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The Fiscal Impact of E-Commerce in Türkiye: Evidence from the COVID-19 and Post-Pandemic Period *

Türkiye'de E-Ticaretin Mali Etkisi: COVID-19 Salgını ve Sonrası Üzerine Bir Analiz

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ÖZ

Bu çalışma, 2019:Ç4–2025:Ç2 dönemini kapsayan üç aylık verileri kullanarak, COVID-19 pandemisi ve sonrası süreçte Türkiye'de e-ticaret harcamalarının merkezi yönetim vergi gelirleri üzerindeki etkisini incelemektedir. En Küçük Kareler (EKK) tahmin yöntemiyle elde edilen bulgular, e-ticaret harcamalarının vergi gelirleri üzerinde pozitif ve istatistiksel olarak anlamlı bir etkiye sahip olduğunu göstermektedir. Ayrıca, Granger nedensellik testi sonuçları, e-ticaret harcamalarından vergi gelirlerine doğru tek yönlü bir nedensellik ilişkisi olduğunu, buna karşılık tersi yönde bir etki olmadığını ortaya koymaktadır. Bulgular, kriz dönemlerinde alternatif bir ekonomik mekanizma olarak e-ticaretin sağlamlığını vurgulamakta ve dijital dönüşüm ilerledikçe mali öneminin artacağını göstermektedir. Bu çalışma, politika yapıcılara dijital altyapının güçlendirilmesi, kayıt dışılığın azaltılması, e-ticaret vergilendirme çerçevelerinin iyileştirilmesi ve küçük ve orta ölçekli işletmelerin (KOBİ'lerin) dijital dönüşümünün desteklenmesi yönünde adımlar atılmasını önermektedir. Bu bulgular, dijital ekonominin sürdürülebilir ve istikrarlı kamu gelirlerini desteklemedeki artan mali önemini ortaya koymaktadır.

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ABSTRACT

This study investigates the impact of e-commerce expenditures on central government tax revenues in Türkiye during the period of the COVID-19 pandemic, employing quarterly data covering 2019:Q4–2025:Q2. Using the Ordinary Least Squares (OLS) estimation technique, the results demonstrate that e-commerce expenditures exert a positive and statistically significant effect on tax revenues. Moreover, the Granger causality analysis reveals a unidirectional causal link running from e-commerce expenditures to tax revenues, with no feedback effect in the opposite direction. These findings emphasise the robustness of e-commerce as an alternative economic mechanism during times of crisis and indicate that its fiscal relevance is expected to expand further alongside the advancement of digital transformation. This paper recommends that policymakers take concrete steps to strengthen digital infrastructure, reduce informality, improve e-commerce taxation frameworks, and support the digital transformation of small and medium-sized enterprises (SMEs). These findings highlight the growing fiscal importance of the digital economy in supporting sustainable and stable public revenues.

1. Introduction

The COVID-19 pandemic has profoundly affected not only healthcare systems but also global economic structures, accelerating the digital transformation process (Yıldırım et al., 2022; Yıldırım et al., 2024). The quarantine and social distancing measures implemented to prevent the spread of the virus brought traditional economic activities to a

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standstill in many sectors, from production to consumption. During this period, business operations were restricted, unemployment rose, income losses increased, and substantial deficits emerged in public budgets. Amid this deepening economic downturn, digitalisation—and particularly e-commerce—played a critical role in maintaining economic vitality and preventing public revenues from declining as sharply as expected (Kovalchuk et al., 2024; Sharma, 2025).

E-commerce has emerged as a sector distinguished by its resilience and adaptability under crisis conditions. It has brought about lasting changes in consumer behaviour and increased the prominence of digital channels in production, distribution, and sales processes (Gibbs and Kraemer, 2004; Sheikh and Basti, 2015). The rapid expansion of the digital economy during the pandemic has also created new opportunities and challenges for public finance. The growth of e-commerce has the potential to alter the structural composition of central government revenues by bringing tax collection through digital channels to the forefront of fiscal policy discussions (López-González and Jouanjean, 2017; OECD, 2023a, 2023b).

The rapid increase in e-commerce volume in Türkiye since the last quarter of 2019 has been regarded both as a tool for economic recovery and as a source of new opportunities for reducing the informal economy. In this context, empirically examining the impact of e-commerce on the fiscal system is crucial for ensuring the sustainability of tax revenues and managing the transition toward a digital economy.

Most studies in the literature suggest that e-commerce can enhance revenue collection by broadening the tax base (Drake and Nicolaidis, 2000; Nathaniel et al., 2022; Purnomo et al., 2021). However, challenges in taxing digital transactions—particularly regarding the traceability of cross-border services and data flows—have highlighted the need for new regulatory frameworks and international cooperation (WTO, 2024a, 2024b). The amendments to the Value Added Tax (VAT) and the introduction of the Digital Services Tax in Türkiye represent a significant milestone in the integration of the digital economy into public finance (European Commission, 2022).

This study empirically examines the impact of e-commerce expenditures on central government tax revenues in Türkiye from the onset of the COVID-19 pandemic to the second quarter of 2025. Using quarterly data, the analysis reveals the driving role of e-commerce in shaping public revenues and evaluates the contribution of digitalisation to the process of economic recovery. The findings indicate that digitalisation is not confined to short-term revenue gains but also carries strategic significance for broadening the tax base, reducing informality, and facilitating the integration of SMEs into the digital economy (Kalalı and Aydemir, 2022).

Unlike earlier studies, this paper covers both the COVID-19 and post-pandemic period, offering an updated assessment of how the rapid expansion of e-commerce contributes to fiscal sustainability in Türkiye. To this end, this study aims to contribute to the limited discussions in the literature by examining the role of e-commerce in maintaining the stability of public revenues despite the contraction of economic activity during the pandemic. The systematic collection of statistical data on e-commerce in Türkiye in recent years has limited the number of empirical analyses in this field. In this context, the study presents up-to-date findings on the impact of e-commerce on budget balance, fiscal sustainability, and the integration of digitalisation into public finance, offering results that are expected to enrich the existing literature.

The remainder of this study is organized as follows: Section 2 reviews the national and international literature examining the relationship between e-commerce and tax revenues and discusses the main findings and methodological approaches of previous research. Section 3 describes the model, methodology, and dataset used in the analysis in detail. Section 4 presents the empirical results and compares them with the existing literature. Finally, Section 5 sums up the major findings, draws conclusions related to the impact of e-commerce on public finances, and provides policy recommendations.

2. Literature review

With the acceleration of digitalisation, e-commerce has radically transformed the structure of economic activity and the formation of the tax base. This transformation has prompted many researchers to examine its impact on public finances. E-commerce has significantly altered both the structure of economic activity and the composition of public revenues. While tax revenues constitute a fundamental element of fiscal sustainability, new forms of trade emerging from the digital economy may have differing effects on the expansion or contraction of the tax base. Accordingly, studies examining the impact of e-commerce on tax revenues have produced varying results depending on factors such as a country's level of digitalisation, implemented tax policies, and its capacity to combat informality. While some studies in the literature suggest that e-commerce increases tax revenues, others argue that digitalisation may reduce them by facilitating informality.

Among the studies arguing that e-commerce increases tax revenues, the analysis by Hündür (2023) for Türkiye stands out. Using data from 2012:M1 to 2021:M12, the study found that a 1% increase in e-commerce leads to a 0.43% rise in tax revenues in the long run. Similarly, Effiong and Nwanagu (2020), using data for the period 2007–2018 in Nigeria and the ordinary least square (OLS) method, found that e-commerce transactions—particularly through ATM and web-based channels—significantly and positively affect tax revenues, while the effects of POS and mobile transactions are more limited. The relatively low impact of POS and mobile channels was attributed to consumers' insufficient financial literacy and education levels. In another study on Nigeria, Clinton et al. (2025) examined the

effects of digital business models, payment systems, and technological infrastructure on tax revenues. They identified a positive and moderate relationship between these factors and tax revenues, emphasizing the need for governments to expand digital tax applications such as e-invoicing and automated transaction tracking systems to strengthen this link. Similarly, Hotunluoğlu and Özçağ (2012), using panel data from 34 OECD countries for the period 1995–2010, found that a 1% increase in internet use is associated with an approximately 0.008% increase in tax revenues. Bristol (2001), employing a microeconomic approach, examined the possible effects of electronic commerce on tax revenues in Caribbean Community countries. The study revealed that e-commerce can increase tax and tariff revenues by expanding foreign trade, although it may also pose risks of tax loss due to reduced revenues from digital products and the displacement of medium-sized enterprises. Overall, these studies indicate that digitalisation strengthens the formal economy by enhancing tax transparency and has a supportive effect on public revenues. Agrawal and Shybalkina (2023) analyse how the surge in online shopping during COVID-19 affected local sales tax revenues in the United States. Using high-frequency administrative data, they show that the expansion of e-commerce not only increased overall tax collections but also altered the geographic distribution of revenues. Their findings highlight the growing fiscal relevance of digital transactions and provide international evidence supporting the link between e-commerce activity and tax revenue performance.

However, there are also studies in the literature that highlight the negative impact of e-commerce on tax revenues. Usman (2019) analysed quarterly data from Nigeria for the period 2010–2017 using ARDL and VECM models and found that e-commerce had a statistically significant but negative effect on VAT revenues in both the short and long run. The study attributed this relationship to the narrowing of the domestic consumption base, the increase in low-value imports, and the proliferation of untaxed digital transactions. Accordingly, it emphasised the need for tax authorities to develop systems for effectively taxing e-commerce, implement regulations to reduce tax losses from digital sales, and invest in modern digital tax practices to ensure fairness in tax burdens. Similarly, Han (2020) employed a mixed-strategy Nash equilibrium model to analyse data from China for the period 2004–2017 and found that the increase in e-commerce transactions led to significant losses in tax revenues, particularly due to information asymmetry weakening tax enforcement. Furthermore, Viboonthanakul (2009), in a study covering EU countries between 1996 and 2005, found that the growth in internet users reduced the sales of taxed goods, resulting in revenue losses for governments. Duke II et al. (2013), analysing the period 2008–2011 in Nigeria, found that e-commerce made only a limited contribution to national tax revenues, with ATM and POS transactions having minor effects and internet- or GSM-based transactions having negligible effects. On the other hand, Hanrahan (2021), using data from 36 OECD countries for the period 1995–2018, applied Pooled OLS, Fixed Effects (Driscoll–Kraay), and System GMM methods and demonstrated that digitalisation decreases tax revenues in countries with high digital maturity but increases them in countries with low digitalisation. The study highlighted that the digital economy could erode the tax base and stressed the need for governments to develop international tax policies tailored to digitalisation. Finally, Hotunluoğlu and Kirli (2015), analysing 28 EU and 97 selected countries for the period 2006–2011, found that the rise in individual internet use statistically significantly reduced tax revenues, explaining this outcome by the spread of informal trade and the facilitation of international tax planning. Novastria and Hani (2024) investigate how e-commerce activities influence corporate tax avoidance among Indonesian firms. Using panel EGLS estimations, they find that companies engaged in e-commerce exhibit significantly higher levels of tax avoidance, measured through effective tax rates (ETR). Their findings suggest that digital business models may erode the tax base by enabling profit shifting and exploiting regulatory gaps. These findings indicate that e-commerce firms tend to avoid taxes more than traditional firms. Although their focus is on firm-level tax behaviour rather than government revenue, the study provides complementary evidence that the expansion of e-commerce has important fiscal implications, particularly for tax compliance and revenue performance. Elfanso and Monica (2023) examine the impact of e-commerce transactions on VAT revenues in Indonesia using a descriptive case-study approach. Despite a substantial increase in e-commerce activity between 2017 and 2021, the study finds that VAT revenues from online transactions did not rise proportionally and even declined sharply in 2021. The authors attribute this discrepancy to low tax compliance, limited taxpayer awareness, and difficulties in detecting online business activities. Their findings highlight that without effective enforcement and digital tax administration, the expansion of e-commerce may not automatically translate into higher tax revenues. Table 1 presents a structured summary of the studies included in the literature review.

Table 1: Literature review results for the impact of e-commerce on tax revenues

Author(s)/ Year	Country / Period	Methodology	Dependent Variable	Key Findings	Results
Agrawal & Shybalkina (2023)	United States (2015-2021)	High-frequency administrative data analysis	Local sales tax revenues	COVID-19 induced growth in e-commerce increased overall tax collections and shifted the geographic distribution of revenues toward smaller/rural jurisdictions.	Provides international evidence that rising e-commerce activity affects tax revenue performance; supports the argument that

					digitalisation has measurable fiscal consequences.
Bristol (2001)	Caribbean countries	Static microeconomic assessment	Tax & tariff revenues	E-commerce may increase revenues via expanded trade; risk of revenue loss for digital products.	Highlights both opportunities and risks associated with e-commerce.
Clinton et al. (2025)	Nigeria	Regression analysis	Tax revenues	Digital business models and payment systems moderately increase tax revenues.	Supports the role of digitalisation in tax administration.
Duke II et al. (2013)	Nigeria (2008–2011)	OLS	Tax revenues	ATM/POS channels have small effects; internet/GSM transactions negligible.	Shows importance of financial literacy and digital maturity.
Effiong & Nwanagu (2020)	Nigeria (2007–2018)	OLS	Tax revenues	ATM and web-based transactions increase tax revenues; POS/mobile limited.	Demonstrates heterogeneous effects across digital channels.
Elfanso & Monica (2023)	Indonesia (2017–2021)	Descriptive analysis	VAT revenue	E-commerce activity increased sharply, but VAT revenue from online transactions rose only slightly and fell significantly in 2021 due to low tax compliance and weak monitoring.	Shows that e-commerce growth does not automatically lead to higher tax revenues; highlights the role of compliance and enforcement.
Han (2020)	China (2004–2017)	Mixed-strategy Nash model	Tax revenues	Information asymmetry weakens enforcement → e-commerce reduces tax revenues.	Points to enforcement challenges in digital economies.
Hanrahan (2021)	36 OECD countries (1995–2018)	Pooled OLS, FE, System GMM	Tax revenues	Digitalisation increases tax revenues in low-digitalisation countries but decreases them in advanced ones.	Highlights asymmetric fiscal effects of digitalisation.
Hündür (2023)	Türkiye (2012–2021)	ARDL	Tax revenues	1% increase in e-commerce → 0.43% increase in tax revenues.	Strong positive relationship; consistent with our findings.
Hotunluoğlu & Kırlı (2015)	28 EU + 97 countries (2006–2011)	Panel data: two-way FEs models	Tax revenues	Individual internet use significantly reduces tax revenues.	Indicates tax base erosion in digital trade.
Hotunluoğlu & Özçağ (2012)	34 OECD countries (1995–2010)	Panel data: two-way FEs models	Tax revenues	1% increase in internet usage → ~0.008% increase in tax revenues.	Shows digitalisation broadens tax base.
Novastria & Hani (2024)	Indonesia (2019–2022)	Panel EGLS	Tax avoidance (ETR)	E-commerce engagement significantly increases corporate tax avoidance; digital business models facilitate profit shifting and reduce effective tax rates.	Shows that e-commerce has fiscal implications through tax-base erosion; complements studies linking digitalisation to tax revenue dynamics.
Usman (2019)	Nigeria (2010–2017)	ARDL, VECM	VAT revenues	E-commerce decreases VAT revenues in both short and long run.	Provides contrasting evidence suggesting tax erosion.
Viboonthanakul (2009)	EU countries (1996–2005)	Panel data: FEs & REs models	Tax revenues	Growth in internet users reduces sales of taxable goods → revenue loss.	Shows indirect consumption-related effects.

When these studies are evaluated together, it is seen that the effect of e-commerce on tax revenues is closely related to the digital infrastructure maturity of economies, the technological compatibility of their tax systems and their capacity to combat the informal economy.

3. Model, methodology and data

This study investigates the relationship between e-commerce expenditures and central government tax revenues in Türkiye throughout the COVID-19 pandemic period, using quarterly data spanning from 2019:Q4 to 2025:Q2. The dataset was constructed by combining official statistics obtained from the Electronic Data Distribution System (EVDS) of the Central Bank of the Republic of Türkiye (CBRT, 2025) and the Ministry of Trade, together with detailed budget revenue components published by the Revenue Administration of the Ministry of Treasury and Finance (MoTF, 2025). This comprehensive data framework enables an empirical assessment of how the rapid expansion of digital trade during the pandemic influenced fiscal dynamics and tax collection performance within the Turkish economy.

The dependent variable of the model is defined as central government tax revenues (TAX), and the independent variable is defined as e-commerce expenditures (ECE). The basic model used in the econometric analysis aims to determine the long-term effects of changes in e-commerce volume on tax revenues. In this context, the model is generally expressed in equation (1):

$$LnTAX_t = \beta_0 + \beta_1 LnECE_t + \varepsilon_t \quad (1)$$

In equation (1), β_0 represents the constant term, and β_1 represents the marginal effect of changes in e-commerce expenditures on tax revenues. ε is the error term representing the effect of other factors not included in the model. t represents the time (quarter) to which the relevant observation belongs. The natural logarithms of all series were taken and incorporated into the model.

The empirical basis of this study is an econometric analysis process designed to measure the impact of e-commerce expenditures on tax revenues. Before examining the relationship between variables, it is necessary to evaluate the time series properties and determine whether they are stationary (Esen and Seren, 2022). Accordingly, the stationarity level of the series was first examined through the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests during the analysis. Then, an econometric model was estimated using the OLS method to determine the relationship between e-commerce expenditures and tax revenues. OLS was preferred as the most statistically appropriate method given the frequency and limited size of the dataset. This methodological framework was chosen to quantitatively reveal the impact of the digitalisation process on fiscal indicators.

This section presents the descriptive statistics that illustrate the fundamental statistical characteristics of the variables used in the study. These statistics provide preliminary insights into the structure of the series by reporting the mean, median, maximum, and minimum values, along with basic distribution measures such as standard deviation, skewness, and kurtosis. In addition, the Jarque–Bera test is employed to assess whether the variables conform to a normal distribution. This information forms the basis for the modelling process and facilitates the evaluation of the overall behaviour of the series. The statistical results are reported in Table 2.

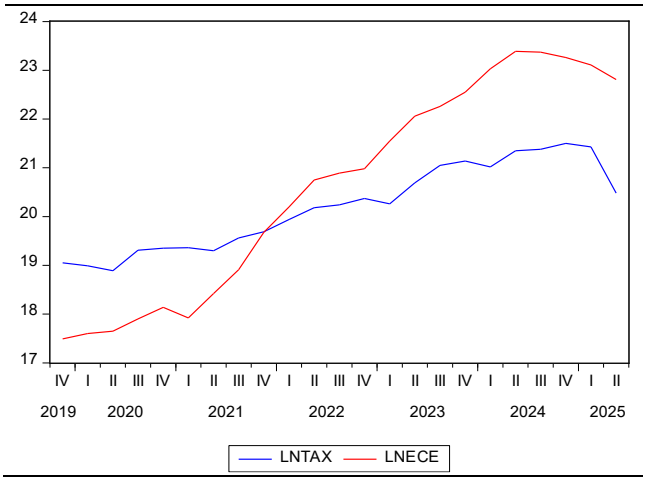
Table 2: Descriptive statistics for the variables

	LnTAX	LnECE
Sample Period	2019Q4 – 2025Q2	2019Q4 – 2025Q2
Observations	23	23
Mean	20.197	20.605
Median	20.240	20.890
Maximum	21.500	23.390
Minimum	18.890	17.490
Std. Dev.	0.874	2.195
Skewness	0.064	-0.156
Kurtosis	1.630	1.473
Jarque-Bera	1.815	2.328

*, ** and *** indicate statistical significance at the 1%, 5% and 10% confidence levels respectively.

Table 2 summarises the descriptive statistics for 23 observations covering the period from 2019:Q4 to 2025:Q2. The mean value of the tax revenues (LnTAX) variable is 20.196, and the low standard deviation (0.87) indicates that the series is relatively stable. The skewness and kurtosis values are close to those of a normal distribution, and the Jarque–Bera test confirms that the error terms are normally distributed. The e-commerce expenditures (LnECE) variable exhibits a higher standard deviation (2.19) and a slightly left-skewed distribution, indicating more pronounced fluctuations over time. However, the Jarque–Bera test shows that this variable also conforms to a normal distribution. Overall, both series display characteristics close to normality and are suitable for regression and causality analyses. The trends of both variables are presented in Figure 1.

Figure 1: Trends in lnTAX and lnECE from 2019:Q4 to 2025:Q2



4. Empirical results

In time series analysis, determining the stationarity properties of variables is a fundamental step in establishing model reliability (Bayrak and Esen, 2012). Stationarity means that the mean and variance of the series remain constant over time and that the effects of exogenous shocks are temporary. In analyses with non-stationary data, relationships between variables that do not actually exist may appear statistically significant; this can lead to the problem of spurious regression (Esen and Dündar, 2021).

Therefore, the ADF and PP unit root tests were applied to determine whether the variables used in the study were stationary at their levels or in their differences. The tests were conducted under constant, constant with trend, and trendless specifications, and the results revealed that the series were largely stationary. This prevented the risk of misleading relationships in the model's estimates. The unit root test results for the variables are shown in Table 3.

The ADF and PP test results in Table 3 indicate that both the tax revenue (LnTAX) and e-commerce expenditure (LnECE) variables are non-stationary at their levels. However, when the first differences of the variables are taken, statistically significant stationarity was achieved only under the constant and trendless model. This demonstrates that the logarithmic transformation largely removed trend and fixed effects from the series, and that the constant and trendless model is a more appropriate option for stationary

analysis. Therefore, to avoid the risk of spurious regression in econometric analyses, estimations were conducted based on the first differences of the variables.

Table 3: Unit root test results

Variables	ADF Unit Root Tests					
	At Level			At First Difference		
	With Constant	With Constant & Trend	Without Constant & Trend	With Constant	With Constant & Trend	Without Constant & Trend
LnTAX	-1.307	-0.762	1.010	-2.280	-2.259	-2.295**
LnECE	-1.458	-0.832	1.039	-2.112	-2.314	-1.699***
	PP Unit Root Tests					
	At Level			At First Difference		
	With Constant	With Constant & Trend	Without Constant & Trend	With Constant	With Constant & Trend	Without Constant & Trend
LnTAX	-1.3070	-0.7615	1.0097	-2.2801	-2.1358	-2.295**
LnECE	-1.0698	-0.7576	2.7528	-2.1123	-2.2614	-1.630***

*, ** and *** indicate statistical significance at the 1%, 5% and 10% significance levels, respectively.

In this study, a linear regression model was established to analyse the effect of e-commerce expenditures on tax revenues, and the model was estimated using the OLS method. The OLS method is one of the most widely used parametric estimation techniques for determining the extent to which the explanatory variable explains the variation in the dependent variable. The regression coefficients obtained through this method provide information about the direction and strength of the relationship between the variables, while significance tests reveal whether this relationship is statistically valid. In this context, the estimation results of the regression model are presented in detail in Table 4.

Table 4: Model estimation results using the OLS method

Variables	Coefficient	Standard Error	t-statistic	P-value
LnECE	0.393	0.020	19.453	0.000*
C	11.657	0.419	27.818	0.000*
R^2 = 0.947; Adjusted R^2 = 0.944, F-statistic= 378.410 (0.0000)				

*, ** and *** indicate statistical significance at the 1%, 5% and 10% significance levels respectively, and the values in parentheses indicate p-values.

According to the results presented in Table 4, e-commerce expenditures have a positive and statistically significant impact on tax revenues. The coefficient for the LnECE variable in the model is 0.39, which is significant at the 5% level ($p < 0.01$). Accordingly, a 1% increase in e-commerce expenditures is associated with an about 0.39% increase in tax revenues. Furthermore, the relatively high R^2 (0.947) is partly a result of the small sample size and the strong trend component observed in both series during the 2019–2025 digitalisation process. This is consistent with the behaviour of trending macro-fiscal variables in short samples.

These results demonstrate that the increase in e-commerce volume in Türkiye since the last quarter of 2019 has supported public revenues and that digitalisation has played a role in expanding the tax base from a fiscal policy perspective. These findings serve as an important reference for policymakers assessing the impact of digital economy-related tax regulations on public revenues.

In time-series applications, determining an appropriate lag length must be determined before conducting the Granger causality analysis. Given the short time span and quarterly structure of the dataset used in this study, the Akaike Information Criterion (AIC) provides a more suitable basis for lag selection. As emphasised by Lütkepohl (2006) and Khan et al. (2020), AIC performs comparatively better with small samples and offers more reliable results than alternative criteria such as the Schwarz Information Criterion (SIC), the Hannan–Quinn criterion (HQ), or the Final Prediction Error (FPE). Consistent with the AIC values reported in Table 5, a lag order of one was selected for the period 2019:Q4–2025:Q2.

Table 5: Lag selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-35.084	NA	0.1700	3.9036	4.0030	3.9204
1	3.8658	65.601*	0.0043*	0.2246*	0.5228*	0.2751*
2	5.5087	2.4212	0.0056	0.4727	0.9698	0.5568
3	6.1733	0.8394	0.0084	0.8238	1.5197	0.9416
4	8.3401	2.2808	0.0111	1.0168	1.9115	1.1682

* indicates lag order selected by the criterion

This study applied the Granger causality test to assess the causal relationship between e-commerce expenditures and tax revenues. The Granger causality test is a widely used statistical method that determines whether past values of one-time series variable can explain the current value of another. In this context, the null hypothesis (H_0) states that one variable does not Granger-cause the other. The estimation results of the Granger causality test are shown in Table 6.

Based on the results in Table 6, H_0 hypothesis that "lnECE does not cause lnTAX" was rejected at the 5% significance level. The results demonstrate that past values of e-commerce expenditure have a statistically significant impact on tax revenues. Therefore, increases in e-commerce expenditure drive tax revenues and have an impact on public finances.

Table 6: Granger causality test results

H_0 Hypothesis	Obs	F-Statistic	Prob.	Remarks
lnECE does not Granger Cause lnTAX	22	15.8082	0.0008*	Reject H_0 Hypothesis
lnTAX does not Granger Cause lnECE		3.34615	0.0831	Accept H_0 Hypothesis

* and ** indicate statistical significance at the 1% and 5% confidence levels respectively.

In contrast, the null hypothesis that 'lnTAX does not Granger-cause lnECE' cannot be rejected at the 5% level—while the p-value (0.0831) would be considered marginally significant at the 10% level, this study follows a 5% significance criterion—indicating that causality runs unidirectionally from e-commerce expenditures to tax revenues.

Overall, these findings suggest that e-commerce, as a key component of the digital economy, expands the tax base and exerts direct effects on public revenues. Consequently, policymakers should take into account the fiscal implications of e-commerce when designing digitalisation strategies.

The reliability of the regression model depends not only on the statistical significance of the estimated coefficients but also on the extent to which the model satisfies its underlying assumptions (Esen et al., 2025). Accordingly, diagnostic tests for autocorrelation, heteroskedasticity, normality, and model specification were conducted to assess the model's validity. These tests are crucial for ensuring the robustness of econometric analyses. Table 7 presents the diagnostic test results for the regression model.

Table 7: Diagnostic test results

Tests	F-statistic	H_0 Hypothesis
Breusch-Godfrey Serial Correlation LM Test	1.707 (0.209)	H_0: There is no serial correlation
Breusch-Pagan-Godfrey Heteroskedasticity Test	2.315 (0.143)	H_0: There is no heteroskedasticity
Ramsey RESET Test	2.150 (0.158)	H_0: There is no specification error in the model

The values in brackets indicate p-values.

To assess the validity and reliability of the model, diagnostic tests for autocorrelation, heteroskedasticity, and the model's functional form were conducted. As shown in Table 7, the Breusch–Godfrey LM test was first performed to detect autocorrelation among the error terms. The obtained F-statistic (1.707) and p-value (0.2094) indicate no evidence of autocorrelation at the 5% significance level. Second, the Breusch–Pagan–Godfrey test was applied to examine whether the variance of the error terms was constant. The F-statistic (2.315) and p-value (0.143) confirm that the homoskedasticity assumption holds. Finally, the Ramsey RESET test was used to evaluate whether the model was correctly specified. The F-statistic (2.150) and p-value (0.158) show that the model contains no specification errors. Overall, these results demonstrate that the classical linear regression assumptions are satisfied, and the model is statistically valid and reliable.

5. Conclusions

This paper examined the effect of e-commerce expenditures on central government tax revenues following the COVID-19 pandemic in Türkiye, using quarterly data from the last quarter of 2019 to the second quarter of 2025. The results of the analysis indicate that e-commerce expenditures have a positive and statistically significant impact on tax revenues. Accordingly, a 1% increase in e-commerce expenditures is associated with an about 0.39% increase in tax revenues. This finding demonstrates that digitalisation has become a factor in expanding the tax base and enhancing fiscal capacity for public finance. Results from the Granger causality tests indicate that e-commerce expenditures Granger-causes tax revenues, while no reverse causality is detected. This finding suggests that tax revenues are influenced by increases in e-commerce expenditures, whereas these revenues have no significant effect on e-commerce activity. Accordingly, a unidirectional causal relationship running from e-commerce expenditures to tax revenues was identified during the pandemic period in Türkiye.

The pandemic has demonstrated that the digital economy can maintain its functionality even under crisis conditions, and that e-commerce is a strategic area for economic resilience. The results indicate that this impact will become even stronger in the future as digital transformation deepens.

The findings of this study demonstrate that e-commerce expenditures have a positive and statistically significant impact on tax revenues, aligning with many empirical studies in the literature. These results are particularly consistent with those of Hündür (2023) for Türkiye, and Effiong and Nwanagu (2020) and Clinton et al. (2025) for Nigeria, which also show that digital commerce increases public revenues by expanding the tax base. Similarly, studies by Hotunluoğlu and Özçağ (2012) and Bristol (2001) emphasise that digitalisation strengthens tax transparency and contributes positively to public finances. Therefore, this study is in line with previous research highlighting the stabilising role of digitalisation in maintaining public revenues, particularly during periods of crisis. On the other

hand, unlike studies such as Usman (2019) and Han (2020), which indicate that e-commerce has adverse effects on tax revenues, the recent proliferation of digital tax practices (e.g., e-invoice and digital services tax) in Türkiye appears to have mitigated these risks, showing that e-commerce has become a mechanism supporting fiscal sustainability.

Based on the findings of this paper, several recommendations are proposed for policymakers. First, strengthening digital infrastructure and increasing accessibility will support the balanced regional growth of e-commerce. Second, expanding digital tracking and e-invoicing systems to combat informality will increase tax transparency. Furthermore, updating e-commerce-specific tax regulations and expanding incentives for SMEs' digital transformation will contribute to strengthening both the tax base and economic inclusiveness.

Finally, the integration of data-sharing and auditing mechanisms across institutions will enable more effective monitoring of e-commerce activities and the development of data-driven decision-making processes in policymaking.

Overall, the study demonstrates that e-commerce is not only a consequence of digitalisation but also a strategic policy tool for sustaining public revenues, reducing the informal economy, and fostering crisis-resilient financial structures. In this context, implementing long-term, holistic, and coherent policies is crucial for Türkiye to enhance its competitiveness and fiscal capacity in the digital economy.

This study has several limitations. First, although the primary aim was to compare the fiscal relationship between e-commerce and tax revenues before and after the COVID-19 pandemic, access to pre-2019 e-commerce statistics in Türkiye was not possible. Therefore, the analysis relies on a relatively short quarterly dataset starting from 2019:4, which constrains the empirical ability to compare the pre- and post-pandemic periods. Second, the short time span and small number of quarterly observations constrained the methodological choices. Due to insufficient degrees of freedom, nonlinear econometric techniques—such as NARDL, threshold regression models, structural break tests, or multivariate cointegration approaches—could not be reliably applied. The limited sample also prevented the inclusion of key macroeconomic control variables, which would normally improve the robustness of the estimations. Therefore, future research may benefit from using higher-frequency data, multi-country settings, and more comprehensive modelling approaches.

References

Agrawal, D. R., & Shybalkina, I. (2023). Online shopping can redistribute local tax revenue from urban to rural America. *Journal of Public Economics*, *219*, 104818. https://doi.org/10.1016/j.jpubeco.2022.104818

Bayrak, M., & Esen, Ö. (2012). Bütçe açıklarının cari işlemler dengesi üzerine etkileri: İkiz açıklar hipotezinin Türkiye açısından değerlendirilmesi. *Ekonomik Yaklasim*, *23*(82), 23-49.

Bristol, M. A. (2001). The impact of Electronic Commerce on Tax Revenues in the Caribbean Community. Being a Paper Prepared as Part of the Graduate Internship Program 2001, for the Regional Tax Policy and Administration Unit CARICOM Secretariat, Georgetown, Guyana, SA

CBRT (2025). *Elektronik Veri Dağıtım Sistemi (EVDS).* (Erişim Tarihi: 02.06.2025), https://evds2.tcmb.gov.tr/

Clinton, O., Adegbite, Y.A., Iyagba, H.A., & Nkak, N. (2025). The Impact of E-Commerce on Tax Revenue in Nigeria. *Accounting and Management International Journal*, 11(1), 1-12.

Drake, W. J., & Nicolaidis, K. (2000). Global Electronic Commerce and GATS: The 'Millennium Round' and Beyond. In *Pierre Sauve and Robert M. Stern (Eds), GATS 2000: New Directions in Services Trade Liberalization*, (pp. 399-437). Washington DC: The Brookings Institution Press.

Duke II, J., Kankpang, K., Emenyi, E., & Efiok, S. (2013). Impediments of electronic commerce as a tax revenue facilitator in Nigeria. *International Business Research*, *6*(6), 1-10.

Effiong, S. A., & Nwanagu, P. O. (2020). E-Commerce transactions and tax revenue: A commensal-symbiotic evaluation. *Test Engineering and Management*, *83*, 26853-26873.

Elfanso, E., & Monica, L. (2023). Analisis dampak transaksi E-Commerce terhadap penerimaan pajak pertambahan nilai. *Owner: Riset Dan Jurnal Akuntansi*, *7*(1), 841-850. https://doi.org/10.33395/owner.v7i1.1477

Esen, Ö., & Dündar, M. (2021). Do energy taxes reduce the carbon footprint? Evidence from Turkey. *JOEEP: Journal of Emerging Economies and Policy*, *6*(2), 179-186.

Esen, Ö., & Seren, G. Y. (2022). The impact of gender inequality in education and employment on economic performance in Turkey: evidence from a cointegration approach. *Equality, Diversity and Inclusion: An International Journal,* 41(4), 592-607. https://doi.org/10.1108/EDI-04-2021-0099

Esen, Ö., Yıldırım, D. Ç., & Akyurt, E. (2025). How Inflation and its Uncertainty Affect Stock Returns: Insights from Borsa Istanbul. *Trends in Business and Economics*, *39*(2), 117-128.

European Commission (2022). *VAT in the digital age. Publications Office of the European Union.* (Erişim tarihi: 17 Haziran 2025). https://op.europa.eu/en/publication-detail/-/publication/a07ffdc4-0966-11ed-b11c-01aa75ed71a1/language-en

Gibbs, J. L., & Kraemer, K. L. (2004). A cross-country

investigation of the determinants of scope of e-commerce use: an institutional approach. *Electronic markets*, 14(2), 124-137.

Han, W. (2020). The analysis on Chinese e-commerce tax losses based on the perspective of information asymmetry. *Electronic Commerce Research*, *20*(3), 651-677. https://doi.org/10.1007/s10660-018-9318-7

Hanrahan, D. (2021). Digitalization as a determinant of tax revenues in OECD countries: A static and dynamic panel data analysis. *Athens journal of business & economics*, *7*(4), 321-348. https://doi.org/10.30958/ajbe.7-4-2

Hotunluoğlu, H., & Kirli, E. (2015). Vergi Geliri Üzerinde Bireysel İnternet Kullanımının Etkisi. *Kahramanmaraş Sütçü İmam Üniversitesi Sosyal Bilimler Dergisi*, *12*(2), 285-292.

Hotunluoğlu, H., & Özçağ, M. (2012). İnternet kullanımının vergi gelirlerine etkisi: OECD üyesi ülkeler için ampirik bir analiz. *Maliye Dergisi*, *163*, 354-366.

Hündür, S. (2023). E-Ticaretin Ekonomik Büyüme ve Vergi Gelirlerine Etkisi: Türkiye İçin Ekonometrik Bir Analiz. Yüksek Lisans Tezi. Karaman: Karamanoğlu Mehmetbey Üniversitesi

Kalalı, G., & Aydemir, C. (2022). İşletmelerin E-ticaret uygulamalarına yönelik internet kullanımlarının bazı değişkenler açısından incelenmesi. *Ekonomi İşletme Siyaset ve Uluslararası İlişkiler Dergisi,* 8(1), 171-187.

Khan, M. K., Khan, M. I., & Rehan, M. (2020). The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. *Financial innovation*, *6*(1), 1. https://doi.org/10.1186/s40854-019-0162-0

Kovalchuk, O., Shevchuk, R., & Banakh, S. (2024). Cryptocurrency crime risks modeling: Environment, e-commerce, and cybersecurity issue. *IEEE Access*, 12,50673-50688. https://doi.org/10.1109/ACCESS.2024.3386428.

López-González, J., & Jouanjean, M. (2017). Digital Trade: Developing a Framework for Analysis. *OECD Trade Policy Papers*, WP. No. 205. Paris: OECD Publishing. http://dx.doi.org/10.1787/524c8c83-en

MoTF (2025). *Merkezi Yönetim Bütçe Gelirleri*. (Erişim Tarihi: 02.06.2025), https://www.hmb.gov.tr/kamu-finansmani-istatistikleri

Nathaniela, T. C., Purnomo, A., Persada, S. F., & Rosyidah, E. (2022). A Systematic Review of Business Process Management in E-Commerce. In *2022 International Conference on Informatics, Multimedia, Cyber and Information System (ICIMCIS),* (pp. 66-70). 16-17 November 2022, IEEE. Jakarta, Indonesia. https://doi.org/10.1109/ICIMCIS56303.2022.10017500

Novastria, R. O., & Hani, A. S. (2024). The Impact of E-Commerce on Tax Avoidance in Indonesia: Empirical Study on Companies Registered in Indonesia Stock Exchange. *Educational Administration: Theory and Practice*, *30*(6), 3122-3137.

OECD (2023a). *Tax challenges arising from digitalisation – Report on Pillar One Blueprint.* (Erişim tarihi: 17 Haziran 2025) https://www.oecd.org/en/publications/tax-challenges-arising-from-digitalisation-report-on-pillar-one-blueprint_beba0634-en.html

OECD (2023b). *Tax challenges arising from the digitalisation of the economy – Subject to tax rule (Pillar Two).* OECD. (Erişim tarihi: 17 Haziran 2025), https://www.oecd.org/en/publications/tax-challenges-arising-from-the-digitalisation-of-the-economy-subject-to-tax-rule-pillar-two_9afd6856-en.html

Purnomo, A., Susanti, T., Anisah, H. U., Sari, A. K., & Maulana, F. I. (2021). Value of m-commerce research: A bibliometric perspective. In *2021 International Conference on Information Management and Technology (ICIMTech)* (Vol. 1, pp. 813-818). 19-20 August 2021, Jakarta, Indonesia. IEEE. https://doi.org/10.1109/ICIMTech53080.2021.9534928

Sharma, A. (2025). *Scope of E-commerce in 2025 and Beyond*. Young Urban Project. (Erişim Tarihi: 15.01.2025), https://www.youngurbanproject.com/scope-of-e-commerce/

Sheikh, S. M., & Basti, M. (2015). Customer satisfaction in business to consumer (B2C) E-commerce: a comparative study of Turkey and Pakistan. *Eurasian Journal of Business and Economics,* 8(16), 73-100.

Usman, A. (2019). An empirical assessment of the impact of e-commerce on value added tax revenue generation in Nigeria. *IOSR Journal of Humanities and Social Science*, *24*(04), 6-17.

Viboonthanakul, S. (2009). Smuggling via e-commerce: effect on tax revenue. *Journal of International Trade Law and Policy*, *8*(3), 272-290. https://doi.org/10.1108/14770020910990650

WTO (2024a). *Electronic commerce. Understanding The WTO: Cross-Cutting and New Issues.* World Trade Organization Publishing. (Erişim Tarihi: 26.12.2024), https://www.wto.org/english/thewto_e/whatis_e/tif_e/bey4_e.htm

WTO (2024b). *Information on the Agreement on Electronic Commerce*. (Erişim Tarihi: 10.03.2025), https://www.wto.org/english/tratop_e/ecom_e/information_on_agreement_ecom.pdf

Yildirim, D. C., Esen, O., & Ertugrul, H. M. (2022). Impact of the COVID-19 pandemic on return and risk transmission between oil and precious metals: Evidence from DCC-GARCH model. *Resources Policy*, *79*,

102939.
https://doi.org/10.1016/j.resourpol.2022.102939

Yildirim, S., Yildirim, D. C., & Esen, Ö. (2024). The rise of the functional beverages market: Indicators post COVID-19 pandemic. In *Economics and Environmental Responsibility in the Global Beverage Industry* (pp. 350-368). USA: IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-2149-2.ch019