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TESTING THE RELATIONSHIP BETWEEN PUBLIC EXPENDITURES AND TAX REVENUES BY FOURIER METHOD: THE CASE OF PALESTINE

KAMU HARCAMALARI VE VERGİ GELİRLERİ ARASINDAKİ İLİŞKİNİN FOURIER YÖNTEMİ İLE TESTİ: FİLİSTİN ÖRNEĞİ

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ABSTRACT

Understanding the direction of the relationship between public expenditures and tax revenues is critical for achieving fiscal balances and formulating sustainable public policies. The study, which aims to analyze the long-run relationship between public expenditures and tax revenues in Palestine, covers the period 2011Q1-2024Q2 and consists of 54 quarterly observations. In the analysis of the study, the FKPSS unit root test and Fourier cointegration (FSHIN) analysis, which allow for slow and soft breaks and are more successful in capturing structural changes, are used as econometric methods. In addition, the causality relationship between the variables is determined by the Fourier causality test. According to the unit root test results of the variables, it is concluded that both public expenditures and tax revenues variables are non-stationary at the level. As a result of the FSHIN cointegration test, no long-run cointegration relationship was found between public expenditures and tax revenues. According to the Fourier causality test, while there is no causality relationship from tax revenues to public expenditures at the 5% level of significance, there is a unidirectional causality relationship from public expenditures to tax revenues at the 5% level of significance. The results support the validity of the Expenditure-Tax Hypothesis and reveal that public expenditures increase tax revenues by stimulating economic activity. The study shows the fragility and external dependence of the fiscal structure in Palestine and provides policy recommendations for long-term fiscal sustainability.
Keywords: *Public Expenditures, Tax Revenues, Palestine, Fourier Cointegration Analysis*

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ÖZ

Kamu harcamaları ile vergi gelirleri arasındaki ilişkinin yönünü anlamak, mali dengelerin sağlanması ve sürdürülebilir kamu politikalarının oluşturulması açısından kritik bir öneme sahiptir. Kamu harcamaları ile vergi gelirleri arasındaki uzun dönemli ilişkinin Filistin özelinde incelenmesinin amaçlandığı çalışma 2011Ç1-2024Ç2 dönemini kapsamakta ve 54 çeyrek dönemlik gözlemden oluşmaktadır. Çalışmanın analizinde ekonometrik yöntem olarak yavaş ve yumuşak kırılmalara izin veren ve yapısal değişimleri yakalamada daha başarılı olan FKPSS birim kök testinden ve Fourier eşbütünleşme (FSHIN) analizinden yararlanılmıştır. Ayrıca değişkenler arasındaki nedensellik ilişkisi Fourier nedensellik ile tespit edilmiştir. Değişkenlerin birim kök test sonuçlarına göre, hem kamu harcamaları hem de vergi gelirleri değişkeninin seviyesinde durağan olmadığı sonucuna ulaşılmıştır. FSHIN eşbütünleşme testi sonucunda ise kamu harcamaları ile vergi gelirleri arasında uzun dönemde eşbütünleşme ilişkisi tespit edilememiştir. Fourier nedensellik testi sonucuna göre vergi gelirlerinden kamu harcamalarına doğru istatistiki olarak %5 anlam düzeyinde nedensellik ilişkisi tespit edilemezken, kamu harcamalarından vergi gelirlerine doğru istatistiki olarak %5 anlam düzeyinde tek yönlü nedensellik ilişkisi tespit edilmiştir. Elde edilen sonuçlar, Harcama-Vergi Hipotezi'nin geçerliliğini desteklerken, kamu harcamalarının ekonomik faaliyetleri teşvik ederek vergi gelirlerini artırıcı bir rol oynadığını ortaya koymaktadır. Çalışma, Filistin'de mali yapının kırılganlığını ve dışa bağımlılığını ortaya koyarak, uzun dönemde mali sürdürülebilirlik için politika önerileri sunmaktadır.
Anahtar Kelimeler: *Kamu Harcamaları, Vergi Gelirleri, Filistin, Fourier Eşbütünleşme Analizi*

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Introduction

The relationship between public expenditures and tax revenues has a critical importance in line with the objectives of states to ensure fiscal sustainability, promote economic growth and increase social welfare. This relationship is seen as a fundamental factor shaping the decision-making processes of states in a wide range of areas from ensuring budget balances to implementing economic development policies. The interaction between these two key elements of public finance varies strongly depending on countries' economic structures, political contexts and institutional capacities. Especially in developing countries, this relationship is affected by factors such as political uncertainties, external dependence and governance problems (Peacock and Wiseman, 1979; Wagner, 1883).

Understanding the direction of the relationship between public expenditures and tax revenues is critical for achieving fiscal balances and formulating sustainable public policies. This relationship provides an opportunity to assess the role of governments in resource allocation and how fiscal imbalances can be addressed (Chang and Chiang, 2009). Therefore, determining the level of interdependence of these two key components of public finance allows for the development of effective fiscal reform strategies (Athanasenas et al., 2014). In particular, the ongoing Israeli-Palestinian conflict, which has evolved into a complex humanitarian and political crisis, has deepened the impact of fiscal and economic sanctions on the Palestinian economy, thus reinforcing the fragility of its public finance system (Turna, 2025).

The case of Palestine provides a remarkable context for understanding the complexity and dynamics of this relationship. The Palestinian economy has been shaped by long-standing political conflicts, external dependence, and constraints imposed by institutional arrangements such as the Paris Economic Protocol. Signed in 1993 as a result of the Oslo Accords, the Paris Economic Protocol defined Palestine's economic management system, but this arrangement has led to many structural problems that limit Palestine's fiscal independence. In particular, the fact that import and tax revenues are largely under Israeli control has made the Palestinian budget fragile. Moreover, Israel's use of these revenues as a tool of political pressure has left the Palestinian economy vulnerable to external interference (Kalloub and Odabaş, 2019; Asfour, 2018).

The structural weaknesses of the Palestinian economy have been increasingly complicated by a number of long-term problems and external factors. The size of the shadow economy severely limits Palestine's official revenue sources and reduces tax compliance. The main reasons for the growth of the shadow economy include high unemployment rates, low income levels and the lack of a reliable tax infrastructure. This weakens public revenues, reducing the state's capacity to effectively finance public services (Michaillat and Saez, 2019; Moreno-Enguix and Lorente Bayona, 2017).

High dependence on international aid is another critical factor jeopardising the sustainability of the Palestinian economy. The Palestinian Authority finances a large part of its budget with aid from international donors. However, the continuity and volume of this aid often depends on political conditions. For example, the US cut aid to Palestine in 2019, prompting the Palestinian Authority to cut public spending and borrow more to balance the budget. This not only reduced the quality of public services but also increased the debt burden, putting severe pressure on fiscal sustainability (Dana, 2020; Kalloub and Odabaş, 2019).

In addition, infrastructure deficiencies in the Gaza Strip and the West Bank, as well as economic restrictions imposed by Israel, limit the growth potential of the Palestinian economy. In particular, the trade blockade imposed in the Gaza Strip has negatively affected local production and foreign trade, increasing unemployment and further weakening public revenues. In the West Bank, the Palestinian Authority's inability to establish sovereignty over large areas of land under Israeli control, such as 'Area C', prevents the utilisation of natural resources and restricts economic activities (Klein, 2018; Asfour, 2018). This situation has led to public expenditures being directed more towards basic services, while development-oriented expenditures have been neglected (Abu-Eideh, 2015).

In addition, Israel's collection of tax revenues and its occasional use as a political pressure tool further limits the independence of the Palestinian economy. In particular, the cutbacks experienced in 2019 caused the Palestinian Authority to be unable to make salary payments and suspend public projects.

These uncertainties over the sustainability of tax revenues have made Palestine's fiscal system fragile, negatively affecting long-term economic development plans (Klein, 2018; Kalloub and Odabaş, 2019).

Determining the direction of the interdependence between public expenditures and tax revenues provides governments and policy makers with the opportunity to identify the source of a possible fiscal imbalance and take appropriate measures (Kollias and Makrydakis, 2000). Such an analysis is important for developing concrete solutions to improve the effectiveness of public policies in countries like Palestine, which face political and economic uncertainties. In this context, in this study, the relationship between public expenditures and tax revenues in Palestine for the period from the first quarter of 2011 to the second quarter of 2024 is tested using an econometric method. Following the introduction section, the study continues with the theoretical framework, followed by a literature review of the studies on the subject, and the last section includes analyses and findings, and the study is completed with the conclusion.

The significance of this study lies in its contribution to understanding the fiscal dynamics in a conflict-affected economy under institutional and external constraints. By applying robust econometric analysis to recent Palestinian data, this research not only fills an empirical gap in the literature but also offers valuable policy insights for promoting fiscal sustainability and economic resilience in fragile state contexts. The distinctive aspect of the study is that the analysis is carried out using current methodological methods such as FSHIN cointegration and Fourier causality test, which allow for capturing structural breaks and asymmetric interactions more effectively than conventional methods.

1. Theoretical Framework

The relationship between public expenditures and tax revenues has been explained by various hypotheses in fiscal theory. Each hypothesis provides a framework for understanding the basic dynamics of public finance by shedding light on different dimensions of this relationship. The Tax-Expenditure Hypothesis, the Expenditure-Tax Hypothesis, the Fiscal Synchronisation Hypothesis and the Institutional Difference Hypothesis stand out as prominent theoretical approaches in this context.

The Tax-Expenditure Hypothesis argues that public expenditures are a function of tax revenues. This approach states that increased tax revenues enable the expansion of public services. Adolph Wagner's Finanzwissenschaft in 1883 is one of the main pillars of this hypothesis. Wagner argued that the need for the state to expand public services arises with economic growth and increasing social complexity (Wagner, 1883). In the Palestinian context, the applicability of this hypothesis is limited due to the external dependence of tax revenues. In particular, Israel's control over tax collection and regulations such as the Paris Economic Protocol make it difficult for this relationship to function as envisaged (Kalloub and Odabaş, 2019).

The Expenditure-Tax Hypothesis, which draws attention to a different aspect of the relationship between tax revenues and public expenditures, argues that public expenditures can increase tax revenues by stimulating economic growth. John Maynard Keynes' The General Theory of Employment, Interest, and Money, published in 1936, provides the basic theoretical framework of this hypothesis. Keynes argued that public expenditures can stimulate growth during periods of economic stagnation by increasing aggregate demand (Keynes, 1936). However, the fact that public expenditure in Palestine is largely directed towards security and current expenditures leads to the neglect of development-oriented expenditures and limits the effective application of this hypothesis. This situation becomes even more evident with the lack of infrastructure investments and the weakening of economic growth potential (Kalloub and Odabaş, 2019).

The Fiscal Synchronisation Hypothesis argues that public expenditures and tax revenues affect each other simultaneously. According to this hypothesis, governments establish a balance by planning their expenditures and revenues together. Alan T. Peacock and Jack Wiseman's The Growth of Public Expenditure in the United Kingdom, published in 1979, emphasises the importance of fiscal synchronisation for budget balance (Peacock and Wiseman, 1979). In the Palestinian economy, the applicability of this hypothesis is complicated by the decisive role of international aid and economic relations with Israel. Israel's use of tax revenues as a tool of political pressure and uncertainties in their transmission negatively affect efforts to achieve fiscal balance (Dana, 2020; Klein, 2018).

Finally, the Institutional Difference Hypothesis argues that the relationship between public spending and tax revenues is influenced by the quality of institutional structures and the political context. Douglas North's Institutions, Institutional Change, and Economic Performance, published in 1990, is one of the main sources of this hypothesis. North argues that institutional structures and governance capacity directly affect the effectiveness of fiscal policies (North, 1990). In Palestine, the applicability of this hypothesis is weakened by factors such as the limitations of the Paris Economic Protocol, dependence on international aid and political instability. Israel's control of tax revenues and its use of tax revenues as a tool of political pressure limit fiscal independence in Palestine and make it difficult to plan public expenditures (Kalloub and Odabaş, 2019; Dana, 2020).

These four hypotheses, which explain different aspects of the relationship between public expenditure and tax revenues, provide an important framework for understanding the dynamics in the Palestinian context. While the Tax-Expenditure Hypothesis emphasises the expansion of public services based on increased tax revenues, the Expenditure-Tax Hypothesis focuses on the impact of public expenditure on economic growth and tax revenues. The Fiscal Synchronisation Hypothesis emphasises a synchronous relationship between expenditures and revenues in search of a balance, while the Institutional Difference Hypothesis addresses how this relationship is affected by the quality of institutional structures and the political context. In the case of Palestine, the applicability of these hypotheses is complicated by factors such as political uncertainties, the constraints of the Paris Economic Protocol, dependence on international aid, and infrastructure deficiencies. Therefore, solving the problems in Palestine's financial system requires a holistic approach that includes not only economic measures but also institutional and political reforms. The theoretical background provided by these hypotheses can be an important tool in shaping the future of Palestinian fiscal policies.

2. Literature

The relationship between public expenditures and tax revenues has a large place in the literature in the context of economic policy and fiscal balance and has been evaluated through different approaches. The theoretical foundations of the tax-expenditure relationship were laid with Friedman's (1978) prominent thesis that tax increases increase public expenditures. Supporting this relationship with concrete data, Von Furstenberg et al. (1986), in their analyses conducted in the USA, found that tax revenues drive public expenditures and create a unidirectional causality relationship. Similarly, Kollias and Makrydakis (2000), in their comprehensive analysis on Greece, Spain, Portugal and Ireland, found different causality relationships among countries. While the findings that tax revenues increase public expenditures in Spain support the Tax-Expenditure hypothesis, the Fiscal Synchronisation hypothesis, which emphasises the simultaneous effect of revenues and expenditures, is confirmed in Greece and Ireland. The fact that no causality relationship was found for Portugal suggests that the relationship between public expenditures and tax revenues is dependent on institutional factors and the economic context.

Ewing and Payne (1998), in their analyses of Latin American countries, have demonstrated the impact of tax revenues on expenditures and emphasised that it supports the expansionary role of public expenditures on economic growth and social welfare. The US analyses by Ewing et al. (2006) using asymmetric modelling techniques have shown that the relationship between tax revenues and public expenditures has an asymmetric structure. This relationship is found to be stronger especially in the case of increasing budget deficits. In the Palestinian context, Abu-Eideh (2015) emphasised that Wagner's Law is valid in Palestine and that tax revenues increase public expenditures. Among more recent studies, Abual-Foul and Baghestani (2023), in their analyses on Jordan and Egypt, reported a strong unidirectional causality relationship from tax revenues to public expenditures. Bulut and Çil (2024), in their comprehensive study on transition economies, elaborated the non-linear effects of tax revenues on public expenditures and revealed the asymmetric nature of this relationship.

Studies conducted in the Turkish context provide important findings in terms of understanding the dynamics of the relationship between public expenditures and tax revenues. Aysu and Bakırtaş (2018), analysing monthly data for the period 2006-2017, found an asymmetric causality relationship from public expenditures to tax revenues. This relationship is especially valid for positive shocks and shows that increasing public expenditures have an increasing effect on tax revenues. Similarly, Yılancı et al. (2020) found a unidirectional causality from tax revenues to public expenditures in the long run using the Frequency Domain Asymmetric Causality Test. Moreover, the asymmetric causality relationship in the short and medium term emphasises that such dynamic effects should be taken into account to increase the flexibility of fiscal policies. Both studies emphasise the importance of considering the effect of asymmetric changes in fiscal policy planning. In addition to these studies, Akkoç and Kargın Akkoç (2017), using quantile cointegration methods for the 2006–2017 period, found a weak but consistent long-run relationship between public revenues and expenditures, particularly resilient during and after the 2008 crisis. The study highlights the importance of analysing asymmetric effects and structural breaks in Turkish fiscal data. Yavuz et al. (2023) extended this line of analysis by applying FNQKS and QCR methods over the 1960–2022 period and found strong evidence for asymmetric fiscal sustainability in Türkiye, revealing that conventional methods may overlook such nonlinear structures. Çağlar and Yavuz (2022), using Fourier-based cointegration and causality techniques, examined the expenditure-revenue relationship for 1975–2021 and found support for the Expenditure-Tax hypothesis, with unidirectional causality from public expenditures to tax revenues. These studies jointly underscore the necessity of advanced econometric tools to reveal asymmetric and nonlinear fiscal dynamics in Türkiye.

The impact of public expenditures on economic growth has been analysed from a different perspective and the view that expenditures can increase tax revenues has been evaluated in the context of the Expenditure-Tax hypothesis in the literature. Peacock and Wiseman's (1961) observations that public expenditures grow as a reflection of economic development are among the early examples of this hypothesis. In studies on Türkiye, Akbulut and Yereli (2016), using Granger causality analysis, found a causality relationship from public expenditures to tax revenues, and this finding suggests that growth-oriented expenditures can expand the tax base. Similarly, Özmen and Bali (2018), by analysing 14 European Union countries, found that there are bidirectional asymmetric effects between public expenditures and tax revenues. This suggests that governments should consider not only economic growth but also fiscal sustainability when planning public expenditures.

On the other hand, the idea that the relationship between public expenditures and tax revenues may have a more complex and simultaneous nature has been addressed within the scope of the Fiscal Synchronisation hypothesis. Hoover and Sheffrin (2010), in their analyses of OECD countries, found a bidirectional causality relationship between revenues and expenditures and emphasised that this is of great importance for the planability of fiscal policies. Dakurah et al. (2001) reached results that support these findings in developing countries and showed that this hypothesis provides an important policy guide for countries seeking economic stabilisation. Among the studies conducted in the Palestinian context, Dana (2020) revealed the relationship between local fiscal autonomy and economic resilience and this finding reinforced the practical validity of the Fiscal Synchronisation hypothesis. In addition, Gounder et al. (2007), in their study on the Fiji Islands, found that government revenues and expenditures are cointegrated in the long run; in the short run, there is a bidirectional interaction between expenditures and revenues and between customs duties and expenditures. These findings point to the importance of simultaneous planning of public finance policies not only in developed countries but also in developing and transition economies.

However, the literature has also revealed that the relationship between public expenditures and tax revenues may be limited by the effect of institutional structures. Baghestani and McNown (1994), in their studies conducted in the USA, stated that there is no strong link between public revenues and expenditures and that this is due to the weakness of institutional structures. Similarly, Moreno-Enguix and Lorente (2017), in the context of developed countries, analysed the role of public expenditures in increasing fiscal efficiency and revealed that this situation shapes tax policies. In the Palestinian context, Kalloub and Odabaş (2023) argue that dependence on foreign aid limits the efficiency of public expenditures and constraints such as the Paris Protocol hinder efforts for fiscal independence. This provides an important framework for understanding the impact of reforms in countries' institutional structures and the pursuit of fiscal independence on public finances.

A chronological and methodological summary of this literature is presented in Table 1. The table comprehensively summarises the variable results obtained on the relationship between public expenditures and tax revenues in different countries, based on various methods and periods analysed.

Table 1: *Literature Review on the Relationship between Public Expenditures and Tax Revenues*

Year	Author(s)	Country/Region	Method	Hypothesis	Findings
1978	Friedman	United States	Theoretical Analysis	Tax-Spend	It has been theoretically suggested that tax increases expand public expenditures.
1979	Peacock and Wiseman	United Kingdom	Trend Analysis	Spend-Tax	It has been observed that public expenditures increase with economic development.
1986	Von Furstenberg et al.	United States	Granger Causality	Tax-Spend	Tax revenues were found to direct public expenditures with a unidirectional causality.
1994	Baghestani and McNown	United States	Cointegration Analysis	Institutional Difference	It was determined that there is no strong causality between public revenues and spending.
1998	Ewing and Payne	Latin American Countries	Panel Causality	Tax-Spend	Tax revenues were found to have a significant effect on expenditures.
2000	Kollias and Makrydakis	Greece, Spain, Portugal, Ireland	VAR Analysis	Tax-Spend, Fiscal Synchronization	In Spain, the Tax-Spend hypothesis was supported, while Fiscal Synchronization was observed in Greece and Ireland. No causality was found for Portugal.
2001	Dakurah et al.	Developing Countries	VAR Analysis	Fiscal Synchronization	Bidirectional causality between expenditures and revenues was found.
2006	Ewing et al.	United States	Asymmetric Modeling	Tax-Spend	The relationship between tax revenues and expenditures was found to be asymmetric, with a stronger effect during budget deterioration.
2007	Gounder et al.	Fiji Islands	Johansen Cointegration and Granger Causality Test	Fiscal Synchronization	Revenues and expenditures were found to be cointegrated in the long run, with short-term bidirectional interaction between expenditures and customs duties.

2010	Hoover and Sheffrin	OECD Countries	Panel Data (Cointegration and VAR)	Fiscal Synchronization	Bidirectional relationship between taxes and expenditures was identified.
2015	Abu-Eideh	Palestine	Johansen Cointegration and Granger Causality	Tax-Spend	Wagner's Law was found to be valid in Palestine, with tax revenues increasing expenditures.
2016	Akbulut and Yereli	Türkiye	Granger Causality	Spend-Tax	Unidirectional causality from expenditures to revenues was identified.
2017	Akkoç and Kargın Akkoç	Türkiye	Quantile Cointegration	Fiscal Sustainability	Weak but continuing long-run relationship between revenues and expenditures; resilience during the 2008 crisis.
2017	Moreno-Enguix and Lorente Bayona	Developed Countries	Panel Data	Institutional Difference	Public expenditures were found to increase fiscal efficiency and support tax policies.
2018	Aysu and Bakırtaş	Türkiye	Asymmetric Causality Test	Spend-Tax	Asymmetric causality from public expenditures to tax revenues was identified.
2018	Klein	Palestine	Vector Autoregression (VAR)	Tax-Spend	The restrictive effect of the Paris Protocol on fiscal independence was observed.
2018	Özmen and Bali	14 EU Countries	ARDL Approach	Fiscal Synchronization	Bidirectional asymmetric effects between tax revenues and public expenditures were identified.
2019	Kalloub and Odabaş	Palestine	Systematic Review	Fiscal Synchronization	External aids and protocols were found to weaken fiscal balance.
2020	Dana	Palestine	Case Study	Fiscal Synchronization	A relationship between strengthening local fiscal autonomy and economic resilience was established.
2020	Yılancı et al.	Türkiye	Frequency Domain Asymmetric Causality Test	Tax-Spend	Unidirectional causality from tax revenues to public expenditures was found in the long run, with asymmetric causality in the short and medium term.
2022	Çağlar and Yavuz	Türkiye	Fourier Cointegration and Causality	Spend-Tax	Government expenditures cause tax revenues; supports Expenditure-Tax hypothesis.

2023	Abual-Foul and Baghestani	Jordan and Egypt	Panel Granger Causality	Tax-Spend	Strong unidirectional causality from tax revenues to public expenditures was found.
2023	Yavuz et al.	Türkiye	FNQKS & QCR Tests	Fiscal Sustainability (Asymmetric)	Strong evidence for asymmetric fiscal sustainability; conventional methods may be insufficient.
2024	Bulut and Çil	Transition Economies	Asymmetric Panel Causality Analysis	Tax-Spend	Nonlinear effects from tax revenues to expenditures were identified.

Source: Created by the authors based on the literature.

Although studies analysing the relationship between public expenditures and tax revenues are generally based on conventional panel data and time series methods, these methods may be insufficient to explain the non-linearity of the relationship between variables or the presence of structural breaks. At this point, alternative analysis tools such as the Fourier method are gaining more importance in the literature as it has a more flexible structure and can provide more reliable results, especially in the presence of structural breaks. The use of this method in this study aims to understand the dynamics of the relationship between public expenditures and tax revenues in the Palestinian context in more depth and brings an important innovation to the literature in this field. The findings obtained with the Fourier method will be able to provide a more holistic and realistic framework for fiscal policy planning.

3. Dataset, Methodology and Findings

3.1. Dataset

In the study examining the existence of a long-term relationship between public expenditures and tax revenues in Palestine, the data set related to the variables covers the period 2011Q1-2024Q2 and consists of 54 quarterly observations. The study's data set was compiled from monthly reports published by the Palestinian Ministry of Finance. The study used public expenditures as the dependent variable and tax revenues as the independent variable. The Eviews program was used in the study analysis. Explanations related to the variables used in the study are shown in Table 2. The variables used in the study are in Israeli Shekels, and the logarithms for these amounts were used.

Table 2: *Variables Used in the Study and Their Explanations*

Variables	Symbol	Unit	Explanation
Total Expenditure	TotalExp	logarithmic	Logarithm of Total Expenditures
Tax Revenues	TaxRev	logarithmic	Logarithm of Total Revenues

3.2. Methodology

This study analyzes the relationship between public expenditures and tax revenues in Palestine. To determine whether the variables are stationary, it utilizes the conventional KPSS and FKPSS tests, which allow for slow and soft breaks and are more successful in capturing structural changes.

The Fourier function eliminates the need for a priori knowledge of the type (sharp or soft), date, and number of breaks frequently encountered in unit root analyses (Omay, 2015). Moreover, the Fourier unit root approach has been used in recent applied studies to determine the stationarity of variables because it allows for slower and softer breaks and more successfully captures structural changes. In contrast to conventional unit root tests (ADF, PP, etc.), the KPSS unit root test developed by

Kwiatkowski et al. (1992) tests the stationarity assumption under the null hypothesis. The Fourier KPSS (FKPSS) test is one of the first unit root studies based on the (KPSS) unit root test developed by Kwiatkowski et al. (1992) and conducted by Becker et al. (2006) using the Fourier function. Like the KPSS test, the FKPSS test tests the stationarity assumption under the null hypothesis. The Fourier KPSS unit root test detects slow and sudden changes, and the form, location, and number of structural changes do not affect the power of the test. In the FKPSS test, the level and trended versions of the equations created by Becker et al. (2006) to test the series' stationarity are given below:

$$y_t = \alpha_0 + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + e_t$$

$$y_t = \alpha_0 + \beta_t + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + e_t$$

In the level and trended versions of the above equations, k represents the number of frequencies, t represents the trend, and T represents the sample size. The hypothesis for both KPSS and FKPSS unit root tests is as follows:

H_0: The series is stationary

H_1: The series is unit rooted

Both unit root tests test the stationarity of the series under the null hypothesis (H_0). Rejection of the null hypothesis (H_0) due to the unit root test reveals that the series has a unit root. After performing the unit root test, the significance of the trigonometric terms of the Fourier functions should be examined with the help of the F test. If the trigonometric terms are significant due to the F test, the FKPSS results should be used in the stationarity test. In contrast, if they are insignificant, the KPSS test results should be considered for the stationarity test. The significance of the trigonometric terms is tested with the following hypothesis:

H_0: Trigonometric terms are not significant

H_1: Trigonometric terms are significant

Tsong et al. (2016) introduced a new cointegration test to the literature using Fourier functions, eliminating the problems of previous cointegration tests. Unlike the cointegration tests in the literature, it tests the presence, not the absence, of cointegration under the null hypothesis (H_0). Due to this approach, it can be considered an extension of the FKPSS unit root test for cointegration. The Fourier cointegration test provides robust results despite the form and number of structural changes (Yılancı, 2017). In the Fourier cointegration (FSHIN) test introduced to the literature by Tsong et al. (2016), the final equation to be used to test the main hypothesis is given below:

$$y_t = \delta_0 + \alpha_k \sin\left(\frac{2k\pi t}{T}\right) + \beta_k \cos\left(\frac{2k\pi t}{T}\right) + X_t^{'}\beta + \upsilon_{1t}$$

In this equation, k is the Fourier frequency, t is the trend, and T is the number of observations.
In the analysis of the study investigating the existence of a long-run relationship between public expenditures and tax revenues in Palestine, Fourier cointegration analysis was used as an econometric method. To perform the Fourier cointegration analysis, firstly, the stationarity of the variables was tested by FKPSS and KPSS unit root tests, and after the determination of non-stationarity, the existence of a long-run relationship between public expenditures and tax revenues was investigated with the help of the Fourier cointegration test (FSHIN). In addition, the existence of a causality relationship between public expenditures and tax revenues in Palestine was investigated with the Fourier causality test.

3.3. Findings

Table 3 presents the descriptive statistics of public expenditures used as the dependent variable and tax revenues used as the independent variable.

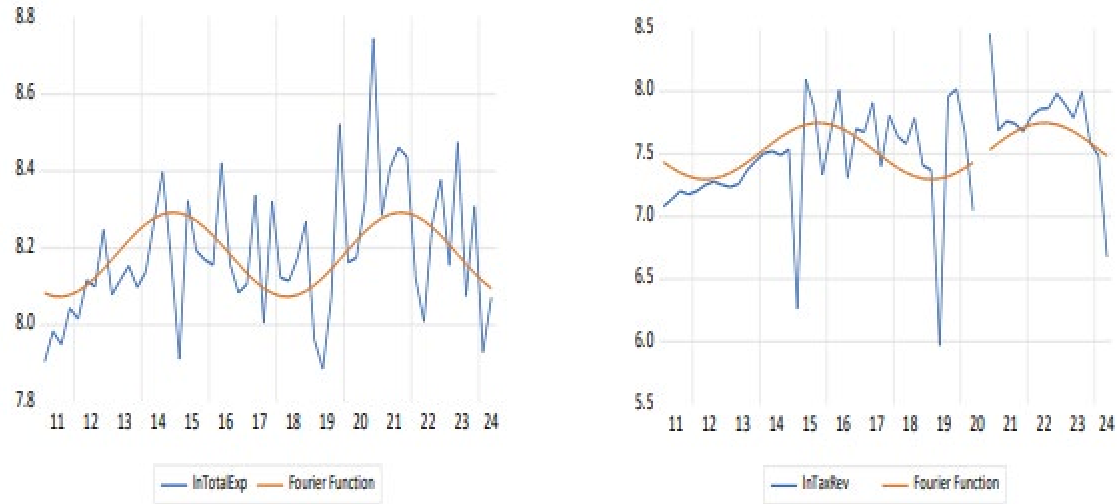
Table 3: *Descriptive Statistics for Variables*

	TotalExp	TaxRev
Mean	8.180	7.522
Median	8.154	7.581
Maximum	8.745	8.462
Minimum	7.886	5.968
Std. Dev.	0.176	0.431
Skewness	0.721	-1.196
Kurtosis	3.573	5.833
Jarque-Bera	5.331	30.36
Probability	0.069	0.000
Observations	54	54

The variables analyzed in Table 3 above consist of 54 observations. Considering the analysis period, the average, maximum, and minimum values of the public expenditures variable are 8.180, 8.745, and 7.886, respectively. The average, maximum, and minimum values of the tax revenues variable in this period are 7.522, 8.462, and 5.968, respectively.

Figure 1 below presents the graphs of the level and first difference of the variables. As can be seen in the figure, Fourier estimations are successful in capturing the series' oscillations.

Figure 1: *Graphs and Fourier Functions for Variables*



The Fourier KPSS unit root test, introduced to the literature using the KPSS unit root test and Fourier functions, tests the stationarity of the series under the null hypothesis (H_0), unlike many other unit root tests. The unit root test results for the series used in the study are presented in Table 4.

Table 4: *Unit Root Test Results*

Variables	Frequency	Min.SSR	FKPSS	KPSS	F Test Stat.
lnTotalExp	2.000	1.321	0.490(1)	0.474	6.249
lnTaxRev	2.000	8.296	0.434 (2)	0.584	4.146

Note: The values in parentheses show the bandwidth obtained by the Newey-West method. While the critical values for the FKPSS test are 0.3150, 0.4152 and 0.6671 at the 10%, 5% and 1% levels, respectively, the critical values required for the KPSS test are 0.3470, 0.4630 and 0.7390 at the 10%, 5% and 1% levels, respectively. The critical values for the F test, which is used to test the significance of trigonometric terms, are 3.935, 4.651 and 6.281 at the 10%, 5% and 1% levels, respectively.

When examining the unit root test results in Table 4, the F-test statistics used to test the significance of trigonometric terms should be compared with the critical values. While the FKPSS test is used to examine whether the variable whose trigonometric terms are significant has a unit root, the conventional KPSS test should determine whether the variable whose trigonometric terms are insignificant has a unit root. According to the F test results, it has been determined that the trigonometric terms of the lnTotalExp variable are significant at the 5% level, but the lnTaxRev variable is insignificant. According to these results, the FKPSS unit root test will be taken into consideration for the lnTotalExp variable, and the conventional KPSS test will be taken into consideration for the lnTaxRev variable in examining whether the variables have a unit root. According to the FKPSS and KPSS unit root test results in Table 4, the null hypothesis that the lnTotalExp and lnTaxRev variables do not have a unit root (the series is stationary) is rejected at the 5% significance level; Therefore, these variables are not stationary in their levels. These results show that all variables are not stationary in their level values.

The Fourier cointegration test, which entered the literature using Fourier functions, unlike many cointegration tests developed, tests the absence of cointegration under the null hypothesis, not the existence. The Fourier Shin cointegration test results applied to test the existence of a long-term relationship between public expenditures and tax revenues in Palestine are given in Table 5 below.

Table 5: *Cointegration Test Results*

Frequency	Min.SSR	Fourier Cointegration Test Statistics	Shin Cointegration Test Statistics	F Test Stat.
2	0.704	0.177 (18)	0.115 (2)	15.615

Note: The critical values for the Fourier cointegration test are 0.070, 0.092 and 0.155 at the 10%, 5% and 1% levels, respectively. The critical values for the F test statistic are 3.351, 4.066 and 5.774 at 10%, 5% and 1% significance levels, respectively.

Table 5 shows the results of the F-Test, FSHIN, and SHIN cointegration tests. Before moving on to the results of the FSHIN and SHIN tests, the significance of trigonometric terms should be examined with the F test at a 5% significance level. If the trigonometric terms are significant as a result of the F test, the FSIN cointegration test should be interpreted; if not, the SHIN cointegration test should be interpreted. As a result of the F test, it was determined that trigonometric terms are statistically significant. According to this result, the FSHIN test will interpret the cointegration relationship between variables. When the FSHIN cointegration test statistic is compared with the critical table value at the 5% level, it reveals no cointegration relationship between public expenditures and tax revenues in Palestine. These results show that changes in tax revenues do not have a long-term effect on public expenditures.

In this study, the Fourier causality test developed by Enders and Jones (2016) was employed to examine the causal relationship between variables. This test serves as an alternative to conventional Granger causality tests, aiming to provide more reliable results, particularly in the presence of structural breaks or nonlinear patterns. The primary feature of this method is that it models structural changes in time series using gradual and smooth transitions, rather than sudden jumps, through the Fourier approach. With the help of the Fourier series, subtle low-frequency fluctuations in time series can be captured, allowing structural changes to be taken into account without requiring predetermined break dates in the model's parameters. In this way, both nonlinearities and breakage effects can be modeled effectively. The Enders and Jones Fourier causality test provide a more flexible alternative, especially in cases that violate the assumptions of the classical Granger approach and contributes to reducing false negative results. The results of this test are given below.

Table 6: *Fourier Causality Results*

Dep. Variable: lnTotalEXP	Statistic	Bootsrap prob.	Lag	Frequency
lnTax	0.058	0.807	1.00	2.00
Dep. Variable: lnTax				
lnTotalEXP	4.220	0.047**	1.00	2.00

Note: ***, ** and * indicate causality at 1%, 5% and 10% significance levels, respectively.

Table 6 presents the results of the Fourier causality test between public expenditures and tax revenues in Palestine. According to the results, there is no causality relationship from tax revenues to public expenditures at the 5% level of significance, while there is a unidirectional causality relationship from public expenditures to tax revenues at the 5% level of significance.

4. Conclusion

The relationship between public expenditures and tax revenues is of fundamental importance for evaluating the effectiveness of fiscal policies and ensuring budget balance. This relationship plays a critical role not only in ensuring fiscal sustainability, but also in ensuring the efficient allocation of resources to promote economic growth and increase social welfare. In a fragile and exogenous economy such as the Palestinian economy, the relationship between these two key variables is further complicated by factors such as international regulations, dependence on foreign aid, and political conflicts.

The study analyses the existence of a long-run relationship between public expenditures and tax revenues in Palestine. The data set for the variables covers the period 2011Q1-2024Q2 and consists of 54 quarterly observations. The data set of the study was obtained from the Palestinian Ministry of Finance database. In the study, public expenditures are used as the dependent variable and tax revenues as the independent variable. In the analysis of the study, Fourier cointegration analysis was used as an econometric method. In order to perform the Fourier cointegration analysis, firstly, the stationarity of the variables was tested by FKPSS and KPSS unit root tests, and after the determination of non-stationarity, the existence of a long-run relationship between public expenditures and tax revenues was investigated with the help of the Fourier cointegration test (FSHIN). In addition, the existence of causality relationship between public expenditures and tax revenues in Palestine was investigated with Fourier causality test.

According to the unit root test results of the variables of the study, it is concluded that both public expenditures and tax revenues variables are non-stationary at the level. As a result of the FSHIN cointegration test, no long-run cointegration relationship was found between public expenditures and tax revenues. According to the Fourier causality test, while no causality relationship was found from tax revenues to public expenditures at 5% significance level, a unidirectional causality relationship was found from public expenditures to tax revenues at 5% significance level. This is consistent with the Expenditure-Tax Hypothesis. This hypothesis is based on the assumption that public expenditures can increase aggregate demand by stimulating economic activities and trigger economic growth in this process. According to the hypothesis, the government's increase in public expenditures can increase economic productivity and employment through infrastructure investments and the development of basic services such as education and health. In this process, the expansion of private sector activities and the increase in the disposable income of individuals contribute to the expansion of the tax base. An expanding tax base enables the government to generate more tax revenues, which in the long run provide a sustainable source of financing public expenditures. In this context, the hypothesis emphasises that public expenditures should be considered not only as a fiscal instrument, but also as a driver of economic growth and welfare. In the Palestinian context, this expenditure not only supports economic development, but can also stimulate economic activity in local markets. This encourages new investment and business activity, leading to increased tax revenues. However, in order for expenditures to increase tax revenues, public expenditures need to be effectively planned and efficient.

In light of these findings, policymakers need to undertake a series of reforms to ensure the fiscal sustainability of the Palestinian economy and reduce external dependence. First and foremost, it is crucial to renegotiate the Paris Economic Protocol signed in 1994. This protocol ensured the integration of the Palestinian economy into the Israeli economy but severely limited its financial independence. Renegotiation of the Protocol should aim to enable Palestine to set its own customs policies and gain independent access to the world economy. In addition, broadening the tax base and combating the informal economy are critical to fiscal sustainability. Fair and effective implementation of the tax system will encourage voluntary tax compliance and contribute to increasing tax revenues. Moreover, the effective use of local resources and the diversification of the economy should be prioritized. Increasing development-oriented public expenditures also plays a crucial role in ensuring fiscal sustainability. Investments in infrastructure, education, and healthcare services contribute to the development of human capital, thereby enhancing productivity and competitiveness. Finally, international community support is of great importance for the success of these reforms. The effective and transparent use of financial aid provided by international actors such as the European Union presents a significant opportunity to strengthen the independence and sustainability of the Palestinian economy.

Future studies are recommended to analyze the relationship between public expenditures and tax revenues on a sectoral basis and examine micro-level data. Additionally, evaluating the impact of international aid on fiscal structure and the long-term consequences of agreements such as the Paris Economic Protocol could contribute to the literature. Furthermore, the use of advanced analytical tools such as the Fourier method can enable a more effective assessment of fiscal policies.

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