ANALYZING THE GAP AND EFFICIENCY IN GOVERNMENT SPENDING: AN EMPIRICAL STUDY USING DATA ENVELOPMENT ANALYSIS AND PANEL DATA MODELS

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Abstract

This study examines the issue of inefficiency and overspending in government expenditures, with a focus on how the size and composition of public spending affect economic growth. Prior studies have highlighted the relationship between government spending and economic growth (Bayrak, 2021; Ullah et al., 2024). The study aims to determine the optimal level of government expenditures and assess the efficiency of these expenditures. To achieve this, the study employs a panel data model and data envelopment analysis (DEA) methodology, utilizing data from 41 countries with structural similarities to Jordan, for the period 2010 to 2023. The methodology enables benchmarking Jordan's fiscal performance against that of peer countries and identifying deviations from optimal spending levels. The results indicate that Jordan's optimal government spending ratio averages around 28% of gross domestic product (GDP). Additionally, actual expenditures consistently exceed this level, indicating a negative budget deficit. Additionally, the Banker-Charnes-Cooper (BCC) model indicates that Jordan achieved 81% of the optimal efficiency level. This reflects the presence of financial waste and inefficiencies in government expenditures. This inefficiency is linked to a high share of non-productive expenditures such as wages and interest payments. The paper recommends that reforming the structure of public expenditure and reallocating resources toward high-return sectors is essential. These reforms are relevant for improving the efficiency of government expenditures.

Keywords: Jordan, DEA, Panel Data, Expenditures, Government, Optimal

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1. INTRODUCTION

Jordanian government expenditure is one of the primary fiscal policy instruments used by the government to achieve its economic objectives, including stimulating economic growth, providing essential public services, and promoting social equity and welfare (Al-Zoubi et al., 2013). However, efficient government expenditure involves directing resources to sectors and programs that maximize social welfare and economic growth, such as health, education, and infrastructure. The optimal allocation depends on factors such as governance quality, transparency, and the ability to target spending toward productive uses rather than non-productive or wasteful activities (Reyna et al., 2024). Good governance, characterized by effectiveness, transparency, and citizen participation, consistently enhances expenditure efficiency and outcomes (Nguyen & Bui, 2022). The relationship between government spending and economic growth is complex and has been extensively studied in economic literature. Empirical studies consistently suggest a nonlinear relationship between government spending and growth, characterized by a positive impact of public expenditure on economic performance up to an optimal threshold. Beyond this threshold, additional spending often results in diminishing returns or even negative consequences, such as increased inefficiency, resource misallocation, and adverse effects on private sector productivity (Barro, 1990). This phenomenon underscores the importance of not only the size but also the composition and quality of government spending in achieving desired economic results (Ahuja & Pandit, 2020; Ullah et al., 2024). Despite the significance of this issue, a notable gap exists in the literature regarding the optimal level of government spending and efficiency in Jordan, a middle-income developing country facing persistent fiscal challenges (Dehnokhalaji et al., 2017). While several studies have explored the effects of public expenditure in broader regional or developing country contexts, few have specifically addressed Jordan's unique economic structure and fiscal environment using advanced econometric and efficiency analysis methods.

This study aims to bridge this gap by estimating the optimal government expenditure-to-gross domestic product (GDP) ratio for Jordan and evaluating spending efficiency through the application of panel data econometric models and data envelopment analysis (DEA). The analysis uses a sample of 41 developing and middle-income countries with economic and structural similarities to Jordan, covering the period from 2010 to 2023. This approach enables benchmarking Jordan's fiscal performance against comparable peers and identifying inefficiencies caused by factors such as poor planning, corruption, and inflated public sector costs.

The findings of this research contribute to the economic literature by providing robust quantitative evidence on the nonlinear relationship between government spending and growth in the Jordanian context, while offering practical insights into the efficiency of public resource use. These insights are crucial for informing fiscal reforms that aim to improve spending effectiveness, optimize resource allocation, and enhance the overall economic environment.

Given the ongoing debate about the appropriate level of government expenditure necessary to balance fiscal responsibility and stimulate growth, this study also investigates whether the optimal spending ratio varies between developed and developing countries or across different regions. This cross-country perspective adds depth to the analysis and allows for more nuanced policy implications.

The paper is structured as follows. Section 1 provides the introduction. Section 2 reviews the relevant literature. Section 3 outlines the methodology applied in the empirical analysis. Section 4 presents the results. Section 5 discusses the main findings. Section 6 concludes the study and offers recommendations for future research.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Theoretical framework

Government spending is a fundamental fiscal policy tool that influences a country's economic performance, particularly in developing economies such as Jordan (Wu et al., 2010). Both classical and modern economic theories have explored how the size and structure of public spending affect economic growth. Views range from advocating for a minimal "night watchman" state with limited expenditures to supporting state intervention as a key driver of economic activity.

The concept of an "optimal level" of public spending that maximizes growth has also emerged (Ullah et al., 2024). Exceeding this level is expected to harm the economy (Ahuja & Pandit, 2020). Theoretical literature explaining the impact of government spending is often grounded in Keynesian theory. John Maynard Keynes argued that increased public spending is necessary during economic recessions when aggregate demand contracts (Laumer, 2020). In such cases, government investment in infrastructure stimulates firms to increase production and employment, thereby raising income and consumption through the Keynesian multiplier effect. Notably, Keynes emphasized maintaining high capital (investment) spending rather than current (recurrent) spending to offset the lack of private sector investment (Laumer, 2020).

In contrast, classical economic theories rejected this view, maintaining that the state's role in the economy should be highly limited to security, law enforcement, and basic public services. Classical economists believed that the free-market forces were sufficient to achieve equilibrium and optimal resource allocation in society, and that excessive government intervention would undermine the efficiency of the economic system (Tsoulfidis, 2007). Consequently, they advocated minimal public spending, financed by low taxes, and a balanced budget with no fiscal deficit.

On the other hand, the Solow-Swan model of growth (neoclassical theory) focuses on the fundamental factors of production — labor, capital, and technology — as the primary drivers of long-term growth (Vafa et al., 2020). This model

assumes that capital accumulation faces diminishing returns and that sustained high growth rates require continuous technological progress. Within this framework, the role of government is indirect, as public spending influences growth through its effects on saving and investment rates or by enhancing the productive environment. This view was later expanded in modern endogenous growth theories (Mimkes, 2006).

Some economists, such as Robert Barro, have developed growth models that incorporate productive public spending as an input in the production function (Barro, 1990). These models show that government spending on infrastructure and productive services can raise long-term growth by improving the economy's efficiency. However, the tax financing of such spending may inhibit growth if it exceeds the optimal threshold. In other words, according to these models, there is an optimal size of government: public spending contributes positively to growth up to a certain point, but exceeding this level weakens private sector incentives due to taxation or crowding out of private investment, and thus slows economic growth (Barman & Gupta, 2010).

The Laffer curve hypothesis also reflects the idea of an optimal tax level for governments (Ferreira-Lopes et al., 2019). Economist Arthur Laffer demonstrated that raising tax rates to very high levels would ultimately reduce public revenues by discouraging economic activity (Di Matteo & Barbiero, 2018). Similarly, economists such as Armey (1995) applied this idea to government spending, proposing that the relationship between the size of the public sector and economic growth follows an inverted U shape. Initially, increases in public spending enhance growth by providing necessary infrastructure and public services. However, once spending exceeds the optimal share of GDP, negative effects begin to emerge, such as increased tax burdens and inefficient resource allocation, resulting in slower growth. In short, any expansion of the state beyond this optimal point will likely hinder economic performance.

Another important perspective is efficiency theory, which examines how resources are allocated for maximum productivity and growth. Resource allocation is efficient when marginal benefits are equal across uses, with no waste (Dehnokhalaji et al., 2017).

Proponents of free market economies argue that the private sector allocates resources more efficiently than government agencies. Price mechanisms and competition guide resources to the most viable activities. Due to political or social factors, excessive government intervention may distort efficiency by directing resources into less productive projects. This viewpoint asserts that the government's optimal role is to correct market failures, like the under-provision of public goods or negative externalities, and to invest in areas the private sector cannot serve. Outside these cases, resource allocation should be left to market forces. According to this criterion, the production of goods and services should be assigned to the most capable provider; if the private sector can deliver a service at a higher quality and lower cost, it should be entrusted with that task, and vice versa.

Accordingly, priority should be given to developmental spending with high economic and social returns. Increasing investment in infrastructure, healthcare, and education enhances the productive base and raises potential growth. In contrast, unnecessary recurrent expenditures should be restrained, as their financing may crowd out resources and increase public debt without yielding comparable returns in growth. Nevertheless, some recurrent expenditures, such as the maintenance of existing infrastructure or the salaries of teachers and healthcare workers, play an indirect but vital role in supporting human capital and preserving physical assets. Therefore, a balanced approach is required to ensure spending efficiency across capital and current expenditures.

2.2. Previous studies

Research on the optimal size of the government's expenses contributes significantly to understanding its impact on economic development and fiscal stability. Many studies detect the relations between government expenditure and sustainable development. While some suggest that effective expenses increase public services and infrastructure, others warn that uncontrolled expansion can cause fiscal imbalance and budget deficit. These studies examine major sectors, including the optimal government spending-to-GDP ratio and its impact on inflation rates and private investment.

Barro (1990) is an early study examining the relationship between government spending and economic growth in developing countries through panel data analysis. It found that the optimal spending level is 15% to 20% of GDP; exceeding this threshold could raise public debt and hinder long-term growth investments. The study established a foundation for understanding the impact of public spending on growth in these economies. A decade later, Fatas and Mihov (2002) identified the optimal government spending threshold at around 20% of GDP. They concluded that government spending must be managed to prevent fiscal deficits and public sector corruption, which can hinder sustainable growth. The study offered a framework for understanding the link between government expenditure and macroeconomic stability.

Blanchard and Giavazzi (2004) found that optimal government spending in advanced European economies is about 40% of GDP. Their study concluded that strategic spending on education, infrastructure, and health can enhance growth. However, it warned about inefficient spending risks, which may cause economic stagnation or increased future taxation.

On the other hand, Pevcin (2004) tested the Armey curve hypothesis using a quadratic model of output with government spending for a sample of 12 European Union countries from 1950 to 1996. Using the fixed effects and least squares dummy variable (LSDV) methods, he confirmed that the results support the Armey curve hypothesis, indicating that the optimal level of government expenditure hovers around 40% of GDP based on different estimation methods. In another study, Altunc and Aydın (2013) examined the relationship in Turkey, Belgium, and Romania for the period from 1995 to 2011, finding that the current share of

public expenditure in GDP exceeded the optimal public spending level for all three countries. The study by Turan (2014) on the Turkish economy, it was indicated that the optimal size of government expenditure as a percentage of GDP, excluding interest payments, is around 14.4% of GDP. Also, in the study on the Turkish economy, Şanli (2022) found the optimal level of public spending in Turkey to be around 25.2%. Furthermore, Asimakopoulos and Karavias's (2016) study found that the optimal size of government for economic growth is around 33% of GDP for developed and developing countries. In Egypt, El Husseiny's study (2019) estimated that the optimal government size bounds between 30.5% and 31.2% of GDP, and the current expenditure level is near the optimal level. Similarly, Makin et al. (2019) assessed the Australian economy and found that the optimal government size (government expenditure as a percentage of GDP) is approximately 31%. Other studies, such as Bayrak (2021), found that the average optimal size of the public sector is around 30% in developed countries and 25% in developing countries. Additionally, according to Alimi (2020), the optimal government size is approximately 14% of GDP for the Economic and Social Commission for Western Asia (ESCWA) countries. In a study by Nouira and Kouni (2021), the optimal government size in developing countries was found to range between 10% and 20% of GDP for the Jordanian economy.

While much of the literature has focused on developed countries or large cross-country panels, a number of studies have also examined the Jordanian case specifically. For instance, Al-Hajaya and Edeinat (2017) used a fully modified ordinary least squares (OLS) approach within the Barro framework and suggested an optimal expenditure level between 36% and 38% of GDP. Similarly, Abbas (2021) conducted an autoregressive distributed lag (ARDL)-based analysis and concluded that Jordan's government spending surpasses its efficient threshold, thereby calling for fiscal consolidation. Aljaloudi and Warrad (2020) also analyzed the relationship between the size of the public sector and the rate of economic growth, using the ARDL econometric technique to quantitatively assess this relationship. The econometric results of the study confirm the existence of an inverse relationship between the size of the public sector and the rate of economic growth in Jordan, which may lend support to the hypothesis of the Armey curve. These studies offer important empirical benchmarks; however, they tend to rely on single-equation or linear models and do not fully explore nonlinearities in the spending-growth nexus, particularly via threshold effects. The current study contributes by applying advanced threshold and quantile methodologies to offer a more nuanced estimation of optimal government size in Jordan.

Additionally, Al-Majali (2025) investigates the optimal size of government expenditure in Jordan using various econometric models, including the Scully model, the Armey curve (quadratic model), and the discrete threshold regression model. The results indicate that Jordan's optimal government expenditure level ranges between 27% and 28% of GDP. In a related study, Alawneh (2025) investigates the impact of government size indicators — specifically, tax revenues, government capital expenditure, and government current expenditure — on the financial stability indicator. Analysis was conducted using Bayesian vector autoregression (VAR) estimates. The results indicate a significant influence of government size on financial stability. Specifically, government capital expenditure is found to reduce the ratio of government debt to GDP, suggesting its role in promoting financial stability.

When comparing previous studies, we find that the estimated values for the optimal size of government spending vary significantly across studies, depending on the time period, type of data, and statistical methods employed. These results suggest the need for a more comprehensive analysis using additional models to determine the optimal spending ratio in the Jordanian economy. It is essential to employ sophisticated models, such as the threshold regression model, to assess the nonlinear relationship between government spending and GDP, and to better determine the optimal threshold, alongside the Scully and Armey models. Various studies have used different statistical methods to estimate the optimal government size, including the ARDL model with bounds testing, the adjusted least squares method, panel data estimation, DEA, and the threshold model.

3. METHODOLOGY AND DATA

3.1. Data

The Jordanian economy faces several significant challenges, including high unemployment, rising public debt, poverty, limited natural resources, refugee pressures, and external shocks such as regional instability, global inflation, and the COVID-19 pandemic. These issues have weakened the government's investment capacity and increased reliance on foreign aid.

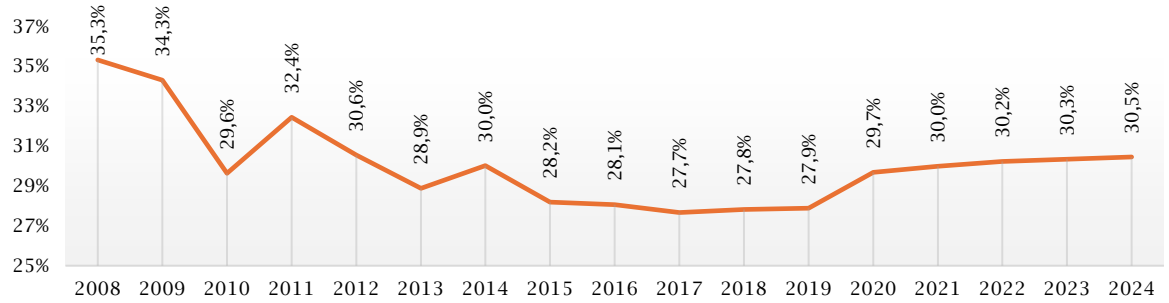
Government spending primarily targets key sectors reflecting socio-economic priorities. A significant portion of the budget is allocated to public sector wages, highlighting the size of the public administration. Substantial investments are also made in social services, especially education, healthcare, and programs for vulnerable groups. Subsidies for essential goods, such as electricity, water, and bread, constitute a major part of public expenditure.

Moreover, a significant portion of the budget is allocated to servicing public debt, including interest and loan repayments, due to the country's dependence on borrowing. Capital expenditure focuses on infrastructure and development projects in sectors such as energy and water, aiming to boost economic growth and improve service delivery. Lastly, defense and security remain major portions of public spending, underscoring the need for stability in a politically and security-challenged region.

Figure 1 shows the ratio of total government expenditure to GDP in Jordan from 2008 to 2024. Starting at 35.8% in 2008, due to high public spending resulting from wage increases, subsidies, and infrastructure investments, the ratio declined

steadily to 27.7% in 2017, following austerity measures and fiscal reforms aimed at reducing the fiscal deficit, as advised by the International Monetary Fund (IMF). From 2020, the ratio rose again, reaching 30.5% in 2024, reflecting increased public expenditure in response to the COVID-19 pandemic, including support for the health sector and social protection programs. While government spending as a share of GDP has ranged between 27% and 36%, exceeding the optimal level for Jordan, this trend may indicate potential economic risks if it continues.

Figure 1. Total government expenditures as a percentage of GDP in Jordan



Source: Jordanian Ministry of Finance statistical bulletins, 2008–2024 (https://mof.gov.jo/EN/List/General_Government_Finance_Bulletins).

Identifying the optimal government spending level as a GDP percentage is a key issue in fiscal policymaking. Governments aim to balance stimulating economic growth and ensuring fiscal sustainability. This balance varies across countries and times, making panel data analysis effective for understanding this complex relationship. Panel data models integrate time series and cross-sectional data, allowing researchers to examine spending across multiple countries over extended periods. This method accounts for internal variations and differing economic contexts. Additionally, panel data models control for unobserved heterogeneity factors influencing spending levels.

This method allows researchers to estimate the optimal government spending level that maximizes economic growth before diminishing returns or negative fiscal effects arise. This analysis equips policymakers with a tool linking fiscal policy to measurable economic and social outcomes within a generalizable framework. The sample includes 41 developing or middle-income countries across Asia, Africa, Latin America, and Eastern Europe, including Jordan, Egypt, Morocco, Lebanon, Brazil, Mexico, Turkey, South Africa, Indonesia, India, and Ukraine. These countries share structural and economic similarities with Jordan, enhancing the findings' credibility and applicability.

The study's data set covers the period from 2010 to 2023. It is sourced from the World Bank's World Development Indicators (WDI), one of the most comprehensive and reliable global databases on economic, social, and financial indicators.

3.2. Models and statistical treatments

3.2.1. First model

The study employs DEA, a non-parametric method used to assess technical efficiency. DEA uses a linear programming model to evaluate the relative efficiency of each decision-making unit (in this case, each country) by comparing inputs (government spending) and outputs (an indicator representing government effectiveness). This method constructs a frontier of outputs (cross-sectional linear frontiers) representing the highest observed performance. A country's efficiency is assessed by comparing its input-output ratio with the best-performing countries on the frontier. DEA is thus used to evaluate performance against the benchmark of "best practice" countries.

The DEA can be input-oriented (minimizing inputs for a given output level) or output-oriented (maximizing output with a given set of inputs). In this study, the output-oriented approach is adopted. The efficiency of each country is measured as the maximum weighted ratio of outputs to inputs (Eq. (1)), with the constraint that this ratio does not exceed one for any country in the sample (Eq. (2)). In general, the DEA model takes the following form:

$$max\ \theta = \frac{\sum_{r=1}^{s} U_r Y_{ro}}{\sum_{i=1}^{m} V_r X_{ro}} \quad (1)$$

Subject to:

$$\left(\frac{\sum_{r=1}^{s} U_r Y_{rj}}{\sum_{i=1}^{m} V_r X_{rj}}\right) \geq 1 \quad (2)$$

Nonnegatively condition $Y_{rj}, X_{ij} \geq 0$

where:

- Y is the output of country i;
- X is the input of country i;
- U_r is the weight assigned to output r;
- V_r is the weight assigned to input r;
- r is the total number of outputs.

There are two primary models in DEA:

1. Constant returns to scale (CRS), developed by Charnes, Cooper, and Rhodes (CCR) (1978), is commonly called the DEA CCR model.

2. Variable Returns to Scale (VRS), developed by Banker, Charnes, and Cooper (BCC) (1984), commonly known as the DEA BCC model.

The CRS model assumes proportional increases in input lead to proportional increases in output, while the VRS model allows for variable increases or decreases in output with additional input. This study employs the VRS model to capture country heterogeneity through non-constant returns to scale. The dual form of the linear programming problem is used to compute efficiency scores.

$$min_{\theta,y}\theta$$

Subject to:

$$Y_j + Y_\gamma \geq 0$$
$$\theta X_j X_\gamma = 1$$
$$\gamma \geq 0$$

where:

- θ is the technical efficiency of country i;
- γ is the vector of variable weights;
- Y is the output matrix;
- X is the input matrix.
- The values of technical efficiency (θ) range from 0 to 1 ($0 < \theta \leq 1$).

The input and output variables used in this study were selected based on a review of the relevant literature.

3.2.2. Second model

This model assumes government spending is a strategic tool for achieving developmental objectives, such as stimulating growth, reducing poverty, supporting health, education, and infrastructure, and ensuring macroeconomic stability. An econometric model was constructed using panel data from developing and middle-income countries. It aims to identify key determinants of public spending as a percentage of GDP and estimate the "optimal threshold" of expenditure, which is the level that maximizes efficiency without burdening public finances or hindering growth.

By identifying this threshold, policymakers can be guided toward more balanced and sustainable fiscal policies. Accordingly, the model is formulated as follows:

$$GS_{it} = \beta_0 + \beta_1 EG_{it} + \beta_2 EC_{it} + \beta_3 GE_{it} + \beta_4 HD_{it} + \beta_5 UR_{it} + \beta_6 ND_{it} + \varepsilon_{it} \quad (3)$$

where:

- *EG* is GDP per capita.
- *GS* is government expenditure as a percentage of GDP;
- *ND* is public debt as a percentage of GDP;
- *GE* is the government effectiveness index;
- *CE* is the wage bill as a percentage of GDP;
- *ME* is military expenditure as a percentage of GDP;
- *IE* is interest payments as a percentage of expenditure;
- *HD* is the human development index;
- *UR* is the unemployment rate;
- ε is a random error term;
- i is country, t is time, β is parameters.

This model is one of the flexible models that allow for estimating the relative impact of each variable on the level of public spending, thereby enabling a deeper understanding of the underlying structure of fiscal decision-making in developing and emerging countries. It also provides a scientific basis for deriving the optimal level of public expenditure, based on actual data from a broad sample of countries. To estimate the model, the panel data methodology was employed, which enables the analysis of changes over time and across different countries. It also improves estimation efficiency through a set of statistical tests and treatments.

The model is evaluated using three primary forms. First, the fixed effects model, which assumes the existence of individual effects that are constant over time for each country. That is, each country has a unique, time-invariant value that influences the dependent variable. Second, the random effects model, which assumes that the individual effects are not fixed but rather randomly distributed across the units. This means that the individual differences are treated as random variables independent of the explanatory variables in the model. Third, the pooled model, which assumes homogeneity across units and time, i.e., that no individual differences are affecting the dependent variable. In this model, a single equation is estimated on the entire pooled dataset. To choose between these three models, the process begins with testing for individual effects (fixed or random) versus the pooled model using Hsiao's homogeneity test to determine whether pooled panel data estimation is appropriate. This test determines whether model coefficients differ significantly between groups by examining coefficient homogeneity over time and across countries in the sample. Suppose the null hypothesis of homogeneity is rejected. In that case, this suggests significant variation in coefficients, implying the need to adopt a model that accounts for such differences.

Suppose Hsiao's test indicates that individual effects should be included. In that case, the next step is to distinguish between fixed and random effects using the Hausman test (Amini et al., 2012). This test compares the estimates generated by the fixed and random effects models to determine if there are significant differences between them. If a statistical difference exists, the model that better fits the data is preferred. Specifically, if the null hypothesis (H_0) is rejected, the fixed effects model is preferred; otherwise, the random effects model may be used as an alternative. On another front, the issue of stationarity of time series data is a fundamental concern and a starting point for any time series analysis. Therefore, it is essential to perform unit root tests to ensure that the time series data used are stationary over time. In this study, a modified panel unit root test is applied, consistent with the nature of panel data, relying specifically on the Levin, Lin, and Chu (LLC) test to confirm the absence of a unit root problem. If non-stationary series are found, cointegration analysis is conducted to examine whether a long-term equilibrium relationship exists among the non-stationary variables.

Additionally, the Johansen cointegration test is used to determine whether the variables share a long-term equilibrium relationship, despite possible short-term instability. The bound test is also used in cases where an ARDL model is estimated. After verifying the time series stationarity and testing for cointegration, if the variables are stationary at different levels and cointegration exists, the ARDL model is estimated. If no cointegration is found, short-run effects are

estimated instead. To enhance estimation efficiency, the generalized method of moments (GMM) proposed by Arellano and Bond (1991) is applied. This method improves estimation quality by addressing biases arising from omitted explanatory variables, handling potential endogeneity issues, and mitigating any unit root problems that may exist.

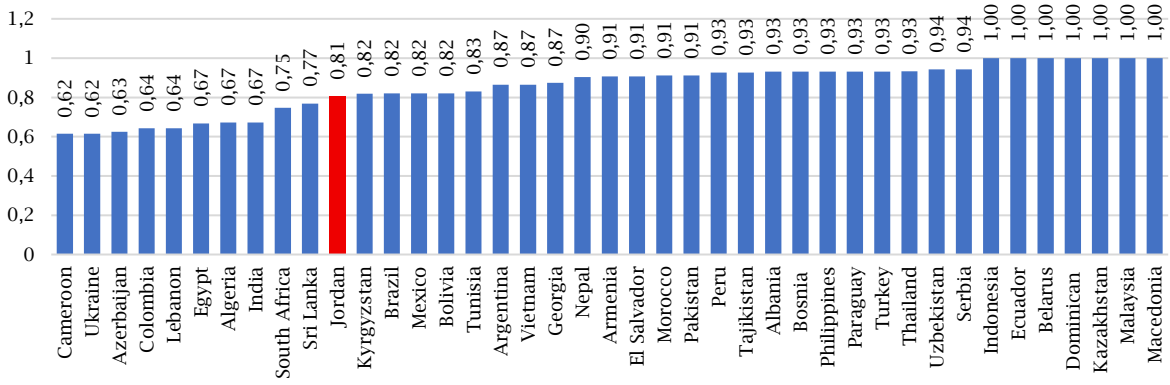
In addition to the panel data models and DEA employed in this study, alternative methods may also be suitable for testing the optimal level of government expenditure, efficiency, and economic growth. For example, the threshold model can be used to find the optimal point. On the other hand, the ARDL model can be estimated to capture the short-run and long-run relationships between government expenditure and economic growth. Moreover, a dynamic stochastic general equilibrium (DSGE) model can provide insights into the broader interactions between government spending, fiscal sustainability, and macroeconomic stability. Threshold regression models, including smooth transition regression or panel threshold models, are also appropriate for capturing nonlinearities in the spending growth relationship. While these alternatives offer valuable perspectives, the choice of panel data econometrics combined with DEA in this study reflects their strength in benchmarking cross-country efficiency and estimating optimal government spending levels in a comparable and policy-relevant manner.

4. ESTIMATION RESULTS

4.1. Results of the data envelopment analysis model

According to Figure 2, Jordan ranked eleventh out of the 41 countries included in the analysis using the BCC model, achieving a technical efficiency score of 0.81. This indicates that Jordan operates at only 81% of the optimal efficiency level compared to the reference units. This result reveals a clear efficiency gap in the Jordanian economy, as a substantial portion of public resources does not translate into outputs that match the scale of expenditure. This reflects the presence of financial waste and inefficiencies in public spending effectiveness. Hence, there is a pressing need to reassess government spending priorities, enhance the efficiency of public resource allocation, and adopt performance-based fiscal policies to ensure the more effective achievement of development goals.

Figure 2. Technical efficiency scores of the selected sample of countries



Source: Authors' elaboration based on the model.

4.2. Homogeneity test (Hsiao test)

The results of the Hsiao homogeneity test indicate rejection of all three model hypotheses, implying that the most appropriate model is the pooled model, which assumes full homogeneity across units and time.

Table 1. Hsiao homogeneity test

Hypothesis	*F-stat*	*P-value*	*Result*
$H1_0$	6.2	0.0000	Reject
$H2_0$	8.02	0.0000	Reject
$H3_0$	4.58	0.0000	Reject

Note: $H1_0$ = null hypothesis: panel is homogeneous vs alternative hypothesis: $H2_0$. $H2_0$ = null hypothesis: $H3_0$ vs alternative hypothesis: panel is heterogeneous. $H3_0$ = null hypothesis: panel is homogeneous vs alternative hypothesis: panel is partially homogeneous.
Source: Authors' elaboration.

4.3. Results of the stationarity test

The results of the variable stationarity tests using the LLC test, as shown in Table 2, indicate that the variables related to total factor productivity and the e-government development index are stationary at different levels. To avoid econometric problems arising from non-stationary data, the GMM was applied to ensure robust estimation results.

Table 2. Stationarity test of variables (Levin, Lin, and Chu)

Variable	*Status when tested*	*Level*		*First difference*		*Result*
		Calculated statistic	*Probability*	*Calculated statistic*	*Probability*	
GS	With intercept	1.26	0.1035	15.49	0.0000	I(1)
	With intercept and trend	11.28	0.0000	14.81	0.0000	I(0)
EG	With intercept	2.32	0.0101	5.99	0.0000	I(0)
	With intercept and trend	0.15	0.4420	6.12	0.0000	I(1)
ND	With intercept	0.65	0.2588	11.47	0.0000	I(1)
	With intercept and trend	8.45	0.0000	11.2	0.0000	I(0)
CE	With intercept	1.88	0.0300	3.44	0.0003	I(0)
	With intercept and trend	2.26	0.0118	1.94	0.0265	I(0)
ME	With intercept	7.6	1.0000	1.81	0.0424	I(0)
	With intercept and trend	11.8	1.0000	43.99	0.0000	I(1)
IE	With intercept	3.97	0.0000	7.03	0.0000	I(0)
	With intercept and trend	8.76	0.0000	6.63	0.0000	I(0)
HD	With intercept	1.66	0.0400	3.21	0.0003	I(0)
	With intercept and trend	2.46	0.0318	1.89	0.0235	I(0)

Source: Authors' elaboration.

4.4. Cointegration test (ARDL bounds test)

The results of the ARDL bounds test for cointegration indicate that there is no cointegration among the variables across all groups, as the F-statistic did not exceed the critical bounds, as shown in Table 3. This finding is significant in the context of analyzing time series relationships between variables, as it implies that long-term effects cannot be assessed using the ARDL bounds test model (Nkoro & Uko, 2016).

Table 3. Results of the cointegration test (ARDL bounds test)

F-test	*Critical values*			*Result*
Calculated value	*Significance level*	*I(0)*	*I(1)*	
2.731	10%	3.02	3.51	No integration
	5%	3.62	4.16	
	2.50%	4.18	4.79	
	1%	4.94	5.58	

Source: Authors' elaboration.

4.5. Hausman test to determine the most appropriate model (fixed or random effects)

Before estimating the core model to identify the key determinants of government spending as a percentage of GDP, it was essential to determine the appropriate type of effects for the panel data used: fixed effects or random effects. To achieve this, the Hausman test was employed. This is a standard statistical tool in panel data analysis used to distinguish between the two modeling approaches. The purpose of the test is to assess whether the differences between the estimates of the fixed and random effects models are statistically significant. The null hypothesis (H_0) assumes that the random effects model is appropriate, while the alternative hypothesis suggests that the fixed effects model is preferred, especially in cases where the independent variables are correlated with unobserved individual effects. Since the p-value resulting from the Hausman test was significantly lower than the conventional significance level (0.05), the null hypothesis is rejected. Therefore, the results clearly indicate that the fixed effects model is the most suitable for analysis.

Table 4. Hausman test results

Test	*Chi. sq.*	*Probability*
Cross-section random	50.67	0.000

Source: Authors' elaboration.

4.6. Model estimation

The estimation results indicate that the wage bill as a percentage of GDP (*CE*) has a significant negative effect on government spending as a percentage of GDP. This implies that higher public sector wage expenditures reduce the fiscal space available for overall government spending relative to output. While salaries are essential for operating the public sector, they increasingly exert pressure on the fiscal structure, thereby weakening the efficiency of macro-level resource allocation.

In contrast, public debt as a percentage of GDP (*ND*) shows a significant positive effect on government expenditure. This suggests that rising debt levels are associated with increased government spending, reflecting the burden of growing financial commitments, whether in interest payments or debt repayment. It also indicates an expanding role of the state in the economy as indebtedness increases.

Military expenditure (*ME*) emerged as one of the most influential variables, with a coefficient of 0.861 and high statistical significance. This highlights the central role of defense spending in the expenditure structure of developing countries, particularly in regions facing security or political challenges.

Interest payments (*IE*) also contribute positively to public spending, with a coefficient of 0.179, reinforcing the hypothesis that a substantial share of public resources is allocated to debt servicing, thereby constraining the government's ability to finance developmental programs. The government effectiveness index (*GE*) significantly adversely affects public spending. Improved government performance correlates with lower public expenditure, indicating efficient resource management and reduced financial waste.

The human development index (*HD*) shows a significant negative effect, with a coefficient of 12.09, suggesting that countries with higher human development often utilize efficient public spending structures or cost-effective service tools. The unemployment rate (*UR*) positively impacts government expenditure, with a coefficient of 0.484, reflecting the state's role in addressing high unemployment through subsidies and support measures. These findings emphasize the need to focus not only on government spending volume but also on its composition. Components like wages and interest payments can erode fiscal space, while efficiency and human development enhance

spending effectiveness. This underscores the urgent need to reform public expenditure structures and reallocate resources to productive sectors that foster sustainable growth.

Moreover, the results show that the model enjoys a high level of statistical and economic explanatory power. The R-squared value stands at approximately 0.95, indicating that the independent variables in the model explain about 95% of the variation in government spending as a percentage of GDP. This is a very high explanatory value, reflecting the strength of the model and its ability to capture real-world interactions among the studied variables. Additionally, the high F-statistic (123.98) with strong significance (Prob = 0.0000) confirms the overall robustness and relevance of the model.

Table 5. Model estimation results

Variable	*Coefficient*	*Std. error*	*T-statistic*	*Prob.*
ND	0.1489	0.0316	4.7186	0.0004
CE	0.027	0.0146	1.854	0.0866
ME	0.8613	0.0379	22.7196	0.0000
IE	0.179	0.0191	9.3873	0.0000
GE	1.1105	0.265	4.1905	0.0011
HD	12.09	2.1782	5.5503	0.0001
UN	0.4845	0.0372	13.0103	0.0000
C	10.2127	1.7078	5.9802	0.0000
R-squared		0.954	F-statistic	123.978
Adjusted R-squared		0.947	Prob (F-statistic)	0.0000

Source: Authors' elaboration.

4.7. Model adequacy testing

4.7.1. Tests for autocorrelation and heteroskedasticity

The Breusch-Pagan-Godfrey test was applied to ensure that there is no heteroskedasticity in the residuals of the model estimation. The results indicated acceptance of the null hypothesis, which assumes homoscedasticity (i.e., no heteroskedasticity), as the F probability was below the 5% significance level. Similarly, the autocorrelation Lagrange multiplier (LM) test was conducted to check for autocorrelation among the variables. The results showed acceptance of the null hypothesis (H_0), indicating no autocorrelation, as the p-value was 0.092, which is greater than the 5% significance level. These findings confirm that no autocorrelation or heteroskedasticity problems exist among the variables in the study model.

Table 6. Results of the heteroskedasticity and autocorrelation tests

Test	*Statistic*	*Probability*
Heterogeneity of variance test *	0.833	0.649
Autocorrelation test **	2.746	0.092

Note: The Breusch-Pagan Godfrey test used the F-test, and the LM test used the Chi-squared test.
Source: Authors' elaboration.

4.7.2. Cross-sectional dependence test

Examining cross-sectional dependence in panel time series data is crucial, as ignoring it leads to biased estimates. The cross-sectional dependence (CD) test detects this dependence. Its null hypothesis assumes no dependence (i.e., no correlation) in error terms. According to Pesaran et al. (2004), the CD test is suitable for various balanced panel data structures, including static and dynamic, stationary and non-stationary, and heterogeneous data. Results in Table 7 rejected the null hypothesis, showing no evidence of cross-sectional dependence in the models. This reinforces the reliability of the statistical estimates.

Table 7. Results of the cross-sectional dependence test

Statistical value	*Probability*
60.97	0.000*

*Note: * Statistically significant at the 1% level.*
Source: Authors' elaboration.

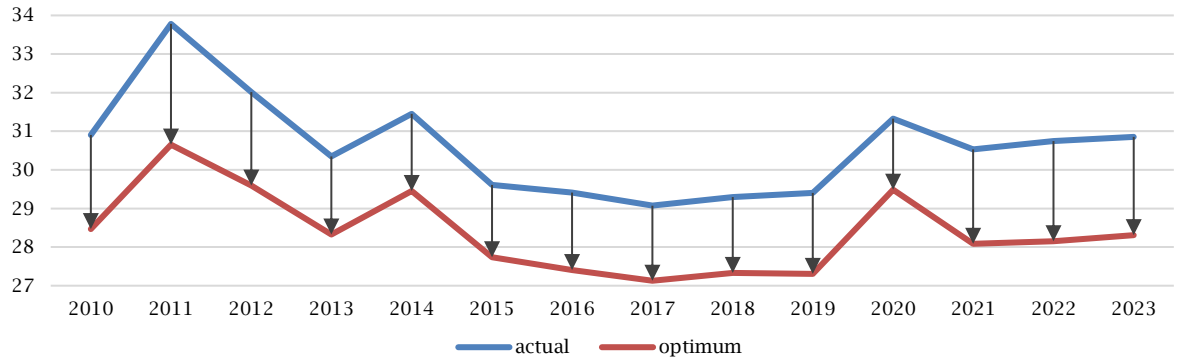
The estimated coefficients from the fixed effects model were applied to the Jordanian economy to calculate the optimal level of government spending within the general budget as a percentage of GDP. This calculation was based on actual data from the Jordanian economy from 2010 to 2023. As illustrated in Figure 3, two trajectories show that the blue line represents actual government spending, and the orange line represents the estimated optimal level, with the gap between them highlighted. The results indicate that Jordan's optimal government spending ratio averages around 28% of GDP. The figure shows that actual spending consistently exceeded this optimal level throughout the study period, revealing a persistent negative spending gap. This gap can be attributed to increased non-productive current expenditures or inefficiencies in public resource allocation, which may contribute to fiscal deficits and reduce the economic effectiveness of public spending.

These findings underscore the need to restructure public expenditure in Jordan, with a stronger focus on allocating funds toward more productive sectors, enhancing fiscal oversight, and improving government management efficiency. This would facilitate a gradual shift toward the optimal spending ratio that balances fiscal sustainability with the state's developmental role. The results are consistent with Barro's (1990) seminal study, which emphasized that government spending can drive economic growth if directed toward productive sectors that foster sustainable development. However, when spending is concentrated on non-productive current expenditures such as public sector wages and consumption, it can weaken the effectiveness of public spending and contribute to growing fiscal deficits in the long run.

This aligns with the findings in Jordan, where actual spending exceeds the estimated optimal level, signaling inefficient resource allocation.

In this context, public choice theory is relevant as it highlights the need for efficient public resource allocation through effective expenditure management (Da Silva Arraes et al., 2024). It supports the idea that enhanced fiscal oversight improves allocation efficiency, aligning with this study's findings that a spending gap may arise from weak allocation and poor administrative efficiency. In conclusion, the evidence indicates an urgent need to restructure public expenditure, with a corresponding increase in resource allocation for capital expenditures that promote sustainable economic growth.

Figure 3. Spending gap between estimated optimal and actual government expenditure ratios



Source: Authors' elaboration based on the model.

5. DISCUSSION OF RESULTS

The estimated econometric model for the Jordanian economy indicates that the optimal level of government spending is approximately 28% of the country's GDP on average. This percentage is higher than the ranges identified in most prior studies on developing countries, such as those by Barro (1990), Fatas and Mihov (2002), and Loayza and Rancière (2006), which generally estimate the optimal ratio to be between 15% and 25%. This divergence suggests the existence of a negative spending gap in Jordan, likely resulting from either an expansion in non-productive current expenditures or inefficient resource allocation, both of which contribute to fiscal deficits and reduce the economic effectiveness of public spending. The model also indicates that the public sector wage bill (*CE*) has a statistically significant negative impact on total government spending as a percentage of GDP, reflecting the fiscal strain caused by this component. This finding aligns with Fatas and Mihov (2002), who concluded that high current spending, particularly on wages, undermines efficiency and increases the likelihood of structural fiscal deficits.

Military expenditure (*ME*) emerged as one of the most influential variables, with a high coefficient and strong statistical significance. This reflects the reality in many developing countries, particularly those facing political or security instability. A similar conclusion is also supported by Loayza and Rancière (2006), who identified military spending as a key driver of public expenditure in fragile environments. Interest payments (*IE*) also show a positive and significant effect, consistent with Blanchard and Giavazzi (2004), who noted the growing burden of interest payments as a constraint on the fiscal space available for productive development-oriented expenditures.

Both the government effectiveness index (*GE*) and the human development index (*HD*) display negative and significant impacts on the level of public expenditure. This suggests that improvements in governance quality and development outcomes are associated with more rationalized spending and reduced pressure for fiscal expansion. On the social front, the unemployment rate (*UR*) exhibits a positive relationship with government expenditure, reflecting the state's social role in Jordan in providing subsidies and employment programs to mitigate rising unemployment. This result is consistent with Sharma et al. (2024), whose study on India showed that regions with higher unemployment require greater public spending to address regional disparities and deliver social support.

Considering the above, it can be concluded that the model's findings support key themes in the economic literature, particularly the importance of restructuring public expenditure, not just reducing its total level. Focus on productive spending and institutional efficiency. Results support prior recommendations: striking a balance between fiscal sustainability and the state's developmental role. This requires comprehensive fiscal and administrative reforms to enhance public expenditure and sustain long-term economic growth. Insights emphasize the need for restructuring public spending and reallocating resources to more productive sectors for sustainable growth, which in turn calls for reassessing spending priorities. For Jordan, this means increasing expenditures in growth-stimulating sectors, such as education, healthcare, research and development, and infrastructure. For instance, investment in technology and innovation can create new economic opportunities.

Effective economic results from public spending require reforms in fiscal management. This includes improving tax collection, fighting corruption, and enhancing fiscal transparency. Additionally, a balanced approach is necessary between social spending and investment to support low-income groups while investing in sectors that promote long-term growth.

6. CONCLUSION

This study analyzed the relationship between the size of government expenditure and economic growth in Jordan to determine the optimal level of government expenditure for achieving this goal. The study, employing panel data based on a sample of 41 countries classified as developing or middle-income economies, reflecting structural and economic similarities with the Jordanian economy, spans from 2010 to 2023. It also utilizes DEA to estimate the efficiency of government expenditure. The results indicate that Jordan's optimal level of government spending is approximately 28% of GDP. However, actual spending has consistently exceeded this level throughout the study period, suggesting

the existence of a negative spending gap. This gap may be attributed to high non-productive current expenditures or inefficiencies in allocating public resources, which could contribute to a persistent fiscal deficit and declining public spending efficiency.

Additionally, the findings emphasize that the focus should not only be on the volume of spending, but also on its composition and quality. Specific components, such as government wages and interest payments, significantly drain fiscal space. In contrast, indicators like government efficiency and human development contribute to enhancing spending effectiveness and rationalization.

The implications of these findings are twofold. First, fiscal reforms should prioritize reallocating resources toward productive sectors such as education, healthcare, and infrastructure that generate higher long-term returns. Second, enhancing government efficiency and fiscal transparency is crucial for improving the effectiveness of public spending and promoting sustainable economic growth.

Nevertheless, this study has limitations. The analysis is based on cross-country data, which may not fully capture the unique institutional and structural characteristics of the Jordanian economy. Additionally, while DEA and panel econometric models provide robust insights, they do not account for all potential dynamic interactions, such as those captured by DSGE or stochastic frontier analysis (SFA) frameworks.

Future research could build on these findings by incorporating more granular sectoral data, applying alternative econometric techniques, and exploring the interaction between fiscal policy, social equity, and financial stability. Such extensions would enhance the understanding of how government expenditure can be optimized to strike a balance between efficiency, growth, and social welfare in Jordan.

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