

Article

Decomposing Economic Growth in Jordan Using the Growth Accounting Method

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Abstract

Despite a growing body of research on economic growth, updated empirical evidence on the relative contributions of factor accumulation and productivity to Jordan's long-run growth remains limited. This study investigates the sources of economic growth in Jordan over the period 1980–2024 by integrating production function estimation with a long-run growth accounting methodology. Annual macroeconomic data are used to estimate the production function through the ordinary least squares (OLS) method. The estimated parameters are then applied in a growth accounting methodology to decompose output growth into the contributions of labor, physical capital, and total factor productivity (TFP). The estimation results indicate that capital per worker has a positive and statistically significant impact on real output per worker. The growth accounting analysis shows that labor has been the primary driver of economic growth, contributing an average of 48.94% of total growth over the study period. Physical capital follows with a contribution of 40.16%, while total factor productivity (TFP) accounts for only 11.13%. These results suggest that Jordan's long-run economic growth has been driven mainly by the accumulation of labor and capital rather than by sustained improvements in productivity. By integrating production function estimation with long-term growth accounting over more than four decades, this study provides updated empirical evidence on the evolution of Jordan's growth drivers and offers a comprehensive country-specific assessment. The findings also underscore the importance of policies that foster innovation, improve resource allocation and production efficiency, accelerate digital transformation, strengthen the business environment, and encourage investment in high-value-added activities to support more sustainable long-run economic growth.

Keywords: economic growth; growth accounting; Jordan; productivity



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1. Introduction

Economic development plans in most countries primarily aim to achieve sustained economic growth that contributes to improving the standard of living for both individuals and society. These plans emphasize that growth should not be temporary or driven by short-term changes that fade once such conditions disappear. Instead, they focus on fostering long-term, well-structured growth derived from both qualitative and quantitative changes in the factors of production. Therefore, the analysis of the sources of economic growth has attracted considerable attention in the field of economics due to its essential role in

explaining the determinants of changes in production and income over time, as well as in understanding the drivers of long-term economic performance.

To identify the sources of growth, the previous literature has employed various analytical approaches, including growth accounting. This methodology provides a systematic framework for decomposing growth rates into their primary components, such as capital accumulation, labor force growth, and technological progress, often expressed as total factor productivity (TFP). The importance of this approach lies in its ability to provide a precise quantitative understanding of each factor's contribution to growth, thereby enabling researchers and policymakers to evaluate the effectiveness of economic policies and to better prioritize structural reforms (Solow, 1957; Zeytoon-Nejad, 2025).

The study of economic analysis through growth accounting has become increasingly important today, particularly in light of ongoing structural transformations and the significant challenges associated with productivity and innovation in the global economy. This approach aims not only to measure growth rates but also to understand the underlying dynamics driving growth, including the contributions of human capital, institutional development, trade liberalization, and technological progress. Furthermore, it facilitates both cross-country and intertemporal comparisons, thereby helping to identify various growth patterns and the critical factors that distinguish successful economies (Caselli, 2005).

Analyzing the sources of growth in the Jordanian economy is of critical importance, particularly in light of the economic and political conditions Jordan experienced between 1980 and 2024. This period was characterized by numerous structural challenges, including limited natural resources, a relative dependence on foreign aid, and sensitivity to regional and international shocks. Despite these constraints, the Jordanian economy exhibited a relative capacity for adaptation and continued to achieve good growth rates. This, in turn, raises important questions regarding the nature and drivers of this growth.

During the study period, Jordan experienced significant fluctuations in economic growth rates. In 1981, growth peaked at a record high of 17.18%, driven largely by the implementation of a comprehensive five-year economic and social development plan supported by both the public and private sectors. However, this strong performance was not sustained, as growth sharply declined to its lowest level in 1989, reaching -10.73% . This downturn was primarily attributed to a combination of external and internal factors, including declining oil prices, shrinking export markets, and a reduction in workers' remittances and foreign aid inflows. This led to a decline in foreign reserves and put pressure on the Jordanian dinar's exchange rate, ultimately leading to its devaluation and subsequent floating (Central Bank of Jordan, 1989).

Jordan's economic growth rate recovered, reaching 6.2% in 1995, as a result of corrective policies, the restructuring of various economic sectors, and addressing distortions by activating market forces and enhancing confidence in the local investment environment to attract both domestic and foreign investment. Growth rates continued to fluctuate in the following years, eventually reaching 8.57% in 2004, a consequence of the comprehensive economic reform program implemented by the Jordanian economy during that period (Central Bank of Jordan, 2004).

The unfavorable political conditions in the region following 2004 had a clear impact on the volatility of Jordan's economic growth rates. The global financial crisis of 2008 also cast a shadow over the Jordanian economy, contributing to continued fluctuations in growth. These pressures persisted until 2020, when the growth rate declined to -1.1% , largely due to the economic repercussions of the COVID-19 pandemic and the associated lockdown measures. Overall, Jordan's average economic growth rate reached 3.91% over the period 1980–2024. Furthermore, the values of real GDP exhibited a general upward trend throughout the study period, with the exception of the years 1983, 1985, 1989, 1990, and 2020.

This presentation of Jordanian economic data indicates persistent fluctuations in economic growth rates, with few periods of sustained expansion. This trend highlights the importance of studying the sources of growth in Jordan to understand its drivers within the structural characteristics of the Jordanian economy over the past period, and to assess the contribution of quantitative and qualitative factors to economic growth. Such an analysis can support policymakers in identifying the main determinants of economic growth and in designing effective economic policies aimed at promoting long-term and sustainable growth, particularly in light of the recent economic slowdown.

Despite the widespread application of growth accounting in the empirical growth literature, evidence on the sources of long-run economic growth in Jordan remains limited. Previous studies have either examined specific sectors, focused on relatively short time periods, or considered Jordan within broader cross-country or regional analyses, which may not fully capture the country's unique economic structure and the sequence of structural changes experienced over time. By covering the period 1980–2024, this study provides a long-term assessment of the factors underlying economic growth in Jordan and the evolution of their relative importance over more than four decades.

This study makes two contributions to the literature. First, it contributes to the empirical application of the neoclassical growth framework by integrating production function estimation with growth accounting in a unified analytical approach. Rather than relying on assumed factor shares, the study estimates output elasticities for Jordan using a log-linearized Cobb–Douglas production function and uses these estimates to decompose economic growth into the contributions of capital, labor, and total factor productivity. In addition, by incorporating a dummy variable into the production function and adjusting the productivity calculation accordingly, this study accounts for the influence of major disruption periods on Jordan's growth process, providing a more context-specific assessment of productivity dynamics. Second, the study offers updated long-run evidence on the relative roles of factor accumulation and productivity improvements in explaining economic growth in a small developing economy. The findings help clarify whether Jordan's growth performance has been primarily driven by the expansion of production factors or by improvements in efficiency and productivity, while providing relevant implications for policies aimed at achieving more sustainable long-term growth.

Finally, this research consists of five parts designed to achieve the study's objectives and answer its questions. The first part provides an introduction to the research topic, clarifies its significance, and identifies the problem that motivated this study. The second part presents the theoretical framework, reviewing the most relevant literature and previous studies that contributed to building the theoretical model upon which the research is based. The third part focuses on the research methodology, explaining the data used and its sources, as well as presenting the analytical model used in the study. The fourth part is dedicated to statistical analysis, where appropriate statistical methods are employed to test the hypotheses and analyze the data scientifically. Finally, the fifth part presents the findings, discusses them in light of the research objectives, and offers a set of recommendations and suggestions that can contribute to the development of future studies in this field.

2. Literature Review

Studying the sources of economic growth is a central topic in macroeconomics, as it seeks to identify the contributions of the main factors of production to long-run economic growth. One of the most widely used analytical frameworks in this field is the growth accounting methodology, which decomposes economic growth into its fundamental sources and quantitatively measures the contribution of each production factor in a systematic manner (Solow, 1957).

The theoretical basis of growth accounting is the aggregate production function, with the Cobb–Douglas production function being the most widely used. This function explains how inputs such as capital and labor are transformed into economic output. Using this approach, researchers can estimate the extent to which economic growth is driven by capital accumulation, labor, and total factor productivity (TFP). TFP is typically calculated as the Solow residual, which captures the share of output growth that cannot be explained by increases in production inputs. It is commonly interpreted as reflecting technological progress, innovation, and improvements in production efficiency (Barro & Sala-i-Martin, 2004; Ataev, 2024).

Under the traditional Solow growth model, TFP is considered an exogenous component that reflects technological progress. However, subsequent developments in growth theory emphasize that productivity changes over time and is influenced by broader economic, institutional, and technological factors. Accordingly, TFP reflects a wider set of determinants, including human capital accumulation, trade openness, foreign direct investment, and macroeconomic conditions. Several empirical studies (Chen & Feng, 2000; Takumah & Iyke, 2017; Ho, 2018) therefore use a modified Solow model where productivity changes over time and responds to these structural factors.

The importance of identifying the sources of economic growth arises from their implications for productivity levels, living standards, and long-run development performance. Growth accounting provides a structured framework for decomposing economic growth into the contributions of capital, labor, and TFP, thereby allowing comparisons across countries and over time (Hulten, 2009). As a flexible analytical approach, it can be applied in cross-country and time-series analyses without imposing excessively restrictive assumptions regarding production structures (Greenwood & Krusell, 2006). Despite its limitations, particularly regarding the measurement and interpretation of technological progress, growth accounting remains one of the most widely used tools for analyzing economic growth and informing policy discussions (Romer, 2012).

A key consideration in applying the growth accounting framework is that TFP is obtained as a residual component after accounting for the contributions of capital and labor. Consequently, productivity estimates may reflect not only technological progress and efficiency improvements but also measurement errors, omitted factors, institutional changes, and economic shocks that influence production performance. Therefore, growth accounting results require careful interpretation, particularly in developing economies where structural transformations, external shocks, and changes in economic conditions may affect the production process and the measurement of productivity. Incorporating the broader economic context is thus essential when evaluating the sources of long-run growth and interpreting changes in TFP (Hulten, 2001; OECD, 2001; Solow, 1957).

Although growth accounting remains one of the most widely adopted approaches for decomposing aggregate output growth into the contributions of capital, labor, and total factor productivity (TFP), the productivity literature has increasingly employed alternative methodologies to examine production performance and productivity dynamics from different analytical perspectives. These approaches do not necessarily represent substitutes for growth accounting; rather, they provide complementary insights depending on the specific research objective and the level of analysis.

One prominent alternative approach is Stochastic Frontier Analysis (SFA), which estimates a production frontier while explicitly accounting for technical inefficiency and statistical noise. Unlike the growth accounting framework, where the unexplained component of output growth is attributed to TFP, SFA allows researchers to distinguish between technological progress and changes in technical efficiency. Therefore, SFA is particularly suitable for stud-

ies focusing on production efficiency, the sources of inefficiency, and deviations from the estimated production frontier (Aigner et al., 1977; Kumbhakar & Lovell, 2000).

Similarly, Data Envelopment Analysis (DEA) and the Malmquist Productivity Index have been widely applied to evaluate productivity changes by decomposing productivity growth into efficiency improvements and technological change. These approaches are especially useful when the objective is to assess relative efficiency performance among firms, sectors, or countries and to identify changes in production possibilities over time (Charnes et al., 1978; Färe et al., 1994; Coelli et al., 2005).

Recent empirical studies demonstrate the growing application of these alternative approaches in productivity analysis. For instance, D'Errico (2024) employed a stochastic frontier framework to investigate sustainable economic growth and production efficiency across OECD countries, emphasizing the role of institutional quality and energy-related factors in explaining efficiency differences. Likewise, Sun et al. (2025) applied an advanced stochastic frontier approach, decomposing output growth into technical change, the input-driven component, and efficiency change, while decomposing TFP growth into technical change, the scale component, and efficiency change. In addition, Diewert and Fox (2024) examined alternative approaches to measuring output, input, and productivity, highlighting that different methodologies provide complementary perspectives on economic performance according to their analytical objectives.

Despite the availability of these alternative methodologies, the choice of an appropriate framework depends primarily on the research question and the nature of the analysis. While SFA, DEA, and related approaches are mainly designed to evaluate production efficiency and identify sources of inefficiency, growth accounting is specifically developed to decompose aggregate economic growth into the contributions of factor accumulation and total factor productivity within the neoclassical growth framework. Therefore, growth accounting remains particularly suitable when the objective is to quantify the contributions of capital, labor, and productivity to economic growth.

In line with this objective, the present study adopts the growth accounting methodology to investigate the sources of economic growth in Jordan. Moreover, unlike conventional growth accounting applications that commonly rely on factor income shares as proxies for output elasticities, this study estimates Jordan-specific output elasticities from a log-linearized Cobb–Douglas production function. These estimated elasticities are subsequently incorporated into the growth accounting framework, providing country-specific parameters that better reflect the structural characteristics of the Jordanian economy. This approach allows the analysis to capture the contribution of production factors based on empirically estimated relationships rather than relying solely on assumptions derived from standard parameter values.

A large body of empirical literature has applied the growth accounting methodology to identify the sources of economic growth across different economic contexts. However, the evidence indicates that the relative contributions of capital accumulation, labor input, and total factor productivity vary considerably across countries and regions depending on economic structures, institutional conditions, and stages of development.

Among the early empirical contributions, Senhadji (1999) examined the sources of economic growth across a group of countries during the period 1960–1994 and found substantial differences in productivity performance across regions. The study showed that sub-Saharan African countries experienced weak growth in total factor productivity, which was associated with limited physical and human capital accumulation and weak productivity improvements. In contrast, the rapid growth experienced by East Asian countries was primarily driven by capital accumulation rather than the improvements in total factor

productivity. These findings highlighted the importance of distinguishing between factor accumulation and productivity growth when evaluating long-run economic performance.

Subsequent studies have provided further evidence regarding the dominant role of factor accumulation in many developing economies. Zelleke and Sraiheen (2012) identified capital accumulation as a major contributor to economic growth in several developing countries. Similarly, Nkoro and Uko (2019) and Senbet and Wodajo (2022) also found that capital accumulation represented a major source of economic growth in Nigeria and Ethiopia, respectively, while the contribution of total factor productivity remained relatively limited.

More recent research has expanded the growth accounting literature by emphasizing the dynamic role of productivity and resource allocation in explaining differences in economic performance. Esfahani et al. (2024) investigated global productivity trends and indicated that productivity growth and resource reallocation contribute significantly to variations in economic performance across countries. Their findings reinforce the view that factor accumulation alone cannot fully explain long-term economic growth and that improvements in productivity remain essential for sustained development. On the other hand, Ataev (2024), applying a growth accounting methodology to Central Asian economies, identified significant cross-country differences in the contribution of production factors and highlighted the importance of considering country-specific characteristics when interpreting growth accounting outcomes.

Within the Middle East and North Africa (MENA) region, several studies have applied growth accounting and related productivity frameworks to investigate the sources of economic growth. Senay et al. (2016) examined the determinants of economic growth in MENA economies and concluded that physical and human capital accumulation were the main contributors to output growth, while technological progress played a relatively smaller role.

Using a broader regional perspective, Malik and Masood (2021) investigated a panel of 14 MENA countries over the period 1970–2016 using a translog stochastic production function estimated through a True Fixed Effects model. Their analysis decomposed total factor productivity growth into technical change, technical efficiency, and scale efficiency components. The findings demonstrated that factor accumulation, particularly capital accumulation, remained the dominant source of output growth across the region, whereas productivity improvements contributed relatively less.

In a recent study, Nadjia et al. (2024) analyzed economic growth in the MENA region over the period 1970–2023 using a set of econometric methods to estimate output elasticities of capital and labor. Their findings indicated that capital accumulation represents the main driver of economic growth, contributing more significantly than labor and total factor productivity. The study further showed that the contribution of TFP in the MENA region remains relatively weak compared with other regions.

Compared with the broader international and regional literature, empirical research applying growth accounting to Jordan remains relatively limited. Among the few studies focusing specifically on Jordan, Akroush et al. (2016) examined productivity growth in the Jordanian agricultural sector over the period 1961–2011. Using a log-linear regression approach, the study analyzed the relationship between total factor productivity growth and its determinants. The results indicated that productivity growth in Jordan's agricultural sector remained relatively low compared with international benchmarks, reflecting persistent structural and efficiency-related constraints. However, the sector-specific nature of the analysis provides only partial insights into economy-wide sources of growth and does not capture aggregate changes in production factors and productivity.

Bani Ata et al. (2024) estimated total factor productivity growth in Jordan over the period 2010–2023 and examined the main factors influencing productivity performance. The study estimated total factor productivity growth over the period 2010–2023 and exam-

ined the factors influencing productivity performance. The findings indicated that labor contributed more significantly to output growth than capital or TFP. Furthermore, the study showed that TFP performance in Jordan is influenced by several factors, including trade openness, the Human Development Index (HDI), the ratio of foreign direct investment to GDP, and imports. However, the relatively short sample period limits the ability of the study to capture long-term growth dynamics and structural changes affecting productivity.

The existing literature indicates that most growth accounting studies have focused on groups of developing countries, such as those examining the MENA region. While these studies provide valuable comparative evidence, their findings may not fully reflect the structural characteristics and growth dynamics of individual economies. This limitation is particularly relevant for Jordan, which has experienced substantial economic transformations, regional instability, economic reforms, and global disruptions over the past four decades.

Consequently, there remains a need for an updated country-specific investigation that applies a growth accounting framework over an extended period to quantify the respective contributions of capital accumulation, labor input, and total factor productivity to Jordan's economic growth. By estimating Jordan-specific output elasticities from a log-linearized Cobb–Douglas production function and incorporating these estimates into the growth accounting framework, this study provides a country-specific assessment of the sources of growth. Furthermore, by considering major structural changes and economic disruptions affecting the Jordanian economy, the study aims to provide a more comprehensive understanding of the factors underlying Jordan's long-run growth performance.

3. Methodology

3.1. Data

To identify the sources of economic growth in Jordan, this study employs annual data covering the period 1980–2024. The analysis is based on a set of macroeconomic variables, including real gross domestic product (GDP) and real gross fixed capital formation (I), both measured in millions of Jordanian dinars at constant 2016 prices. These data were obtained from the [World Bank \(2026\)](#) database. This study also includes labor (L), measured as the number of employed persons (in millions), with data sourced from the [Penn World Table \(2025\)](#).

Since official data on Jordan's capital stock are unavailable, the capital stock series was estimated using the Perpetual Inventory Method (PIM) following the methodology proposed by [Nehru and Dhareshwar \(1993\)](#). Under this approach, the capital stock is constructed recursively by combining real gross fixed capital formation with a constant depreciation rate. Specifically, the capital stock in period (t) is equal to the undepreciated portion of the previous period's capital stock plus real gross fixed capital formation in the current period. This approach is widely adopted in empirical studies when official capital stock data are unavailable and provides a consistent measure of the productive capital stock for production function estimation.

Finally, the model incorporates a dummy variable to capture the effects of major episodes of political and economic instability during the sample period. The dummy variable takes the value of 1 for the years 1989, 1990, 2003, 2008, 2011, 2012, 2020, and 2021, and 0 otherwise.

3.2. Econometric Model

The theoretical framework adopted in this study indicates that the analysis of the sources of economic growth in Jordan over the period 1980–2024 is based on the production function, specified as follows:

$$Y_t = A_t K_t^\alpha L_t^\beta \quad (1)$$

Consistent with the existing literature, this study assumes constant returns to scale ($\alpha + \beta = 1$) in order to simplify the estimation of the production function and to ensure that the sum of factor contributions equals total output growth. Under this assumption, the estimated production elasticities represent the returns associated with each factor of production.

To obtain labor productivity in period (t), the production function is divided by the labor input, as follows:

$$\left(\frac{Y}{L}\right)_t = A_t \left(\frac{K}{L}\right)_t^\alpha \quad (2)$$

For estimation purposes, the previous exponential equation is transformed into a linear specification by taking natural logarithms, to be presented in the following econometric form:

$$\log\left(\frac{Y}{L}\right)_t = \log A_t + \alpha \log\left(\frac{K}{L}\right)_t + \varepsilon_t \quad (3)$$

where $\log$ is the natural logarithm and ε_t is the error term.

The above equation has been modified to incorporate a dummy variable capturing the years of political and economic instability in the region during the study period.

$$\log\left(\frac{Y}{L}\right)_t = \log A_t + \alpha \log\left(\frac{K}{L}\right)_t + \gamma D_t + \varepsilon_t \quad (4)$$

where D is a dummy variable taking the value of 1 in 1989, 1990, 2003, 2008, 2011, 2012, 2020, and 2021, and 0 in all other years, and γ is the parameter associated with the dummy variable.

The empirical approach adopted in this study combines production function estimation with the growth accounting methodology in order to obtain a country-specific assessment of the sources of economic growth in Jordan. Unlike approaches that rely on predetermined factor income shares, this study estimates the output elasticity of capital from a log-linear Cobb–Douglas production function expressed in per-worker terms. Under the assumption of constant returns to scale, the output elasticity of labor is subsequently derived from the estimated capital elasticity. The resulting elasticities are then used to quantify the contributions of capital and labor to aggregate output growth.

Moreover, the production function contains a dummy variable that considers any major disruption periods that may have affected Jordan's economic performance. By incorporating this variable into the production function, the analysis indicates that changes in output may reflect not only variations in factor accumulation but also exceptional economic and political disruptions. Accordingly, total factor productivity growth is calculated after accounting for the contributions of capital, labor, and the estimated effect of these disruption periods. This adjustment provides a more refined interpretation of the Solow residual by reducing the likelihood that major temporary shocks are captured as unexplained productivity changes.

3.3. Growth Accounting

Economic growth is commonly defined in the literature as the percentage change in real GDP over time. Mathematically, it can be expressed by taking the time derivative of the aggregate production function, as follows:

$$\frac{dY_t}{dt} = K_t^\alpha L_t^\beta \frac{dA_t}{dt} + A_t L_t^\beta \frac{dK_t^\alpha}{dt} + A_t K_t^\alpha \frac{dL_t^\beta}{dt} \quad (5)$$

Taking the time derivatives of the explanatory variables yields the following expressions:

$$\frac{dY_t}{dt} = K_t^\alpha L_t^\beta \frac{dA_t}{dt} + A_t L_t^\beta \alpha K_t^{\alpha-1} \frac{dK_t}{dt} + A_t K_t^\alpha \beta L_t^{\beta-1} \frac{dL_t}{dt} \quad (6)$$

To express the derivative in terms of growth rates, both sides of the equation are divided by Y_t , or equivalently by its expanded form $A_t K_t^\alpha L_t^\beta$, yielding the following expression:

$$\frac{1}{Y_t} \frac{dY_t}{dt} = \frac{1}{A_t} \frac{dA_t}{dt} + \frac{\alpha}{K_t} \frac{dK_t}{dt} + \frac{\beta}{L_t} \frac{dL_t}{dt} \quad (7)$$

This expression can be simplified as follows:

$$\dot{Y}_t = \dot{A}_t + \alpha \dot{K}_t + \beta \dot{L}_t \quad (8)$$

To measure total factor productivity growth, the previous expression is modified to include a dummy variable and rearranged to decompose productivity growth into total output growth and the contributions of production factors, as follows:

$$\dot{A}_t = \dot{Y}_t - (\alpha \dot{K}_t + \beta \dot{L}_t + \gamma D_t) \quad (9)$$

where $\dot{A}$ is total factor productivity growth, $\dot{Y}$ is total output growth, $\dot{K}$ is capital growth, and $\dot{L}$ is labor growth. This equation shows that total factor productivity (TFP) growth is measured as the difference between the total output growth rate and the sum of the contributions of production factors.

4. Results and Discussion

Identifying the sources of economic growth in Jordan depends on estimating the labor productivity equation specified in Equation (4). Before estimation, it is necessary to examine the stationarity properties of the variables to avoid spurious regression. Accordingly, the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests were employed to assess the stationarity of the data. These tests evaluate the null hypothesis that a series contains a unit root (i.e., the variable is non-stationary) against the alternative hypothesis that the series is stationary. The results of the ADF and PP tests are reported in Table 1.

Table 1. The unit root tests.

Variable	ADF Test				PP Test			
	Statistic Value	Critical Value	Prob.	Lags	Statistic Value	Critical Value	Prob.	Bandwidth
$\log\left(\frac{Y}{L}\right)_t$	−2.93	−2.93	0.05	1	−3.18	−2.93	0.028	5
$\log\left(\frac{K}{L}\right)_t$	−3.23	−2.93	0.025	1	−2.956	−2.93	0.047	2

The results of the ADF and PP tests indicate that all variables in the study are stationary at level (I(0)), as the null hypothesis of a unit root is rejected for each variable. In the ADF test, the optimal lag length, used to eliminate autocorrelation in the residuals, was selected based on the minimum value of the Akaike Information Criterion (AIC). For the PP test, the bandwidth parameter was determined using the Newey–West bandwidth selection procedure.

After confirming that all variables were stationary at level, the study proceeded to estimate the labor productivity equation specified in Equation (4) using the Ordinary Least Squares (OLS) method. The results are presented in Table 2.

Table 2. The results of OLS.

Dependent variable: $\log\left(\frac{Y}{L}\right)$			
Variable	Coefficient	t-statistic	Probability
Constant	2.366	2.776	0.008
$\log\left(\frac{K}{L}\right)$	0.657	5.051	0.000
Dum	−0.034	−3.417	0.002
AR(1)	0.977	20.586	0.000
R-squared	0.96		
Adjusted R-squared	0.96		
F-statistic	268.00		
Prob (F-statistic)	0.00		

The estimation results reported in Table 2 indicate that the elasticity of capital per worker is (0.657), which is positive and statistically significant. This means that a 1% increase in capital per worker leads to a 0.657% increase in real output per worker, holding other factors constant. This finding suggests that capital has played an important role in supporting labor productivity in Jordan during the study period. However, because the estimated elasticity of output with respect to capital is below unity, increases in capital per worker generate less-than-proportional increases in output, indicating diminishing marginal returns on capital. Overall, the estimated elasticity falls within the range commonly reported in empirical studies of developing economies and as predicted by neoclassical production theory, which emphasizes the positive contribution of capital accumulation to output growth.

The results also indicate that the coefficient of the instability dummy variable is negative and statistically significant, suggesting that periods of instability are associated with lower output than periods of stability, *ceteris paribus*. This finding implies that instability adversely affects production by increasing uncertainty, discouraging investment, disrupting productive activities, and reducing the efficiency of resource utilization.

Overall, the findings suggest that the explanatory variables used in the production function explain 96% of the variation in real labor productivity, suggesting a strong explanatory power of the model. Furthermore, the statistical significance of the F- statistic indicates that the independent variables are jointly significant.

Finally, residual diagnostic tests were conducted to ensure that the model is free of statistical problems. Heteroskedasticity was examined using the Breusch–Pagan–Godfrey test, whose null hypothesis assumes homoskedasticity. The results indicate that the null hypothesis cannot be rejected at the 5% significance level ($p = 0.55$), suggesting the absence of heteroskedasticity. In addition, multicollinearity was assessed using the Variance Inflation Factor (VIF), and the results, reported in Table 3, indicate no evidence of multicollinearity, as all VIF values are below 5. However, the model initially exhibited autocorrelation, as indicated by a Durbin–Watson statistic of 0.137. This issue was corrected by introducing an AR(1) term into the model, which improved the Durbin–Watson statistic to 1.624.

After ensuring the validity of the estimated model through a set of diagnostic tests, the analysis proceeds to assess the robustness of the baseline results by employing an alternative estimation technique, namely Generalized Least Squares (GLS). The findings indicate that the estimated coefficients remain statistically significant and retain their expected signs, confirming the stability of the main results. Although a slight change in the magnitude of the parameters is observed, the overall pattern remains consistent. Specifically, the coefficient of

capital is estimated at 0.719, while the dummy variable coefficient is -0.033 . These results, presented in Table 4, support the robustness of the baseline estimates to changes in the estimation technique.

Table 3. Variance Inflation Factor.

Variable	VIF
C	-
$\log\left(\frac{K}{L}\right)$	1.216
D	1.154

Table 4. The results of GLS.

Dependent variable: $\log\left(\frac{Y}{L}\right)$			
Variable	Coefficient	t-statistic	Probability
Constant	1.64	0.01	0.99
$\log\left(\frac{K}{L}\right)$	0.719	5.759	0.000
Dum	-0.033	-2.776	0.01
AR(1)	1	8.995	0.000
R-squared	0.97		
Adjusted R-squared	0.96		
F-statistic	373.81		
Prob (F-statistic)	0.00		

Based on the results presented in Table 2, the output elasticity with respect to capital is 0.657, assuming a constant rate of return, and the implied output elasticity with respect to labor is 0.343. These values are subsequently used to analyze the sources of growth.

To apply the growth accounting methodology, the study period is divided into five sub-periods, each characterized by a set of economic, social, and political conditions that influenced Jordan's economic growth rate, as shown in the following Table 5:

Table 5. The results of Growth Accounting.

Stage	Period	$\dot{Y}$	$\dot{K}$	$\dot{L}$	CK	CL	TFP
Economic disequilibrium	1980–1989	3.332	0.29	5.403	0.191	1.853	1.291
The initial of economic reform	1990–1999	4.314	1.239	7.127	0.814	2.445	1.061
Economic liberalization and high growth	2000–2008	6.629	2.964	3.411	1.947	1.17	3.519
Financial and economic crisis impacts	2009–2014	3.083	4.129	1.613	2.713	0.553	-0.168
Economic slowdown and the effects of the pandemic	2015–2024	2.121	1.9	5.986	1.248	2.053	-1.174
The entire period	1980–2024	3.907	1.905	5.012	1.252	1.719	0.943

where CK, and CL denote the contributions of capital, and labor, respectively. The dummy variable affects TFP in the years in which it takes the value of one ($TFP = \dot{Y}_t - 0.657\dot{K}_t - 0.343\dot{L}_t - 0.034D_t$).

The results of the growth accounting presented in Table 5 identify the contribution of the main factors of production to economic growth in Jordan over the period 1980–2024. For a more detailed analysis, the study period was divided into five sub-periods, as outlined below:

- **The first sub-period (1980–1989):** This period was characterized by relatively low economic growth, with an average growth rate of 3.332%. Capital accumulation was also low during this period, with an average growth rate of 0.29%, resulting in a weak contribution to economic growth 0.191 percentage points. In contrast, the average growth rate of

the labor was 5.403%, making a relatively strong contribution of 1.853 percentage points to total economic growth. Meanwhile, total factor productivity (TFP) made contribution of 1.291 percentage points.

These outcomes can be attributed to several structural and macroeconomic factors, including the debt crisis experienced by the Jordanian economy during that period, the decline in workers' remittances following falling oil prices, and weak private investment. Overall, economic growth during this period was predominantly driven by labor expansion rather than productivity improvements.

- **The second sub-period (1990–1999):** This period witnessed a gradual increase in economic performance, with the average economic growth rate increasing to 4.314%. Capital accumulation also improved, recording an average growth rate of 1.239%. Although this remained below expectations, its contribution to economic growth increased to 0.814 percentage points. The contribution of labor also rose during this period, reaching 2.445 percentage points. While total factor productivity (TFP) remained relatively weak, with a contribution of 1.061 percentage points.

These findings were linked to a number of factors, most notably the return of expatriate workers after the First Gulf War, increased domestic consumption, the implementation of economic reform programs, and the expansion of education. Consequently, growth during this period was primarily driven by domestic demand and increased government expenditure, particularly in the education sector.

- **The third sub-period (2000–2008):** This period recorded the highest average economic growth rate during the study period, reaching 6.629. This strong performance was driven primarily by capital accumulation, which grew at an average rate of 2.964% and contributed 1.947 percentage points to overall economic growth.

In contrast, the employment growth rate declined to 3.411%, and its contribution to economic growth fell to 1.17 percentage points during this period. Meanwhile, total factor productivity (TFP) contributed 3.519 percentage points to economic growth, accounting for more than half of total economic growth. This substantial contribution suggests that improvements in productivity—including technological progress, greater production efficiency, institutional reforms, trade liberalization, and other efficiency-enhancing factors—played a major role in driving economic growth during this period.

- **The fourth sub-period (2009–2014):** The results indicate that the slowdown in economic growth during this period occurred despite a substantial increase in capital accumulation. Capital grew by 4.129% and contributed 2.713 percentage points to economic growth, while labor made only a modest contribution of 0.553 percentage points. More importantly, total factor productivity (TFP) recorded a negative contribution (−0.168) of percentage points, suggesting a decline in the efficiency with which capital and labor were utilized. This pattern indicates that economic growth during this period was driven mainly by factor accumulation rather than productivity improvements.

The negative TFP contribution may be attributed to several adverse developments, including the lingering effects of the global financial crisis, regional political instability following the Arab Spring, disruptions in trade with neighboring countries, repeated interruptions in Egyptian natural gas supplies that increased production costs, and the economic pressures associated with the influx of Syrian refugees. Collectively, these factors reduced production efficiency and constrained the economy's ability to translate higher capital accumulation into stronger economic growth.

- **The fifth sub-period (2015–2024):** The results indicate that economic growth continued to weaken during this period, with the average growth rate declining to 2.121%, the lowest recorded during the study period. Capital accumulation also slowed, with an average growth rate of 1.9%, reducing its contribution to economic growth to 1.248 per-

centage points. In contrast, employment expanded considerably, growing at an average annual rate of 5.986% and contributing 2.053 percentage points to overall growth. Despite this increase in labor input, total factor productivity (TFP) remained negative, contributing (−1.174) percentage points to economic growth.

This finding suggests that the additional labor and capital were utilized less efficiently, resulting in a further deterioration in overall productivity. The persistent decline in TFP may reflect the combined effects of weak private investment, slow structural transformation, limited technological progress, high production costs, the economic repercussions of the Syrian refugee crisis, and the disruptions caused by the COVID-19 pandemic. Consequently, growth during this period was driven primarily by quantitative factors—particularly labor—rather than qualitative factors associated with productivity, where increases in factor inputs were insufficient to offset the decline in production efficiency.

As shown in Figure 1, the contributions of the factors of production to economic growth in Jordan vary across the five sub-periods examined in this study.

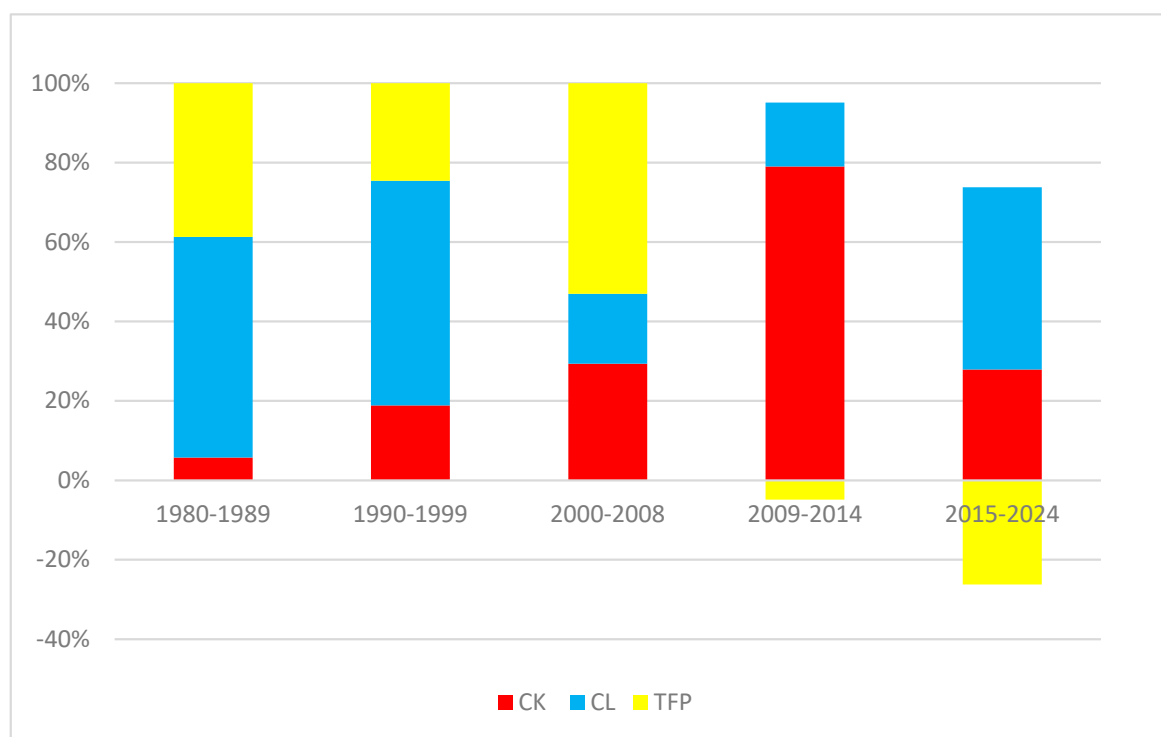


Figure 1. Source of Economic Growth.

Figure 1 summarizes the relative contributions of capital, labor, and total factor productivity (TFP) to economic growth across the five sub-periods of the study. The results reveal a clear shift in the sources of economic growth over time. During the first two sub-periods (1980–1989 and 1990–1999), labor was the dominant contributor to economic growth, indicating that growth was primarily driven by the expansion of the labor force. In the third sub-period (2000–2008), total factor productivity (TFP) became the main driver of growth, reflecting improvements in production efficiency and the more effective utilization of production factors. However, this pattern changed markedly after 2008. During the fourth sub-period (2009–2014), capital became the largest contributor to economic growth, while TFP recorded a negative contribution, suggesting that growth relied increasingly on capital accumulation despite a decline in production efficiency. In the final sub-period (2015–2024), labor once again emerged as the largest contributor to growth; however, the continued negative contribution of TFP indicates that the expansion of factor inputs was

accompanied by a persistent deterioration in productivity. Overall, the figure highlights a transition in the Jordanian economy from productivity-driven growth during the mid-2000s to input-driven growth in the subsequent periods, with declining productivity becoming an increasingly important constraint on long-term economic growth.

Overall, the results of the growth accounting analysis indicate that labor has been the primary source of economic growth in Jordan over the period 1980–2024, accounting for an average of 48.94% of total growth. Physical capital contributes approximately 40.16%, while total factor productivity accounts for 11.13%. The reported overall contributions represent the arithmetic mean of the estimated relative contributions across the sub-periods. These results reflect the Jordanian economy's historical reliance on labor expansion as the main drivers of growth.

5. Conclusions, Policy Implications, and Future Research

5.1. Conclusions and Policy Implications

To decompose the sources of economic growth in Jordan, this study utilizes annual data for the period 1980–2024 for a number of macroeconomic variables. The output elasticities of the explanatory variables were estimated using the ordinary least squares (OLS) method. Subsequently, a growth accounting methodology was employed to determine the contribution of each production factor to economic growth.

The results of the production function analysis indicate a statistically significant and positive relationship between capital per worker and real output per worker, consistent with both economic theory and previous empirical evidence. Moreover, the growth accounting analysis reveals that labor has been the primary driver of economic growth in Jordan over the period 1980–2024, accounting for an average of 48.94% of total economic growth. Capital contributed 40.16%, while total factor productivity (TFP) accounted for the remaining 11.13%, after controlling for the effects of dummy variables representing selected years. Overall, the findings indicate that the Jordanian economy has historically depended mainly on labor expansion as the primary driver of economic growth. This result is consistent with a growing body of empirical literature that highlights factor accumulation as the central source of growth, notably [Bani Ata et al. \(2024\)](#), [Nadjia et al. \(2024\)](#) and [Malik and Masood \(2021\)](#).

A periodized analysis reveals notable differences in the sources of economic growth across sub-periods. During the first sub-period (1980–1989), Jordan's economy recorded an average annual growth rate of 3.332%, with labor emerging as the largest contributor, accounting for 1.853 percentage points of total growth. The dominant role of labor during this period may reflect the expansion of the labor force and the increasing availability of workers resulting from population growth and a growing labor market. This suggests that economic growth during this period was primarily driven by the accumulation of factors of production rather than improvements in efficiency or technological progress.

In the second sub-period (1990–1999), the average annual growth rate increased to 4.314%, while labor remained the dominant source of growth, contributing 2.445 percentage points. The continued dominance of labor as a driver of growth during this period indicates that economic expansion in Jordan remained largely dependent on increases in labor input. This pattern may be associated with the continued growth of the working-age population and the gradual expansion of economic activity.

The third sub-period (2000–2008) recorded the highest average annual economic growth rate, reaching 6.629%. This strong performance was primarily driven by total factor productivity (TFP), which contributed 3.519 percentage points, followed by physical capital with a contribution of 1.947 percentage points, highlighting the prominent role of these two growth factors during this period. The increased contribution of TFP during this period represents a significant shift in the growth pattern of the Jordanian economy, indicating

improved production efficiency and effective utilization of available resources. This period coincided with greater economic openness, increased investment activity, and structural reforms aimed at enhancing the business environment, all of which may have contributed to this productivity improvement.

In the fourth sub-period (2009–2014), the average annual economic growth rate slowed to 3.083%. Despite this slowdown, physical capital remained the main contributor to growth, accounting for approximately 2.713 percentage points. The increasing role of physical capital during this period indicates that investment continued to support economic activity despite the slowdown in overall economic growth. However, the weaker contribution of productivity compared to the previous period suggests that capital accumulation alone was insufficient to maintain the previously achieved high economic growth rates.

In the final sub-period (2015–2024), the average annual economic growth rate continued to decline, reaching 2.121%. Labor once again emerged as the main contributor to growth, accounting for 2.053 percentage points. At the same time, the negative contribution of total factor productivity (TFP) became more pronounced, indicating a deterioration in productivity performance during this period. The return of labor as a key driver of growth, combined with the negative contribution of TFP, suggests a return to a factor-driven growth pattern. The deterioration in productivity performance may reflect several challenges faced by the Jordanian economy during this period, including regional economic uncertainty, slower investment dynamics, and the adverse effects of external shocks, such as the COVID-19 pandemic.

Overall, the periodized analysis points to a gradual transition in Jordan's growth model. While earlier decades were characterized by growth driven primarily by labor accumulation, the period from 2000 to 2008 demonstrated the potential contribution of productivity improvements. However, the recent decline in TFP suggests that the sustainability of future growth may depend increasingly on enhancing productivity rather than relying primarily on factor accumulation.

Based on these findings, this study concluded with a set of key recommendations, most notably the need to transition from a growth model driven by labor expansion to one centered on enhancing labor productivity. This can be achieved by improving the quality of education and training, developing skills, and better aligning them with labor market requirements. This study also recommends replicating the experience of the third sub-period (2000–2008) by encouraging productive investment, enhancing resource allocation efficiency, and channeling resources toward high-productivity sectors, thereby supporting sustainable, productivity-led economic growth.

Finally, the results reveal a negative contribution of total factor productivity (TFP) during the last two sub-periods, suggesting that weak productivity performance has been an important factor behind the recent slowdown in economic growth and may constrain Jordan's ability to achieve sustained long-term growth. These findings highlight the importance of policies that improve productivity growth. Although the present study does not directly examine the determinants of productivity, previous studies suggest that greater investment in innovation, accelerated digital transformation, improvements in human capital, and stronger institutional efficiency and governance are among the factors associated with higher productivity. Strengthening these areas may help facilitate a gradual shift from a growth model driven primarily by factor accumulation toward one based on productivity-led growth.

5.2. Limitations and Future Research

Despite the contributions of this study, several limitations should be acknowledged. First, due to data availability constraints, the analysis uses an aggregate measure of capital

stock and does not distinguish between public and private capital. Since these two types of capital may have different effects on economic growth and productivity through distinct channels, future research could extend the current analysis by incorporating separate measures of public and private capital to provide a more detailed understanding of their respective contributions to economic growth in Jordan.

Second, this study covers a relatively long period (1980–2024), during which the Jordanian economy experienced several structural changes and economic shocks. Although the analysis incorporates dummy variables to account for major episodes of instability and the COVID-19 pandemic, the estimated production elasticities are assumed to remain stable over the entire period. Future studies could investigate whether the contributions of capital, labor, and total factor productivity have changed over time by employing approaches that allow for structural breaks or time-varying parameters.

Future research could also complement the aggregate growth accounting approach used in this study by conducting sectoral analyses to examine differences in growth drivers across economic activities. Such extensions would provide deeper insights into the sources of productivity growth and help identify sectors with greater potential for supporting sustainable economic development in Jordan.

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