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Monetary and Macroeconomic Determinants of Tax Revenue: The Case of Türkiye

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Vergi Gelirinin Parasal ve Makroekonomik Belirleyicileri: Türkiye Örneği

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Abstract

In this study, the effects of selected monetary and macroeconomic variables on tax revenues are investigated. For this purpose, the effects of the USD/TRY exchange rate, broad money (M2), industrial production index, deposit interest rate, unemployment rate and exports on the tax revenues are analyzed with the Autoregressive Distributed Lag Model (ARDL) with monthly observations for the period between 2006:1-2022:11 in Türkiye. The empirical findings reveal that there is a cointegration relationship between tax revenues and all series. According to the long-run coefficient estimates, the broad money (M2), industrial production index, deposit interest rate and export series affect the tax level positively, while the unemployment rate and USD/TRY exchange rate affect the tax level negatively. Furthermore, the results show that the broad money (M2) has the greatest effect in tax revenues. In this context, it is recommended that the tax authorities seeking to increase tax revenues should pay more attention to the effect of broad money (M2), as well as other indicators, on tax revenues when determining the tax policy targets.

Keywords: *Tax revenues, determinants of tax revenues, ARDL, Türkiye.*

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Öz

Bu çalışmada seçilen parasal ve makroekonomik değişkenlerin vergi gelirleri üzerindeki etkileri araştırılmıştır. Bu amaçla Türkiye'de 2006:1-2022:11 dönemi için aylık gözlemler dâhilinde geniş para (M2), USD/TRY kuru, sanayi üretim endeksi, mevduat faiz oranı, işsizlik oranı ve ihracatın vergi gelirleri üzerindeki etkileri Gecikmesi Dağıtılmış Otoregresif Model (ARDL) ile analiz edilmiştir. Ampirik bulgular, vergi gelirleri ile tüm seriler arasında bir eşbütünleşme ilişkisi olduğunu ortaya koymuştur. Uzun dönem katsayı tahminlerine göre geniş para (M2), sanayi üretim endeksi, mevduat faiz oranı ve ihracat serileri vergi düzeyini pozitif yönde etkilerken, işsizlik oranı ve USD/TRY kuru vergi düzeyini negatif yönde etkilemektedir. Ayrıca, sonuçlar geniş paranın (M2) vergi gelirleri üzerinde en fazla etkiye sahip olduğunu göstermiştir. Bu bağlamda, vergi gelirlerini artırmak isteyen vergi otoritelerinin vergi politikası hedeflerini belirlerken diğer göstergelerin yanı sıra geniş paranın (M2) vergi gelirleri üzerindeki etkisini daha fazla dikkate almaları önerilmektedir.

Anahtar Kelimeler: *Vergi gelirleri, vergi gelirlerinin belirleyicileri, ARDL, Türkiye.*

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1. Introduction

Tax revenues are important for both developed and developing countries due to their function, their size within the budget, and being a compulsory and regular source of revenue. Tax is the main source of revenue for the central government and provides a stable income for the treasury. The provision of public goods and services and the establishment of justice and security by the state require a regular flow of income (Addison and Levin, 2012). Many developing countries are required to spend to ensure economic growth, to fight poverty and to provide education and health services. Affording these expenditures depends on sufficient tax revenues (Bird et al., 2008; Piancastelli and Thirlwall, 2020). On the other hand, Peacock (2003) argues that the government should issue as much money to the market as the taxes collected from citizens. The amount of money to be issued to the market is closely related to the tax revenues collected. Accordingly, while the expenditures for public services are financed with taxes, these services are provided to the citizens in return for a bill (Peacock, 2003; Yılmaz and Çelikay, 2017).

Tax has a key importance for ensuring economic growth and mobilizing domestic resources, and the tax policies are an effective tool in this regard (Karagöz, 2013). Taxes and fees constitute appropriate sources for channelling savings to capital formation. Tax revenue generated in excess of public expenditures allows to use this revenue for the creation of capital assets (Kaldor, 1963). In the absence of sufficient tax revenues, governments have to resort to borrowing. A growing public debt stock can lead to reimbursement difficulties and fiscal crises in the absence of new sources of revenue (Piancastelli and Thirlwall, 2020). Governments face financing challenges due to the limited sources of revenue and the increasing needs of citizens. To finance the expenditures, the governments should focus on mobilising domestic resources through an effective tax policy. In developing countries, the tax system is characterised by complexity and governance issues (Boukbech et al., 2018). A good tax system ensures a country's economic structure, tax enforcement capacity, ability to meet public service needs, and access to other sources of revenue such as aid-oil (Bird, 2008).

Policymakers' various policy decisions on the interest rates, the exchange rate, the degree of import restrictions and the inflation rate have an impact on the level of taxation in a given period and these decisions change over time (Tanzi, 1989). Empirical evidence suggests that the monetary, fiscal, political and macroeconomic environments have an impact on tax revenue performance (Ghura, 1998; Gupta, 2007; Karagöz, 2013; Castro and Camarillo, 2014; Bird et al., 2014; Kutbay, 2019; Ali and Audi, 2018; Karabulut and Şeker, 2018; Öz-Yalaman, 2019). Taxes are a basic source of revenue for Türkiye, as in many countries. The state has many duties that it is required to fulfil. Increasing public expenditures, budget deficits, structural problems, and domestic and foreign debt levels all highlight the importance of tax revenues in the treasury. For any reason whatsoever, all countries are required to regulate and collect taxes in order to achieve a stable level of taxation that allows the Treasury to provide the revenue it needs according to economic, social, political and cultural conditions.

Tax revenue is directly affected by all the elements affecting the income, wealth and expenditures to which the tax is levied. All these elements interact, particularly with monetary and macroeconomic indicators. Investigating these factors is important in terms of showing policymakers the economic factors that affect tax revenues and the direction of such effects. In this respect, it is obvious that the effect of money supply (M2) on tax revenues is not sufficiently discussed in the literature. To the best of our knowledge, there are two studies in the literature in Türkiye that include broad money (M2) in the model as an explanatory variable and investigate its effect on tax revenues. Karagöz (2013) studied the determinants of tax revenues in Türkiye, and examined the effects of the shares of agricultural - industrial sectors, the monetisation rate of the economy, the urbanisation rate and the foreign debt stock on tax revenues using the Ordinary Least Square (OLS) method. Yüksel et al. (2013) analyzed the relationship between tax revenues and macroeconomic indicators in Türkiye and found a bidirectional causality relationship between tax revenues and broad money (M2). There are also studies in the foreign literature, investigating that broad money (M2) may be a determinant of tax revenues (Chaudhry and Munir, 2010; Castañeda Rodríguez, 2018; Nguyen-Phuong et al.,

2022). Our study expands the existing models by adding a new variable and thus it is expected to fill a research gap in the literature. This study aims to make a valuable contribution to the current literature in this way.

This study aims to test the hypothesis that broad money (M2), industrial production index, deposit interest rate, unemployment rate and USD/TRY exchange rate are directly related to the tax level in Türkiye. For this purpose, the relationship between USD/TRY exchange rate, broad money (M2), deposit interest rate, industrial production index, unemployment rate and export variables, which are considered to be effective on the tax level in Türkiye, will be investigated through the ARDL method using the monthly data for the period between 2006:1-2022:11. Broad money (M2), USD/TRY exchange rate and deposit interest rate will be addressed as monetary variables, while industrial production index, unemployment rate and exports will be addressed as macroeconomic variables.

The rest of the article is organized as follows: The first section presents the introduction and a brief review of the empirical literature. The second section discusses the empirical literature, model and methodology. The third section presents the empirical results, and finally, the fourth section concludes the study with concluding remarks and policy recommendations.

2. Literature Review

One of the important topics in the literature is the research on the determinants of tax revenues. A ariety of economic, social, cultural and sociological factors are effective on tax revenues. In the literature, there are numerous empirical studies that concentrate on various determinants of tax revenues. The results of studies vary depending on the characteristics of the country or region, types of variables, empirical methods, and the time period of the samples. A summary of the empirical literature on the determinants of taxes is presented below.

Early studies in the literature mainly investigate the possible determinants of tax effort (the ratio of tax revenue to GDP) using regression analysis methods. Lotz and Morss (1967) investigated the effect of per capita income and exports on the tax effort in 72 countries between 1953 and 1964 and found that per capita income and exports had a strong positive effect on tax effort. In their later studies, Lotz and Morss (1970) found that the monetisation rate of the economy and the trade surplus had a positive effect on tax effort. Chelliah et al. (1975) investigated various factors affecting tax effort in 47 developing countries for the period between 1969 and 1971 using regression analysis. Chelliah et al. attained similar results with the study of Chelliah (1971). The empirical results demonstrated that the share of mining in GDP had a positive effect on tax revenues. Consistent with the literature, the share of agriculture in GDP had a negative impact on tax revenues. Following the study of Chelliah et al., Tait et al. (1979) analyzed the same countries and obtained similar findings.

In the literature, the effects of a comprehensive group of indicators such as agriculture, manufacturing, mining, per capita income, debt, foreign trade and broad money (M2) on tax revenues have been investigated. Agbeyegbe et al. (2006) used Generalised Method of Moment (GMM) for 22 countries in Sub-Saharan Africa for the period between 1980 and 1996. In their study, they found that there was a negative correlation between exchange rates and tax revenues. They identified a strong relationship between trade liberalisation and tax revenues. The determinants of lower tax revenues in Pakistan were investigated by Chaudhry and Munir (2010) using time series techniques for the period between 1973 and 1990. In their study, they concluded that the service sector, agricultural sector and exchange rate had a negative impact on the tax-to-GDP ratio. On the other hand, the authors found that the manufacturing sector, trade openness, M2 money supply, inflation, foreign aid, foreign debt and political stability had a positive effect on tax revenues. In their study on the Nigerian economy for the period between 1970 and 2011, Muibi and Sinbo (2013) concluded that tax revenues were significantly sensitive to changes in income level, exchange rate and inflation rate. Ayenew (2016) investigated the main determinants of tax revenues in Ethiopia for the period between 1975 and 2013.

According to the empirical results obtained in the study, it was revealed that real GDP per capita, foreign aid and industry had a positive effect on tax revenues, while inflation had a negative effect on tax revenues.

The importance of political and demographic factors in determining tax revenues was emphasized in a number of studies. In his study, Dioda (2012) found that civil liberties, female labour force participation, the age structure of the population, degree of political stability, level of education, population density and size of the informal economy had a statistically significant effect on tax revenues for the period between 1990 and 2009 in Latin American countries. In their study, Hassan and Mishra (2017) analyzed the economic, political and demographic components of the increase in tax revenues for the period between 1984-85 and 2013-14 in Jammu and Kashmir, a state of India with fiscal resource constraints. The indirect taxes, the share of income from the service sector to national income, total foreign trade and export value variables, which are considered as economic determinants of tax revenues, had a positive and statistically significant impact on tax revenues. The ratio of industrial sector income to national income, the unemployment rate and the share of agriculture were identified as the negative and significant determinants of tax revenues. Regarding the political determinants of tax revenues, it was determined that political crises and turmoil had a negative and significant effect on the increase in tax revenues, while the elections had a positive but insignificant effect on tax revenues. After 2000, population density and urbanization, which are considered as demographic determinants, had a significant positive effect on tax revenues. Additionally, political stability and political governance also played an important role on tax revenues. Similarly, Castañeda Rodríguez (2018) found that economic, social, political and cultural factors in 138 developing and developed countries had significant effects on tax revenues for the period between 1976 and 2015.

In the literature on the determinants of tax revenue, there are a limited number of studies on the Turkish sample. The studies on the determinants of taxation in the domestic literature can be summarised as follows. Özmen (2016) analyzed the determinants of tax revenues for BRIC-T countries for the period between 1996 and 2013. The findings of the study concluded that economic, fiscal, social and political indicators had a determining role on tax revenues. Çalcalı and Altıner (2019) examined the macroeconomic variables affecting the level of tax revenues for 16 OECD countries for the period between 1991 and 2015. In this study, the macroeconomic determinants revealed different results between countries, and the findings obtained for Türkiye revealed that economic growth and the increase in unemployment did not have any effect on tax revenues. On the other hand, while the increase in the level of globalisation increased total tax revenues, the increase in inflation led to a decrease in tax revenues. Yıldız (2019) analyzed the economic determinants of tax revenues for 19 high-income OECD countries with the data for the period between 1995 and 2017. According to the findings of the study, GDP per capita had a positive effect on tax revenues. The public expenditures and agricultural added value negatively affected the tax revenues. Trade openness and inflation did not have a statistically significant effect on tax revenues. Özhan and Keyifli (2020) investigated the effects of urbanisation rate, level of democracy, GDP per capita and trade openness on tax revenues for G20 countries for the period between 2005 and 2018. According to the findings of the study, urbanisation rate, democracy and trade openness affected the tax revenues positively. In his study, Karagöz (2013) found that the tax revenues in Türkiye for the period between 1970 and 2010 were significantly affected positively by the industrial sectors, external debt stock, monetisation of the economy and urbanisation rate, while the agricultural sector had a negative effect on tax revenues as expected. Yüksel et al. (2013) analyzed the relationship between tax revenues and macroeconomic indicators in Türkiye for the period between 1980 and 2012 and applied the Vector Error Correction Mechanism and Granger Causality Test. In their study, they identified a bidirectional causality between tax revenue - real exchange rate and tax revenue - broad money (M2). A unidirectional causality relationship was identified from tax revenues towards foreign direct investments and external debt stock. Öztürk et al. (2019) investigated the impact of key economic variables on tax revenues in Türkiye for the period between 1980 and 2017. As a result of the study,

it was concluded that economic growth and urbanisation had a positive effect on tax revenues, while unemployment, informal economy and inflation had a negative effect on tax revenues. In addition, the summary of the studies on the determinants of taxation for Türkiye and other countries in the domestic and foreign literature is presented in detail in Table 1.

Table 1. Empirical Literature

Author(s)	Country(s) (Period)	Method	Gross Domestic Product (GDP)	GDP Per capita	Industrial Production Index	Interest Rate	Inflation Rate	M2 Money Supply	Employment Rate	Unemployment Rate	Export	Import	Trade Openness	Foreign Direct Investment	Informal Economy	Agriculture	Industry	Mining	Service	Exchange Rate	Government Expenditure	Debt	Foreign Debt	Globalization Index
Stotsky and WoldeMariam (1997)	43 Sub Saharan African countries (1990-95)	Panel OLS		(+)							(+)	(+)				(-)		(-)						
Ghura (1998)	39 Sub Saharan African countries (1985-96)	Panel Data Regression Analysis		(-)			(-)						(+)			(-)		(+)						
Gupta (2007)	105 developing countries (1980-2004)	Dynamic Panel Data Analysis		(+)								(+)	(+)			(-)						(-)		
Karagöz (2013)	Türkiye (1970-2010)	OLS						(+)								(-)	(+)						(+)	
Torrance and Morrissey (2014)	36 Sub Saharan African countries ((1970-2010 (10 year averages))	Panel OLS		(+)								(+)				(-)								
Castro and Camarillo (2014)	34 OECD countries (2001-2011)	Static and Dynamic Panel Data Analysis		(+)										(-)		(-)	(+)							
Bird et al., (2014)	110 developing and transitional countries (1990-1999)	OLS		(+)							(+)	(+)			(-)	(-)							(+)	
Kutbay (2019)	BRIC-T (1995-2017)	Panel Data Analysis		(+)	(+)		(-)		(+)					(-)										(-)
	G7 (1995-2017)			(+)	(+)		(+)		(+)					(+)										(+)
Ali and Audi (2018)	Pakistan (1975-2016)	ARDL				(-)		(+)		(+)														

Table 1 (Cont.). Empirical Literature

Karabulut and Şeker (2018)	Türkiye (2002-2016)	Multiple Linear Regression Analysis	**(+)**								**(-)**									**(-)**				
Sağdıç (2019)	The basis of provinces (1990-2001)	Panel Data Analysis		**(+)**									**(+)**			**(-)**			**(+)**		**(-)**			
	The basis of 26 Development Regions (2004-2011)	Panel Data Analysis		**(+)**									**(+)**			**(-)**	**(+)**		**(+)**		**(-)**			
Öztürk et al., (2019)	Türkiye (1980-2017)	Multiple Linear Regression Analysis	**(+)**				**(-)**			**(-)**					**(-)**									
Çalcalı and Altıner (2019)	16 OECD (1991-2015)	Panel Augmented Mean Group Test					**(-)**																	**(+)**
Erdoğdu et al., (2021)	Türkiye (2006M01-2021M01)	ARDL	**(+)**			**(-)**	**(+)**																	
		Nonlinear Autoregressive Distributive Lag	**(+)**			**(-)**	**(+)**																	

Note: Statistically insignificant variables are disregarded. The effect of the determinant on tax revenues is indicated with the symbol (+) if positive and with the symbol (-) if negative.

3. Data, Methodology and Empirical Findings

3.1. Data

This study investigates the effects of selected monetary and macroeconomic variables on tax revenues using ARDL analysis methods with monthly observations (203 obs) for the period between 2006:1-2022:11 in Türkiye. For this purpose, broad money (M2), USD/TRY exchange rate and deposit interest rate are considered for monetary variables and industrial production index, unemployment rate and exports are considered for macroeconomic variables. Ignoring seasonal effects in monthly data may cause the variance of the models used in the estimation to be high (Alper and Arubo, 2001; Çuhadar, 2013). Therefore, in order to obtain an accurate forecast, the data are seasonally adjusted using the Seasonal-Trend decomposition using Loess (STL) method. The natural logarithm of the seasonally adjusted series is included in the model. The data set and sources of the study are presented in Table 2.

Table 2. Data Set and Sources

Symbol	Variables	Source
lnTAX	Tax Revenue (In Billion Turkish Liras)	Republic of Türkiye Ministry of Treasury and Finance
lnEXC	USD/TRY Exchange Rate	CBRT
lnM2	M2 Money Supply (In Thousand Turkish Liras)	CBRT
lnIPI	Industrial Production Index (%)	CBRT
lnINT	Interest Rate (1 Year and More TRY Deposits) (Flow Data, %)	CBRT
lnUNE	Unemployment Rate (%)	TURKSTAT
lnEXP	Exports (In Millions Dollars)	TURKSTAT

Note: Central Bank of the Republic of Türkiye (CBRT).

The basic descriptive statistics of the variables used in the model are presented in Table 3. The contents of the descriptive statistics comprise the maximum, minimum, mean, median, standard deviation, skewness, kurtosis probability, and Jarque–Bera values.

Table 3. Descriptive Statistics

	Variables						
	lnTAX	*lnEXC*	*lnM2*	*lnIPI*	*lnINT*	*lnUNE*	*lnEXP*
Mean	24.17945	1.041988	20.75066	4.515850	2.466109	2.347927	9.911736
Median	24.10737	0.781641	20.67344	4.530493	2.391583	2.334598	9.442034
Maximum	26.45461	2.924744	22.79470	5.050926	3.184799	2.698420	22.79465
Minimum	22.84705	0.145808	19.28326	3.853111	1.829714	2.000978	8.748848
Std. Dev.	0.753625	0.729804	0.875725	0.265060	0.304880	0.160930	2.603334
Skewness	0.616853	0.866825	0.383026	-0.019292	0.192567	0.214684	4.659618
Kurtosis	3.023972	2.767308	2.345318	2.001635	1.878703	2.126961	22.96924
Jarque-Bera	12.87869	25.87988	8.588961	8.443283	11.88933	8.006268	4107.524
Probability	0.001597	0.000002	0.013644	0.014675	0.002620	0.018258	0.000000
Sum	4908.429	211.5235	4212.385	916.7175	500.6200	476.6293	2012.082
Sum Sq. Dev.	114.7259	107.5880	154.9125	14.19187	18.77633	5.231459	1369.024
Observations	203	203	203	203	203	203	203

The results in Table 3 reveal that the series are consistent. The standard deviation value, which expresses the degree of deviation of the variables from the mean, is relatively low except for the *lnEXP* series. In order to be normally distributed, the values of the series must be "0" for Skewness and "3" for Kurtosis. According to these skewness values, the *lnIPI* series is negatively skewed to the left. All other series are positively skewed to the right. According to kurtosis values, *lnTAX* and *lnEXP* series have *Leptokurtic* positive kurtosis, while *lnEXC*, *lnM2*, *lnIPI*, *lnINT* and *lnUNE* series have *Platykurtic* positive kurtosis. Lastly, the Jarque Bera test statistic rejects the null hypothesis that the residuals are normally distributed. Accordingly, the series are not normally distributed.

3.2. Methodology

This study mainly focuses on selected monetary and macroeconomic determinants of tax revenues in the Turkish economy. Empirical studies in the literature were taken into consideration in the selection of the variables in the model. In this context, the selection of the series for the model was based on the studies of Karagöz (2013); Karabulut and Şeker (2018); Ali and Audi (2018); Kutbay (2019); Erdoğdu et al. (2021); Öztürk et al. (2019) and Bird et al. (2014). In the study, tax revenue (*lnTAX*) represents the dependent variable, while the USD/TRY exchange rate (*lnEXC*), broad money (*lnM2*), industrial production index (*lnIPI*), deposit interest rate (*lnINT*), unemployment rate (*lnUNE*) and exports (*lnEXP*) are the explanatory variables.

The analysis of this study was conducted using the ARDL method developed by Pesaran et al. (2001). Natural logarithms of all variables were used in the model. The following equation (Eq. 1) describes the model in logarithm format:

$$lnTAX_t = \alpha_0 + \alpha_1 lnEXC_t + \alpha_2 lnM2_t + \alpha_3 lnIPI_t + \alpha_4 lnINT_t + \alpha_5 lnUNE_t + \alpha_6 lnEXP_t + \varepsilon_t \quad (1)$$

The ARDL method offers significant advantages over other time series analysis methods. According to Pesaran et al. (2001), this method can be applied regardless of whether all series are I(0) and/or I(1). However, the ARDL bounds test cannot be applied in the case the series are stationary at degrees I(2) and above. According to Narayan (2004), this method provides consistent results against omitted variables and autocorrelation problems by estimating the long-run and short-run components of the model simultaneously. In addition, this method allows to distinguish between dependent and independent variables. For these reasons, the estimates of co-integration analysis obtained from the ARDL method provide efficient and unbiased results. The adapted form of equation (1) to the ARDL model is presented in equation (2).

$$\Delta lnTAX_t = \alpha_0 + \sum_{j=1}^{p} \alpha_{1,j}\Delta lnTAX_{t-k} + \sum_{j=0}^{p} \alpha_{2,j}\Delta EXC_{t-k} + \sum_{j=0}^{p} \alpha_{3,j}\Delta YM2_{t-k} + \sum_{j=0}^{p} \alpha_{4,j}\Delta IPI_{t-k} + \sum_{j=0}^{p} \alpha_{5,j}\Delta lnINT_{t-k} + \sum_{j=0}^{p} \alpha_{6,j}\Delta lnUNE_{t-k} + \sum_{j=0}^{p} \alpha_{7,j}\Delta lnEXP_{t-k} + \beta_1 lnTAX_{t-1} + \beta_2 lnEXC_{t-1} + \beta_3 lnM2_{t-1} + \beta_4 lnIPI_{t-1} + \beta_5 lnINT_{t-1} + \beta_6 lnUNE_{t-1} + \beta_7 lnEXP_{t-1} + \varepsilon_t \quad (2)$$

In the equation, Δ is the difference operator, α_0 is the constant term, ε_t is the error term, p is the appropriate lag length, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ and β_7 are the short-run coefficient estimates and $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$ and α_7 are the long-run coefficient estimates. In order to make a valid long-run forecast, there should be a long-run relationship between the variables. Pesaran et al. (2001) tested the existence of a long-run relationship through the Eq. (2), F bounds test with the hypotheses H_0: $\alpha_1 = \alpha_2 = \ldots = \alpha_k = 0$ (no cointegration) and H_1: $\alpha_1 \neq \alpha_2 \neq \ldots \alpha_k = 0$. If the F statistic value calculated with the bounds test is greater than the critical upper bound value, the null hypothesis stating that there is no cointegration is rejected. If a long-run relationship is detected between the series, the error correction model is constructed. The series are expected to converge to the long-run equilibrium value in the frame of the error correction model. Accordingly, equation (2) as adjusted to the error correction model is presented in equation (3).

$$\Delta lnTAX_t = \alpha_0 + \sum_{j=1}^{p} \alpha_{1,j}\Delta lnTAX_{t-k} + \sum_{j=0}^{p} \alpha_{2,j}\Delta EXC_{t-k} + \sum_{j=0}^{p} \alpha_{3,j}\Delta YM2_{t-k} + \sum_{j=0}^{p} \alpha_{4,j}\Delta IPI_{t-k} + \sum_{j=0}^{p} \alpha_{5,j}\Delta lnINT_{t-k} + \sum_{j=0}^{p} \alpha_{6,j}\Delta lnUNE_{t-k} + \sum_{j=0}^{p} \alpha_{7,j}\Delta lnEXP_{t-k} + \beta_1 lnTAX_{t-1} + \beta_2 lnEXC_{t-1} + \beta_3 lnM2_{t-1} + \beta_4 lnIPI_{t-1} + \beta_5 lnINT_{t-1} + \beta_6 lnUNE_{t-1} + \beta_7 lnEXP_{t-1} + \lambda \mathrm{ETC}_{t-1} + \varepsilon_t \quad (3)$$

ETC_{t-1} in equation (3) stands for the error correction term. The error correction coefficient indicates to which extent the system is corrected after a short-run deviation.

3.3. Empirical Findings

In time series analysis, the stationarity levels of the series should be investigated at the first stage. Analyses conducted without taking into account the stationarity levels of the variables lead to spurious regression results. In this study, the unit root conditions of the series are investigated with Augmented Dickey-Fuller (ADF; 1979, 1981) and Phillips-Perron (PP; 1988, 1990) unit root tests, which are among the most preferred unit root tests in econometric analyses. In ADF and PP tests, the null hypothesis is specified as 'there is a unit root' and the hypotheses are set as H_0: $\alpha = 0$ and H_1: $\alpha < 0$. The asymptotic distributions of the test statistics are the same in both tests. The decision is made by comparing the test statistic with the MacKinnon critical values. If the ADF-t statistic is less than the MacKinnon critical values, the null hypothesis is rejected (Çağlayan and Saçaklı, 2006; Demirbaş et al., 2009). Table 4 provides PP and ADF unit root test results for the intercept and intercept - trend model.

Table 4. Unit Root Test Results

Variables	***Model***	***PP***		***ADF***	
		t-Statistic	***Stationarity***	***t-Statistic***	***Stationarity***
$lnTAX_t$	Intercept	-30.5714***	I(1)	-7.0472***	I(1)
	Intercept & Trend	-6.7340***	I(0)	-7.6389***	I(1)
$lnEXC_t$	Intercept	-9.1435***	I(1)	-10.0585***	I(1)
	Intercept & Trend	-9.2504***	I(1)	-10.6372***	I(1)
$lnM2_t$	Intercept	-11.6826***	I(1)	-11.4917***	I(1)
	Intercept & Trend	-12.0622***	I(1)	-12.0732***	I(1)
$lnIPI_t$	Intercept	-44.0474***	I(1)	-14.6503***	I(I)
	Intercept & Trend	-9.1899***	I(0)	-4.7275***	I(0)
$lnINT_t$	Intercept	-10.9011***	I(1)	-10.9335***	I(1)
	Intercept & Trend	-10.9397***	I(1)	-10.9204***	I(1)
$lnUNE_t$	Intercept	-17.5439***	I(1)	-6.8420***	I(1)
	Intercept & Trend	-17.5180***	I(1)	-6.8436***	I(1)
$lnEXP_t$	Intercept	-14.1442***	I(1)	-14.1442***	I(1)
	Intercept & Trend	-14.3011***	I(1)	-14.2988***	I(1)

Notes: (*) Significant at 10%; (**) Significant at 5%; (***) Significant at 1%. The values in parentheses indicate the degree of stationarity of the series.

According to the results of the ADF test in Table 4, only the industrial production index series is stationary at the level value in the model (intercept & trend) and the series of all other variables are stationary when the first difference is taken. According to the PP test, the tax revenue and industrial production index series are stationary at the level value in the model (intercept & trend) and the series of all other variables become stationary when the first difference is taken. Since the variables have different degrees of stationarity, the ARDL approach is preferred in this study. To be able to apply the ARDL bounds test, in addition to ensuring stationarity, the series should not be stationary at degrees I(2) and above.

In the ARDL analysis, the F-statistics, diagnostic tests, short and long-run coefficient estimates and ECT_{t-1} coefficients are calculated and presented in Panel A, Panel B and Panel C in Table 5. In the model, the diagnostic test results are presented in Panel C. In testing the diagnostic test hypotheses, the decision is made according to the Chi-Square probability value. In the case the Chi-Square probability value is above 0.05, then zero hypothesis or alternative hypothesis is opted for. Accordingly, the Breusch-Godfrey LM test was applied for autocorrelation, the Breusch-Pagan-Godfrey test was applied for heteroscedasticity (constant variance) test, the Jarque-Bera test was applied for normality, and the Reset (Ramsey RESET) test was applied for specification errors (e.g. omitted variables, incorrect functional form). Based on the Breusch Godfrey LM test values obtained ($p>0.05$), the null hypothesis that there is no serial correlation was accepted and it was resolved that the model does not have an autocorrelation problem. According to the Breusch-Pagan-Godfrey test values ($p>0.05$), the null hypothesis of homoscedasticity was accepted. According to the result of the Breusch-Pagan-Godfrey test ($p>0.05$), the model does not have a heteroscedasticity problem. According to the Ramsey RESET test values ($p>0.05$), the null hypothesis of correct specification was accepted. According to the Ramsey Reset test, there is no model misspecification. Lastly, according to the Jarque-Bera test values ($p<0.05$), the null hypothesis that the residuals are normally distributed was rejected.

Table 5. The estimation results of the long-run and short-run model of ARDL (6, 0, 6, 6, 2, 0, 2)

Panel A. Short-run coefficients				
Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.**
$lnTAX_{(t-1)}$	-0.103964	0.066895	-1.554131	0.1220
$lnTAX_{(t-2)}$	-0.066810	0.069400	-0.962680	0.3371
$lnTAX_{(t-3)}$	0.148599	0.067566	2.199313	0.0292**
$lnTAX_{(t-4)}$	-0.150823	0.064283	-2.346223	0.0201**
$lnTAX_{(t-5)}$	-0.082931	0.065219	-1.271584	0.2053
$lnTAX_{(t-6)}$	0.383501	0.064226	5.971107	0.0000***
lnEXC	-0.165440	0.077754	-2.127733	0.0348**
lnM2	0.374636	0.329546	1.136827	0.2572
$lnM2_{(t-1)}$	0.991140	0.495377	2.000779	0.0470**
$lnM2_{(t-2)}$	0.380452	0.480338	0.792050	0.4294
$lnM2_{(t-3)}$	-0.381195	0.443901	-0.858737	0.3917
$lnM2_{(t-4)}$	0.229831	0.440834	0.521354	0.6028
$lnM2_{(t-5)}$	-0.229465	0.448862	-0.511214	0.6099
$lnM2_{(t-6)}$	-0.583712	0.326782	-1.786242	0.0759*
lnIPI	0.568498	0.090716	6.266761	0.0000***
$lnIPI_{(t-1)}$	0.290066	0.096403	3.008891	0.0030***
$lnIPI_{(t-2)}$	0.255068	0.100120	2.547609	0.0117**
$lnIPI_{(t-3)}$	-0.242264	0.102561	-2.362132	0.0193**
$lnIPI_{(t-4)}$	-0.280370	0.103827	-2.700354	0.0076***
$lnIPI_{(t-5)}$	-0.022020	0.098499	-0.223559	0.8234
$lnIPI_{(t-6)}$	-0.298774	0.094829	-3.150650	0.0019***
lnINT	-0.114974	0.092931	-1.237197	0.2177
$lnINT_{(t-1)}$	0.048700	0.143666	0.338979	0.7350
$lnINT_{(t-2)}$	0.190987	0.099707	1.915480	0.0571**
lnUNE	-0.206262	0.074432	-2.771137	0.0062**
lnEXP	-0.000850	0.007642	-0.111190	0.9116
$lnEXP_{(t-1)}$	0.050656	0.009787	5.175675	0.0000***
$lnEXP_{(t-2)}$	-0.034495	0.007523	-4.585349	0.0000***
C	3.802631	2.171599	1.751074	0.0818*
Panel B. Long-run coefficients				
Variable	***Coefficient***	***Std. Error***	***t-Statistic***	***Prob.****
$lnEXC_t$	-0.189631	0.100713	-1.882884	0.0614*
$lnM2_t$	0.895991	0.111986	8.000890	0.0000***
$lnIPI_t$	0.309715	0.158014	1.960051	0.0516**
$lnINT_t$	0.142949	0.048804	2.929037	0.0039***
$lnUNE_t$	-0.236423	0.082539	-2.864360	0.0047***
$lnEXP_t$	0.017550	0.004536	3.869005	0.0002***

Panel C. Bounds tests, ECT_{-1} and Diagnostics tests

				Asymptotic Critical Values	
F-Statistics (Bounds Test)[a]	Value	k	Significance level	Lower Bound -I(0)	Upper Bound - I(1)
	3.956097**	6	10%	2.088	3.103
			5%	2.431	3.518
Adjusted R^2	0.988660	*Breusch-Pagan-Godfrey Heteroskedasticity*			0.783448 (0.7731)
ECT_{t-1}	-0.872428 (0.0000)	*Breusch-Godfrey Serial Correlation LM*			0.966551 (0.3825)
F-statistic	611.3046 (0.000000)	*Jarque-Bera*			58.92384 (0.000000)
		Ramsey RESET			1.900473 (0.0591)

Notes: (*) Significant at 10%; (**) Significant at 5%; (***) Significant at 1%. Probability values are presented in parentheses. [a] The ARDL model is estimated by using restricted constant (Case II).

The cointegration relationship between the variables was investigated with the F-Bounds test. The choice of the maximum lag length is very important for the F-Bounds test. In determining the lag length, the Akaike information criterion (AIC) among the information criteria was taken into account.

Accordingly, the lag length of the current study was determined as 6. The critical values for the F-statistic are (2.431) at the lower bound and (3.518) at the upper bound at 5% significance level. The estimated F-statistic value is (3.956), which is greater than the upper bound limit value of (3.518) at 5% significance level. Accordingly, there is a long-run cointegration relationship between the variables at 5% significance level.

Before analyzing the long-run coefficient results, the significance levels among the variables were examined. Accordingly, there is a statistically significant relationship between exchange rate and tax revenues at 10% significance level. A statistically significant relationship between industrial production index and tax revenues was identified at 5% significance level. There is a statistically significant relationship between the tax revenues and broad money (M2), deposit interest rate, unemployment rate and export rates at 1% significance level.

According to the long-run coefficient estimates, a 1% increase in broad money (M2), industrial production index, deposit interest rate and exports increases total tax revenues by 0.89%, 0.30%, 0.14% and 0.01%, respectively. On the contrary, a 1% increase in the exchange rate and unemployment rate leads to a decrease in tax revenues by -0.18% and -0.23%, respectively. According to these results, exchange rate and unemployment have a negative effect on tax revenues, while broad money (M2), industrial production index, deposit interest rate and exports have a positive effect on tax revenues. In the study, it was determined that both monetary variables and selected macroeconomic variables are effective on tax revenues. In this study, the variable that has the highest impact on tax revenues is broad money (M2). It is essential for tax authorities to take into account specifically the effect of broad money (M2), along with other indicators, in increasing tax revenues. According to the ECT_{t-1} coefficient, short-run shocks are corrected by -0.87% after some time (after 1.14 months) and converge to long-run equilibrium values.

4. Conclusion and recommendations

In this study, the relationship between tax revenue and the USD/TRY exchange rate, broad money (M2), industrial production index, deposit interest rate, unemployment rate and export variables, as well as the direction and degree of this relationship, were investigated with monthly data for the period between 2006:1-2022:11. In the study, broad money (M2), exchange rate and deposit interest rate were considered as monetary variables, while industrial production index, unemployment rate and exports were considered as macroeconomic variables. As a result of the analysis, a statistically significant long-term cointegration relationship was identified between tax revenues and all series. In other words, the empirical findings demonstrated that all variables have a long-run effect on tax revenues. According to the long-run coefficient estimates, broad money (M2), industrial production index and deposit interest rate affect the tax level positively, while the unemployment rate and USD/TRY exchange rate affect it negatively. In this study, the results concerning the industrial production index are similar to the findings of Kutbay (2019). The findings concerning the broad money supply (M2) in the study are in line with the results of previous studies conducted by Karagöz (2013), Chaudhry and Munir (2010), Ali and Audi (2018), and Nguyen-Phuong et al. (2022). The findings concerning the unemployment rate are also similar to the results of Öztürk et al. (2019). As for the findings concerning the export series, they are in line with the results of Bird et al. (2014). Lastly, the findings concerning the USD/TRY exchange rate are consistent with the results of the studies conducted by Karabulut and Şeker (2018) and Agbeyegbe et al. (2006).

The positive effect of the increase in broad money on tax revenues suggests that an increase in liquidity for individuals and corporations leads to an increase in taxable items (income, expenditure and wealth) and tax collections. It also supports the theory by Peacock (2003) that the money supply should be increased by the amount of tax revenues. It is important for fiscal authorities to take broad money (M2) into account in order to increase tax revenues.

Similarly, the increase in deposit interest rates with a maturity of 1 year and longer has affected tax revenues positively. It is believed that levying income tax withholding on deposits in Türkiye was effective in this increase. The negative effect of the USD/TRY exchange rate on tax revenues supports the view suggested by Tanzi (1989). According to Tanzi (1989), the overvaluation of exchange rate in developing countries narrows the export and import base, and leads to capital flight, currency substitution, goods and capital restrictions and black market. The import restrictions caused by the overvalued exchange rate, the discouragement of imports due to overvalued exchange rate and the shortage of required inputs lead to the avoidance of export by exporters, while producers divert their production to untaxed domestic activities. All these developments lead to a decline in production and employment, which in turn reduces the taxes collected from exports and imports.

Industrial production and the level of unemployment have important functions on the performance of tax revenues. The industrial production index is an important indicator of economic growth. Increased industrial production leads to more productivity, growth and higher tax revenues. Conversely, tax revenues decrease during periods when economic activities slow down and growth decreases. In addition, an increase in unemployment leads to a decline in the income of individuals and production, which has a negative impact on tax revenues. Although exports affect tax revenues positively, this effect is limited in terms of the findings of the study.

The results of this study provide empirical evidence that M2 money supply, industrial production, deposit interest rate, exports, unemployment and exchange rate have an impact on tax revenue performance. Approximately 85% of Türkiye's central government budget revenues consists of tax revenues alone. In addition to its role in financing public services, tax is an important fiscal policy instrument. Rising budget deficits, public debt - principal and interest payments - and increasing demand for public services put increasing pressure on governments to raise more public revenues. The findings of this study suggest that it is important for policymakers to support production, exports and employment when determining the tax policies for a strong treasury, and to pursue a balanced and stable exchange rate and interest rate policy when determining the policy targets. In this context, the fiscal authorities should reduce the taxes on industrial production, exports and employment, while the monetary authorities should establish a stable interest rate and exchange rate policy that covers money supply and predictable interest rate decisions that take into account market conditions. Moreover, the tax authorities and monetary authorities should work in harmony in determining the tax policies. As a result of the empirical findings of this study, it is suggested that tax authorities seeking to increase tax revenues should pay more attention to the effect of broad money, as well as other indicators, on tax revenues when determining the tax policy targets.

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