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Revisiting Economic Growth in Jordan: Labor, Capital, and the Role of Technological Progress

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Abstract:
This study investigates the role of technological progress in shaping economic growth in Jordan over the period 1991–2024, while also considering the contributions of labor and physical capital. The analysis is grounded in the neoclassical growth framework and relies on a Cobb–Douglas production function combined with time-series econometric techniques to uncover both long-run relationships and short-run dynamics. The results reveal a stable long-run relationship between real GDP, labor, and capital, confirming that these factors move together over time. The growth decomposition shows that labor has been the main driver of economic growth in Jordan, reflecting the labor-intensive nature of the economy. In contrast, the contribution of physical capital has been relatively limited. Technological progress has played a supportive role in growth, but its contribution has been modest and uneven, with negative effects observed in several years. These fluctuations highlight structural challenges related to the efficiency of investment and the economy's ability to absorb and effectively use new technologies. Overall, the findings suggest that while labor has sustained growth, long-term economic performance in Jordan will increasingly depend on improving productivity through better-quality investment and more effective use of technological progress.

Keywords: Economic Growth; Technological Progress; Total Factor Productivity.

1. Introduction

Economic growth has never depended on a single factor. For a long time, economists explained growth mainly through the accumulation of capital and the expansion of the labor force. Investment in machinery, infrastructure, and production capacity was seen as the main engine of higher output, while labor provided the human effort needed to run the economy (Solow, 1956). Over time, however, it became clear that simply adding more capital and workers could not fully explain why some countries grow faster and become richer than others (Mankiw et al., 1992).

As research evolved, attention shifted toward productivity and how efficiently economies use their resources. Many studies show that differences in productivity, rather than differences in inputs alone, explain much of the gap in economic performance across countries (Easterly & Levine, 2001; Bosworth & Collins, 2003). Technology plays a central role here by helping capital and labor work together more effectively. At the same time, capital remains essential, since new technologies often require modern equipment and infrastructure to be productive. Labor also

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matters greatly, especially the skills, education, and adaptability of workers, which determine how well new technologies are adopted and used.

Recent research increasingly highlights that growth is the result of interaction among several forces. Financial development helps firms invest in both capital and innovation, making it easier to turn ideas into productive activity (Le et al., 2023). Entrepreneurship connects technology to the real economy by transforming knowledge into new products, services, and jobs (Feki & Mnif, 2016). Trade further supports growth by allowing countries to learn from others and benefit from international knowledge spillovers (Coe & Helpman, 1995).

At the same time, studies warn against overstating the role of any single factor. Capital accumulation without productivity improvements often leads to diminishing returns, and labor growth without skill development limits long-term progress (Mankiw et al., 1992). Evidence from developing and resource-dependent economies shows that weak institutions and inefficiencies can reduce the impact of capital, labor, and technology alike (Kumo, 2022; Bannaga & Lezar, 2024). Research that carefully addresses causality also confirms that technology both shapes and responds to economic growth, reinforcing its close connection with other production factors (Kyzy, 2020).

Overall, the recent literature paints a clear and intuitive picture. Long-term economic growth emerges from the combined contributions of capital, labor, and technological progress, supported by strong institutions, effective financial systems, entrepreneurship, and openness to knowledge. Technology enhances growth by raising the productivity of capital and labor, but it is the way these elements work together that ultimately determines an economy's ability to grow and sustain development over time (Cavdar & Aydin, 2015; Yagmur et al., 2022).

Within this broader context, the present study focuses on the Jordanian economy, with the specific objective of examining the contribution of technological progress to economic growth in conjunction with labor and capital. By adopting a production-function framework, the study aims to assess how these three core inputs interact over time and to identify the relative importance of technological progress compared to traditional factors of production. Studying Jordan provides a useful case, as the economy faces structural challenges related to productivity, labor market dynamics, and investment efficiency. Understanding how technology contributes to growth alongside labor and capital offers valuable insights for policy design and long-term development strategies.

2. Literature Review

The study of economic growth has undergone a substantial evolution over the past decades. Early growth theories focused primarily on the accumulation of physical capital and the expansion of labor as the main drivers of output growth. Within the neoclassical framework, technological progress was treated largely as an exogenous factor that shifted the production function upward over time (Solow, 1956). Although this framework provided an elegant explanation of steady-state growth, it became increasingly clear that capital deepening alone could not account for sustained differences in growth rates or income levels across countries.

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Empirical evidence reinforced this limitation. Mankiw et al. (1992) showed that even after extending the Solow model to include human capital, a large portion of cross-country income variation remained unexplained. Easterly & Levine (2001) further demonstrated that differences in factor accumulation explain only a small share of growth disparities, while productivity differences—closely linked to technology and institutions—play a dominant role. These findings marked a turning point in growth research, shifting attention decisively toward technological progress and total factor productivity (TFP) as the core engines of long-term growth.

Theoretical advances followed this empirical shift. Endogenous growth models explicitly incorporated innovation, knowledge accumulation, and human capital investment as outcomes of economic decisions rather than external forces (Romer, 1990; Aghion & Howitt, 1992). These models emphasize that sustained growth depends on incentives to innovate, invest in skills, and adopt new technologies. Importantly, they highlight the role of institutions, market structure, and policy in shaping the pace and direction of technological change, thereby providing a strong theoretical foundation for empirical investigations into technology-led growth.

A growing body of empirical research supports these theoretical insights. Evidence from Latin America illustrates how differences in innovation capacity translate into divergent growth outcomes. Bujari & Venegas Martínez (2016) find that countries with higher investment in research and development and stronger knowledge accumulation experience faster and more stable economic growth. Their results show that reliance on capital accumulation without continuous technological improvement leads to diminishing growth returns. The study emphasizes that weak innovation systems constrain productivity gains, helping to explain why some Latin American economies lag behind despite similar levels of capital and labor.

Cross-country studies further reinforce the idea that technology operates as part of a broader innovation system. Cavdar & Aydin (2015) decompose technological development into measurable components such as R&D expenditure, patent activity, and human capital, showing that each plays a significant role in explaining economic performance. However, their findings also highlight that technological progress delivers meaningful growth effects only when economies possess sufficient absorptive capacity. This insight helps explain why similar technologies generate different outcomes across countries, depending on education levels, institutional quality, and governance structures.

The literature increasingly recognizes that innovation must be connected to real economic activity to affect growth. Feki & Mnif (2016) provide strong evidence that entrepreneurship acts as a crucial transmission channel through which technological innovation translates into economic growth. Their panel-data analysis shows that economies grow faster when innovation is accompanied by entrepreneurial activity, supportive institutions, and flexible business environments. Without these conditions, technological advances may remain underutilized, limiting their contribution to output and employment.

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More recent studies have strengthened these conclusions by addressing methodological challenges such as reverse causality and model uncertainty. Kyzy (2020) adopts a robust empirical approach by testing multiple model specifications for developed economies. The study confirms that technological progress remains a consistent and independent driver of long-term growth even after accounting for feedback effects between growth and innovation. This finding reinforces the argument that technology is not merely a by-product of economic expansion, but a fundamental force sustaining it.

Evidence from emerging and developing economies adds further nuance to the discussion. Yagmur et al. (2022) show that technological progress significantly enhances growth in BRICS-T countries when supported by investment, productive capacity, and macroeconomic stability. Their results indicate that country-specific differences in integrating technology into the production process explain divergent growth trajectories. In contrast, Kumo (2022), focusing on Sierra Leone, shows that weak productivity growth and structural inefficiencies are the main sources of output volatility and persistent output gaps. This evidence highlights that improving efficiency can be more important than increasing factor inputs in low-income economies.

International channels of technology diffusion also play a central role in the growth process. Coe & Helpman (1995) provide early empirical evidence that international R&D spillovers transmitted through trade significantly enhance domestic productivity. More recent work by Le et al. (2023) extends this analysis to developing countries, showing that the benefits of trade-related technological spillovers depend critically on financial development. Economies with deeper financial systems are better able to finance investment, adopt foreign technologies, and translate external knowledge into productivity gains. Where access to finance is limited, the growth effects of openness and innovation remain weak.

The literature also highlights the importance of productivity and efficiency in resource-dependent economies. Bannaga and Lezar (2024) show that differences in total factor productivity and economic efficiency explain much of the variation in growth performance among GCC countries. Their findings suggest that heavy reliance on natural resources can mask inefficiencies and delay structural transformation unless accompanied by diversification, human capital development, and institutional reform. This perspective aligns with broader evidence that productivity growth, rather than input expansion, is essential for long-term sustainability.
More recently, researchers have expanded the scope of analysis beyond economic growth to include environmental outcomes. Abbasi et al. (2024) demonstrate that technological innovation can mitigate the environmental costs of economic expansion in Asian economies by promoting cleaner and more efficient production methods. Their findings suggest that innovation allows countries to reconcile growth with environmental sustainability, reinforcing the idea that technology plays a multidimensional role in modern development processes.

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In conclusion, the literature presents a clear and comprehensive picture. Long-term economic growth emerges from the interaction between capital accumulation, labor development, and technological progress, reinforced by entrepreneurship, financial development, institutional quality, and openness to international knowledge flows. Technology enhances growth primarily by raising the productivity of capital and labor, but its impact is conditional on the broader economic and institutional environment. This integrated view provides a strong and well-grounded foundation for examining the contribution of technological progress to economic growth alongside labor and capital, particularly in country-specific contexts such as Jordan.

3. Methodology

This study seeks to understand how technological progress has contributed to economic growth in Jordan over time, taking into account the roles of both labor and physical capital. Rather than focusing on short-term fluctuations, the analysis is designed to capture long-run relationships and underlying structural dynamics within the economy. To achieve this, the study adopts a time-series approach that allows for a careful examination of how output, capital, labor, and technology evolve together over an extended period.

The analysis is based on a well-established production framework widely used in the economic growth literature, namely the Cobb–Douglas production function. Consistent with the approaches adopted by Alwan (2015) and Hamdan & Abu-Mudallalah (2013), this framework offers a simple yet powerful structure for linking economic output to its core inputs while explicitly allowing technological progress to affect productivity. Within this setting, real gross domestic product is generated through the combined use of physical capital and labor, with technology playing a crucial role in enhancing the efficiency with which these inputs are employed. Accordingly, the production relationship can be represented as:

$$RGDP = A\, L^{\alpha} K^{\beta} \qquad (1)$$

where ($RGDP$) denotes real GDP, (K) represents physical capital, (L) refers to labor, and (A) captures technological progress. The parameters (α) and (β) measure how responsive output is to changes in labor and capital, respectively.

To make the model suitable for empirical analysis, the production function is transformed into a log-linear form. This transformation simplifies estimation and allows the coefficients to be interpreted as elasticities. The log-linear specification is given by:

$$Ln\, RGDP = Ln\, A + \alpha\, Ln\, L + \beta\, Ln\, K \qquad (2)$$

Since technological progress is not directly observable, it is captured indirectly through the residual of the production function. Following common practice in the literature, this residual represents total factor productivity and reflects improvements in efficiency, knowledge, and

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technology that are not explained by changes in capital or labor. Accordingly, the estimating equation can be written as:

$$Ln\ RGDP_t = \alpha\ Ln\ L_t + \beta\ Ln\ K_t + \varepsilon_t \qquad (3)$$

where the error term (ε) serves as a proxy for technological progress and t represents time.

The empirical analysis relies on annual data covering the period 1991–2024. This extended time span allows the study to capture long-run growth patterns as well as major structural changes that have shaped the Jordanian economy over time. The data are obtained primarily from the World Bank database, ensuring consistency, comparability, and reliability across variables and years.

Before estimating the model, the time-series properties of the data are examined carefully. Macroeconomic variables often display trends and persistence over time, which can lead to misleading results if not properly addressed. For this reason, unit root tests are conducted to determine whether the variables are stationary or require differencing. Establishing the order of integration is a crucial step in selecting the appropriate econometric methodology.

Once the stationarity properties are identified, the analysis proceeds to test for the existence of a long-run relationship among real GDP, capital, and labor. Cointegration analysis is used for this purpose, as it allows the study to determine whether these variables move together over time despite short-run deviations. When evidence of cointegration is found, a Vector Error Correction Model (VECM) is employed to capture both the long-run equilibrium relationship and the short-run adjustments toward that equilibrium.

Finally, the estimated long-run elasticities of capital and labor are used within a growth accounting framework to measure the contribution of technological progress to economic growth in Jordan. By decomposing output growth into contributions from labor, capital, and technology, the study provides a clear picture of the relative importance of technological progress compared to traditional factors of production. Overall, this methodology combines a well-established theoretical framework with rigorous time-series techniques, allowing for a comprehensive and intuitive assessment of how technology, labor, and capital have jointly shaped economic growth in Jordan over the study period.

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4. Empirical Results
4.1 Unit Root Test

Economic time-series data often evolve in ways that reflect long-term trends, policy changes, and structural shifts in the economy. As a result, many macroeconomic variables do not fluctuate around a constant mean over time, which means they may be non-stationary. Ignoring this characteristic and estimating relationships among such variables without proper testing can lead to misleading results that appear statistically significant but lack any real economic meaning. For this reason, examining the stationarity of the data is an essential first step in the empirical analysis.

When variables are stationary in their levels, standard estimation techniques such as Ordinary Least Squares (OLS) can be applied safely. However, if the variables contain a unit root and only become stationary after differencing, a different approach is required. In such cases, meaningful long-run relationships may still exist if the variables are cointegrated. Estimating models in levels without first confirming stationarity or cointegration risks producing spurious regressions and unreliable inference.

To assess the stationarity properties of the data, this study employs the Augmented Dickey–Fuller (ADF) unit root test. The ADF test is widely used in applied economic research because it allows for serial correlation in the error term by including lagged differences of the variable under consideration. To ensure robustness, the test is conducted under two specifications: one including a constant term only, and another including both a constant and a deterministic time trend. This helps capture different possible data-generating processes.

The results of the ADF test at the level form of the variables are reported in Table 1. The findings indicate that real GDP ($RGDP$), physical capital (K), and labor (L) are generally non-stationary in levels under both test specifications.

Table 1. Augmented Dickey–Fuller (ADF) Unit Root Test Results at Level

	Level	
	Constant	Constant & Trend
$RGDP$	-1.239	-0.193
K	-1.754	-2.180
L	-2.557	-2.554

To further examine the time-series properties, the ADF test is applied to the first differences of all variables. As shown in Table 2, the test statistics for $RGDP$, capital, and labor are highly significant at the 1% level under both specifications. This leads to rejection of the null hypothesis of a unit root and confirms that all variables become stationary after first differencing. Accordingly, the variables are classified as integrated of order one, I(1).

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Table 2. Augmented Dickey–Fuller (ADF) Unit Root Test Results at First Difference

	1st Difference	
	Constant	Constant & Trend
RGDP	-4.623***	-4.614***
K	-5.769***	-5.622***
L	-5.320***	-5.231***

(***) denotes rejection of the null hypothesis of a unit root at the 1% significance level, indicating that the series are stationary in first differences.

Choosing an appropriate lag length is a critical step in unit root testing, as too few lags may leave serial correlation in the residuals, while too many lags can weaken the power of the test. In this study, the optimal lag length is selected using the Akaike Information Criterion (AIC). Overall, the unit root test results indicate that the variables are non-stationary in their level form but become stationary after first differencing. This finding provides a solid foundation for conducting cointegration analysis to investigate the existence of a stable long-run relationship among real GDP, capital, and labor, despite short-run deviations from equilibrium.

4.2 Cointegration Test

Once the stationarity properties of the variables are established, the analysis moves to examining whether a meaningful long-run relationship exists among real GDP, physical capital, and labor. Although these variables are non-stationary in their levels, economic theory suggests that they may still be linked by a stable equilibrium relationship over time. Cointegration analysis provides a way to test this possibility by identifying whether the variables move together in the long run despite short-term fluctuations.

To explore the existence of such long-run relationships, this study applies the Johansen cointegration approach. This method is particularly well suited for systems involving more than two variables, as it allows all variables to be treated symmetrically and accounts for potential interactions among them. Unlike simpler techniques, the Johansen framework makes it possible to detect multiple long-run relationships within the same system.

The Johansen methodology relies on two complementary test statistics: the trace test and the maximum eigenvalue test. Both tests examine the null hypothesis that no cointegrating relationship exists among the variables. The trace test evaluates whether the number of cointegrating vectors is less than or equal to a given rank, while the maximum eigenvalue test focuses on identifying the exact number of cointegrating relationships. In both cases, the null hypothesis is rejected when the calculated test statistic exceeds the corresponding critical value at a chosen significance level.

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Table 3. Johansen Cointegration Test Results – Trace Statistic

H_0	H_1	Trace statistic	5% tabulated value
$r = 0$	$r \geq 1$	29.630*	29.797
$r \leq 1$	$r \geq 2$	10.302	15.495
$r \leq 2$	$r \geq 3$	3.478*	3.842

(*) indicates rejection of the null hypothesis at the 10% significance level.

The results of the trace test, presented in Table 3, indicate evidence of cointegration among the variables. The calculated trace statistics exceed the critical values at conventional significance levels, suggesting the presence of a long-run equilibrium relationship linking real GDP, capital, and labor. Similarly, the maximum eigenvalue test results reported in Table 4 support the same conclusion, though the evidence is relatively weaker and statistically significant at the 10% level. Taken together, the two tests consistently point to the existence of cointegration among the variables.

Table 4. Johansen Cointegration Test Results – Eigenvalue Test

H_0	H_1	Max. Eigenvalue statistic	5% tabulated value
$r = 0$	$r = 1$	19.328*	21.132
$r \leq 1$	$r = 2$	6.825	14.264
$r \leq 2$	$r = 3$	3.477*	3.841

(*) indicates rejection of the null hypothesis at the 10% significance level.

From an economic perspective, these findings imply that real GDP, physical capital, and labor do not evolve independently over time. Instead, they are tied together by an underlying long-run relationship, consistent with the production framework adopted in this study. While short-run shocks may cause temporary deviations, the variables tend to adjust and move back toward their long-run equilibrium path. The presence of cointegration has important implications for the empirical analysis that follows. It justifies the use of a Vector Error Correction Model (VECM), which allows the study to capture both the long-run equilibrium relationship and the short-run dynamics governing how the variables adjust after disturbances. This framework provides a more complete and realistic representation of the growth process in Jordan. Overall, the cointegration results offer strong support for a stable long-run relationship between economic growth, capital accumulation, and labor, forming a solid foundation for the subsequent analysis of short-run adjustments and the contribution of technological progress.

4.3 Vector Error Correction Model

Choosing the appropriate econometric model depends largely on the statistical behavior of the data. When economic variables are stationary in their level form, simple estimation techniques such as Ordinary Least Squares (OLS) can be used without difficulty. However, when variables are non-stationary and become stationary only after first differencing, estimating relationships in levels using OLS can be misleading. In such cases, the analysis must rely on models that explicitly account for both non-stationarity and long-run relationships.

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Since the variables in this study are integrated of order one and cointegration among them has been confirmed, the Vector Error Correction Model (VECM) provides a suitable and reliable framework for analysis. The VECM is particularly useful because it allows the study to examine short-run movements in the data while simultaneously preserving information about the long-run equilibrium relationship among real GDP, labor, and capital (Gujarati & Porter, 2011). Rather than treating short-run fluctuations and long-run trends separately, the VECM brings them together within a single, coherent system.

A central component of the VECM is the error correction term. This term captures the extent to which the variables deviate from their long-run equilibrium in one period and measures how quickly they adjust back toward equilibrium in the next. From an economic perspective, a negative and statistically significant error correction coefficient is exactly what theory predicts. It indicates that when output, labor, and capital move away from their long-run path, adjustment mechanisms are set in motion to restore equilibrium over time.

The empirical results from the VECM estimation provide clear evidence of a stable long-run relationship among the variables. The error correction term is negative and statistically significant, confirming that deviations from equilibrium are corrected and that the system converges back to its long-run course. This finding also suggests the existence of long-run causality running from labor and capital toward real GDP.

The estimated long-run coefficients highlight the relative importance of production inputs in the Jordanian economy. The elasticity of labor is estimated at approximately 0.83, indicating that labor plays a dominant role in driving long-run output growth. In contrast, the elasticity of physical capital is much smaller, at around 0.03, suggesting that capital accumulation on its own contributes relatively little to long-run economic growth.

These results reflect the structural characteristics of the Jordanian economy, where labor—particularly in terms of workforce participation and human capital—appears to be the main engine of production, while capital accumulation plays a more limited role. For example, when looking at the government budget, we see the huge expenditure that classified as current expenditure mainly salaries. Even for the capital spending, we see some items that are classified in this item though in fact they have current spending characteristics like some kind of maintains, short term training programs, repeated purchase of furniture, some types of consolations, and many others.

These results reflect the structural characteristics of the Jordanian economy, where labor—particularly through workforce participation and human capital—appears to be the primary driver of production, while capital accumulation plays a more limited role. This pattern is evident when examining the government budget, which is dominated by current expenditures, especially wages and salaries. Even within capital expenditure items, a closer look reveals that many components are current in nature rather than genuinely investment-oriented. These include routine maintenance, repeated purchases of furniture and equipment, and information technology–related expenditures such as software subscriptions, system updates, and technical

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support services. Such spending does not substantially expand productive capacity, which helps explain the relatively modest contribution of capital accumulation to long-run economic growth in Jordan.

Importantly, the estimated elasticities of labor and capital are used in the subsequent growth accounting analysis to isolate and measure the contribution of technological progress to economic growth. Overall, the VECM framework offers a realistic and comprehensive way to understand how economic growth, labor, and capital interact over time in Jordan. By capturing both long-run equilibrium relationships and short-run adjustments, the model provides a solid empirical foundation for assessing the role of technological progress in shaping long-term economic growth.

4.4 The Effect of Technological Advances on Economic Growth

This section examines how much technological progress has actually contributed to economic growth in Jordan. Rather than treating technology as an abstract or assumed driver of growth, the analysis builds directly on the estimated production function and the long-run elasticities obtained earlier. Using a growth accounting framework allows economic growth to be broken down into clear and intuitive components, making it possible to assess the relative importance of labor, capital, and technology. This approach follows the standard methodology discussed by Snowdon & Vane (2005).

Within this framework, the growth rate of real GDP is expressed as the combined outcome of three forces: technological progress, labor growth, and capital accumulation. Formally, this relationship can be written as:

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha\frac{\Delta L}{L} + \beta\frac{\Delta K}{K} \qquad (4)$$

This equation highlights a simple but important idea: economic growth depends not only on how much labor and capital increase, but also on how efficiently these inputs are used. By rearranging the equation, the contribution of technological progress can be isolated as a residual:

$$\frac{\Delta A}{A} = \frac{\Delta Y}{Y} - \alpha\frac{\Delta L}{L} + \beta\frac{\Delta K}{K} \qquad (5)$$

In practical terms, technological progress captures improvements in productivity that cannot be explained by changes in labor or capital alone. It reflects gains in efficiency, organization, skills, and knowledge that allow the economy to produce more with the same resources.

Using the estimated elasticities of labor (α) and capital (β) obtained from the long-run production function, the contributions of labor and capital are calculated following the standard

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approach outlined by Hamdan & Abu-Mudallalah (2013). The contribution of labor is computed by multiplying labor growth by its elasticity, while the contribution of capital is calculated in the same way. These elasticities, reported earlier, form the basis for the growth decomposition exercise.

The results of this analysis, reported in Appendix (1), show that technological progress made an average contribution of about 0.62 percentage points to annual economic growth in Jordan over the period 1991–2024. This suggests that technology has supported growth, but it has not been the main driver of economic expansion.

What is particularly striking, however, is how much the contribution of technology fluctuates over time. The strongest positive contribution—about 7.6%—occurred in 1992, a year marked by major economic adjustments and increased openness following significant regional and domestic changes. At the other extreme, technological progress made a sharply negative contribution of –8.7% in 1991. This decline coincides with the economic disruptions caused by the Gulf War and the instability in the period leading up to it, which severely affected productivity and efficiency.

More broadly, the contribution of technology to economic growth was not always positive. In fact, technological progress made a negative contribution in 11 of the 34 years examined. Although this may seem unexpected at first, it reflects deeper structural challenges within the Jordanian economy. In some periods, inefficiencies in technology-related spending and limited capacity to absorb and effectively use new technologies appear to have weakened productivity gains. In other years, economic growth was driven mainly by expansions in labor or capital, leaving a smaller role for technology in explaining output growth. Overall, the pattern and evolution of technology's contribution to real economic growth are generally in line with the findings reported by Alwan (2015) and Hamdan & Abu-Mudallalah (2013).

Looking more closely at the traditional factors of production, the results clearly show that labor has been the main engine of economic growth in Jordan. On average, labor contributed about 3.5 percentage points to annual growth during the study period. The highest contribution, 10.8%, was recorded in 2007, reflecting strong labor market conditions at that time. By contrast, the weakest contribution of labor occurred in 2021, a year marked by significant economic disruption and labor market challenges.

Capital accumulation, on the other hand, played a much more limited role. The average contribution of capital to economic growth over the period was only **0.11 percentage points**, making it the smallest contributor among the three components. This weak contribution likely reflects the structure of investment in Jordan, where a substantial share of spending classified as capital does not translate into lasting productive capacity. As discussed earlier, some capital expenditures are effectively current in nature—such as routine maintenance, short-term training programs, repeated purchases of equipment, and information technology–related services—which help sustain existing activity but do little to raise productivity in the long run.

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Taken together, these results paint a clear picture of the growth process in Jordan. Economic growth over the past decades has relied heavily on labor, while the contributions of capital accumulation and technological progress have been relatively modest and uneven. This suggests that future growth will depend less on expanding inputs and more on improving productivity—through better-quality investment, stronger absorptive capacity, and more effective use of technology.

5. Conclusion

This study examined how technological progress has contributed to economic growth in Jordan over the period 1991–2024, while also taking into account the roles of labor and physical capital. By combining a production-function framework with time-series econometric analysis, the study provides a clear and practical picture of where growth in the Jordanian economy has come from and how its main drivers have evolved over time.

The results show that labor has been the main engine of economic growth in Jordan. Workforce participation and human capital have consistently played a central role in supporting output growth, reflecting the labor-intensive nature of the economy. In contrast, physical capital has made only a limited contribution. This weak impact of capital accumulation appears to be linked to the structure and quality of investment, where a large share of spending classified as capital does not translate into durable productive capacity or long-term efficiency gains.

Technological progress has supported economic growth, but its contribution has been modest and uneven. On average, technology made a positive contribution, yet this effect varied considerably across years. In several periods, technological progress even contributed negatively to growth, suggesting that productivity improvements were not consistently achieved. These fluctuations point to deeper structural challenges, including inefficiencies in technology-related spending, limited capacity to absorb and effectively use new technologies, and weak links between investment and productivity.

The findings highlight an important message: while labor expansion has helped sustain growth, it cannot serve as a long-term growth strategy on its own. For growth to become more stable and sustainable, greater emphasis must be placed on improving productivity. This requires not only higher-quality investment, but also better use of technology, stronger institutional support, and an economic environment that encourages efficiency and innovation.

Overall, the study suggests that Jordan's future growth prospects depend less on expanding inputs and more on making better use of existing resources. Strengthening the role of technological progress—by improving absorptive capacity, investment efficiency, and productivity—would allow technology to move from a volatile and secondary contributor to a more consistent driver of long-term economic growth.

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