlight the urgent need for credit allocation reforms to redirect financial flows toward sustainable and inclusive growth. Similar with the long-run results, inward FDI flows exert insignificant effect on Egypt's growth in the short run, reinforcing that FDI fails to stimulate growth due to Sectoral concentration and Bureaucratic delays. Lastly, governance reforms exert insignificant immediate impact across all quantiles and the Lagged governance effects also show no delayed influence, implying that measures

like anti-corruption drives or bureaucratic digitization fail to produce immediate growth gains. To conclude, governance's growth benefits in Egypt are delayed, requiring sustained reforms and complementary policies to offset short-term inefficiencies.

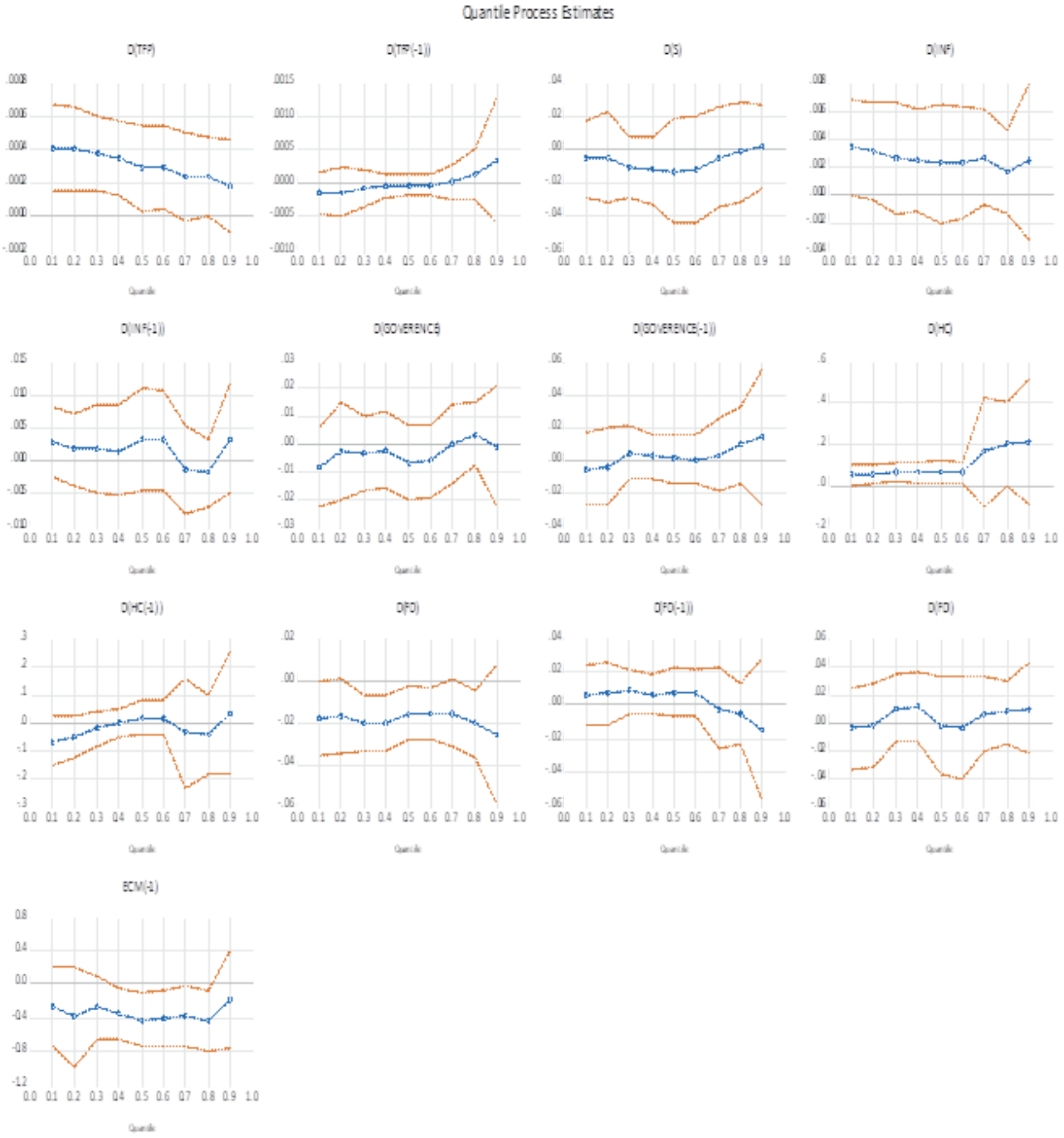

Figure 2. Short-run Quantile Process Estimates

5.2.4 QARDL Robustness Checks

Table (4) presents the results using Huber-White robust standard errors, which account for heteroskedasticity (non-constant variance in residuals) and ensure reliable inference even when residuals deviate from normality. This adjustment is particularly relevant in quantile regression, where residuals often exhibit asymmetry or heavy tails. The Huber-White method corrects for unequal residual variance, providing unbiased standard errors and t-statistics. This is especially critical in Egypt's context, where structural inefficiencies—such as credit misallocation and a large informal economy—frequently induce heteroskedasticity. Although quantile regression does not assume normality, robust standard errors further enhance the reliability of the results by addressing potential skewness or outliers in the residuals. The use of robust standard errors ensures valid significance levels. For instance, Human Capital and Financial Development remain highly significant ($p < 0.01$), underscoring their robust roles in Egypt's economic growth. Savings and TFP retain moderate significance, while inflation, FDI and governance are statistically insignificant.

Table 8. Correlogram of Residuals for QARDL Model

Long-Term					Short-Term			
Lags	(AC)	(PAC)	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	-0.073	-0.073	0.258	0.611	0.248	0.248	2.953	0.086
2	-0.138	-0.144	1.220	0.543	0.131	0.074	3.792	0.150
3	0.130	0.111	2.085	0.555	0.111	0.067	4.413	0.220
4	-0.034	-0.038	2.147	0.709	0.050	0.001	4.541	0.338
5	-0.095	-0.070	2.634	0.756	-0.007	-0.037	4.544	0.474
6	-0.250	-0.297	6.082	0.414	-0.159	-0.172	5.908	0.434
7	0.019	-0.041	6.101	0.528	-0.052	0.022	6.056	0.533
8	0.015	-0.050	6.115	0.634	-0.172	-0.149	7.753	0.458
9	-0.089	-0.041	6.591	0.680	0.001	0.116	7.753	0.559
10	-0.048	-0.116	6.733	0.750	-0.036	-0.030	7.832	0.645
11	0.110	0.032	7.495	0.758	-0.002	0.039	7.832	0.728
12	-0.038	-0.132	7.587	0.817	-0.009	-0.049	7.838	0.798
13	-0.096	-0.107	8.199	0.830	-0.102	-0.105	8.523	0.808
14	-0.003	-0.121	8.200	0.879	-0.075	-0.095	8.911	0.837
15	0.040	-0.033	8.313	0.911	0.060	0.155	9.163	0.869
16	-0.042	-0.110	8.441	0.935	0.095	0.057	9.821	0.876
17	0.023	0.018	8.481	0.955	0.062	0.086	10.114	0.899
18	0.119	0.019	9.590	0.944	0.010	-0.077	10.122	0.928
19	0.043	0.008	9.742	0.959	0.014	-0.037	10.137	0.949
20	-0.063	-0.113	10.079	0.967	-0.103	-0.199	11.026	0.946

Note(s): Autocorrelation (AC): Measures the correlation between residuals at different lags.

Partial Autocorrelation (PAC): Measures the correlation between residuals at a specific lag, controlling for shorter lags.
Q-Stat: Ljung-Box Q-Statistic for testing joint significance of autocorrelations up to the given lag.
Prob: Probability value for the Q-Statistic. A value > 0.05 indicates no significant autocorrelation at that lag
Source: Author's calculations using EViews 13.

By employing Huber-White robust standard errors, the QARDL estimates are resilient to heteroskedasticity and non-normality, offering reliable insights for policymakers. These findings enable policymakers to confidently prioritize investments in human capital and financial sector reforms, assured that the results are robust to data challenges. Furthermore, the correlogram results, (Table 8), indicate no significant autocorrelation in the QARDL model's residuals, both in the short and long term.

To assess the stability of the QARDL model, the Ramsey-RESET test was conducted. The probability value of the F-statistic (0.66) indicates that the functional form of the conditional mean is correctly specified, as detailed in Tables 4 and 6. This further validates the model's reliability.

Finally, the study evaluated asymmetry in the relationships between variables over the short- and long-term using the quantile slope equality Wald test, based on the chi-square distribution. The results support the null hypothesis of linearity between variables in both the short and long run, confirming the validity of symmetry in parameter dynamics across quantiles. This is evidenced by the p-value of the asymmetry Wald test exceeding 5% (Table 9).

Table 9. The Quantile Slope Equality Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test (Short-term Dynamics)	54.1	104	0.99
Wald Test (Long-term Dynamics)	37.3	56	0.97

Source: Author's calculation by using E-Views-13 packages.

6. Conclusion, Policy Recommendation and Future Research

This paper uniquely utilizes the Quantile Autoregressive Distributed Lag-Error Correction Model (QARDL-ECM) to analyze whether FDI, TFP, inflation, savings, human capital, financial development, and governance asymmetrically affect Egypt's economic growth across different quantiles from 1977 to 2023.

The results reveal the asymmetric impacts of key determinants on Egypt's economic growth across varying economic phases.

TFP drives growth in low-to-mid quantiles by addressing inefficiencies but diminishes in high-growth phases due to structural bottlenecks like limited R&D and innovation saturation. Savings paradoxically hinder growth during downturns, reflecting systemic financial intermediation failures and inflationary erosion, while human capital consistently supports growth but faces diminishing returns and skill mismatches in stable phases. Financial development exhibits a persistent negative impact, worsened by credit misallocation to unproductive sectors and elite capture, aligning with the "finance curse" hypothesis. FDI remains negligible due to sectoral concentration and institutional barriers, while governance reforms disrupt informal networks in mid-growth phases, incurring short-term costs. Inflation's weak demand-pull effects in high-growth phases and governance's delayed benefits further highlight the complexity of growth dynamics in Egypt. Short-run dynamics highlight TFP's transient positive effects during downturns, human capital's role in recovery, and FD's persistent negative impact due to credit misallocation.

These findings highlight the need for tailored, phase-specific interventions to navigate Egypt's growth asymmetries. During economic downturns, prioritizing TFP improvements and human capital investments can tackle inefficiencies and stimulate recovery, while high-growth phases demand institutional and regulatory reforms to sustain momentum. Additionally, financial sector reforms should redirect credit flows towards SMEs and innovation-driven sectors, supported by strengthened bankruptcy frameworks and transparent lending practices to curb elite capture and enhance financial inclusivity.

Governance modernization must integrate anti-corruption measures with digitized public services and private-sector collaboration to minimize short-term disruptions and align reforms with growth phases.In periods of high economic growth, it's important to implement and maintain institutional and regulatory reforms to ensure that the growth continues and doesn't stagnate. These reforms can include improving the efficiency and transparency of institutions, streamlining regulations to reduce bureaucratic hurdles, and creating a favorable environment for businesses to prosper. Finally, Egypt's FDI strategy should target high-spillover sectors like renewable energy and technology supported by efficient bureaucratic processes to improve absorptive capacity and attract transformative investments (such as infrastructure development, healthcare improvements and Education and skills training). Together, these measures can harmonize short-term stabilization with long-term structural transformation, fostering sustainable and equitable growth.

To release Egypt's growth potential and eventually drive sustainable inclusive growth, policymakers should adopt a multidimensional strategy targeting structural asymmetries.

This includes enhancing productivity through targeted investments in R&D and technology adoption, especially in lagging sectors like agriculture and textiles during economic recoveries. Modernizing production techniques and fostering innovation ecosystems will help bridge efficiency gaps and integrate Egypt into global value chains. In addition, to optimize human capital, education and vocational training must align with labor market requirements, particularly during economic downturns. Oriented programs in digital literacy, engineering, and healthcare can reduce skill mismatches and prepare the workforce for evolving industries. Moreover, Savings mobilization requires innovative financial instruments, like green bonds and SME-focused microfinance, to direct domestic savings into productive investments. Utilizing digital platforms, like mobile banking, can integrate Egypt's informal sector into the formal economy, unlocking idle capital for growth-oriented projects. Furthermore, to reduce bureaucratic delays and corruption, and to improve public service delivery, it's essential to create a synergy between governance and infrastructure. This can be achieved by implementing e-governance portals to digitize land registries, tax systems, and permit approvals. Lastly, Sectoral Diversification is needed through attracting FDI to high-value sectors (renewable energy, tech) instead of reliance on volatile industries like hydrocarbons. This is achieved through tax incentives, export zones, and public-private partnerships. All these measures can transform structural constraints into opportunities, fostering inclusive, sustainable growth through innovation, institutional efficiency, and economic resilience.

The study encounters three limitations. First, reliance on aggregate metrics may overlook sectoral or regional heterogeneities in TFP, governance, and financial intermediation. Second, the Quantile ARDL-EC framework, while robust, does not account for external shocks (e.g., global commodity prices) or political instability. Third, Governance measurement may not fully capture gradual institutional improvements, underscoring the need for a more comprehensive approach to understanding the impact of governance reforms on economic growth.

Future research should Investigate the nonlinear interactions between governance, political stability, and growth. Also, to enhance the Quantile ARDL-EC framework, the model can be expanded to account for external shocks (such as global commodity price volatility, geopolitical instability, or pandemics) and sector-specific dynamics (such as agriculture, manufacturing, tourism). This extension improves policy relevance by capturing how external forces and sectoral heterogeneity elaborate or mitigate growth asymmetries in Egypt.

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