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The Effects of Direct and Indirect Taxes on Income Distribution in Türkiye: Evidence from ARDL and Toda-Yamamoto Analyses

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Abstract

This study examines the long-run and short-run effects of direct and indirect taxes on income distribution in Türkiye using annual data for the period 1988–2024. Income inequality is represented by the Gini Index, while direct and indirect taxes are measured as a percentage of GDP. Real GDP growth, inflation, and unemployment rates are included in the analysis as control variables. The empirical analysis employs the Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root tests, the Autoregressive Distributed Lag (ARDL) bounds testing approach, and the Toda-Yamamoto causality test. The results reveal the existence of a long-run cointegration relationship among the variables. In the long run, indirect taxes have a statistically significant effect on reducing income inequality, whereas direct taxes do not exhibit a significant redistributive effect. The causality analysis identifies a unidirectional causal relationship running from Gini coefficient to indirect taxes. These findings suggest that the redistributive impact of taxation in Türkiye depends not only on the composition of tax revenues but also on the fiscal mechanisms through which these revenues are transformed into public expenditures and social policy interventions.

Türkiye'de Doğrudan ve Dolaylı Vergilerin Gelir Dağılımı Üzerindeki Etkileri: ARDL ve Toda-Yamamoto Analizlerinden Elde Edilen Bulgular

Öz

Bu çalışma, 1988-2024 dönemine ait yıllık verileri kullanarak Türkiye'de doğrudan ve dolaylı vergilerin gelir dağılımı üzerindeki uzun ve kısa vadeli etkilerini incelemektedir. Gelir dağılımı Gini Endeksi ile temsil edilirken, doğrudan ve dolaylı vergiler GSYİH'nin yüzdesi olarak ölçülmektedir. Reel GSYİH büyümesi, enflasyon ve işsizlik kontrol değişkenleri olarak analize dahil edilmiştir. Ampirik analizde Genişletilmiş Dickey-Fuller (ADF) ve Kwiatkowski-Phillips-Schmidt-Shin (KPSS) birim kök testleri, Otoregresif Dağıtılmış Gecikme (ARDL) sınır testi yaklaşımı ve Toda-Yamamoto nedensellik testi kullanılmıştır. Sonuçlar, değişkenler arasında uzun vadeli bir eşbütünleşme ilişkisinin varlığını ortaya koymaktadır. Uzun vadede, dolaylı vergilerin gelir eşitsizliğini azalttığı, doğrudan vergilerin ise istatistiksel olarak anlamlı bir etki göstermediği bulunmuştur. Nedensellik analizi ise Gini katsayısından dolaylı vergilere doğru tek yönlü nedensellik olduğunu göstermektedir. Bu bulgular, Türkiye'de vergilendirmenin yeniden dağıtım etkisinin sadece vergi yapısına değil, aynı zamanda vergi gelirlerinin kamu harcamalarına ve sosyal politikalara dönüştürüldüğü mali mekanizmalara da bağlı olduğunu göstermektedir.

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1.Introduction

Since the dawn of humanity, distinct social classes have emerged within society. However, the share of total income received by these classes has not been equal. This has led to income disparities between individuals and social groups. The increasing disparity in income distribution over time has resulted in imbalances in income distribution.

While income inequality has existed throughout history, it became even more pronounced with the Industrial Revolution. The transition from an agricultural to an industrial society marked the beginning of a new economic era. The radical changes in the production structure during this period further widened the income gap between capitalists and laborers. Although the Industrial Revolution positively impacted economic growth, it also paved the way for increased income inequality.

Today, economic transformations, technological advancements, and globalization have made the problem of income distribution a significant economic and social issue for many countries. Unequal income distribution has significant consequences for both society and the state.

The fact that this problem has become structural and chronic over time presents itself as a major issue negatively impacting economic and social balances.

In this context, the book "The Theory of Public Finance," written by Richard Musgrave (1959), assigns certain fundamental responsibilities to the state. According to Musgrave, one of the state's primary duties is to ensure fairness in income distribution. The state can fulfill this duty through taxes, one of the tools of fiscal policy. Within this framework, there is a significant relationship between taxes and income distribution.

Taxes, in addition to being a significant part of public revenues, are one of the important tools of fiscal policy in reducing inequality in income distribution. Especially thanks to the progressive nature of direct taxes, individuals with higher incomes pay higher taxes. This contributes to reducing the gap between those with higher and lower incomes, helping to make income distribution more equitable.

In the case of Türkiye, where indirect taxes constitute a dominant source of government revenue, the long-term distributional consequences of the tax structure remain a significant empirical question. In this context, this study investigates the effects of direct and indirect taxes on income distribution in Türkiye over the period 1988–2024, using the ARDL bounds test approach and the Toda-Yamamoto causality test. Unlike most previous studies on Türkiye that concluded that indirect taxes have an unequal effect on income distribution, this study presents evidence that indirect taxes are associated with lower income inequality in the long run. This finding underscores the importance of considering not only the impact of taxation but also the redistributive role of government expenditures financed by tax revenues. Using the longest available annual dataset and combining both short- and long-term estimates with causality analysis, this study contributes to the literature by providing current empirical evidence on the interaction between

tax structure and income inequality in Türkiye, and by offering new insights into the fiscal mechanisms underlying distributional outcomes.

2. Theoretical Background

Income is defined as the monetary return that economic actors obtain from the added value created through their participation in the production process during a specific period (Yüce, 2002: 4). In a broader sense, income refers to the total economic gains that individuals obtain through labor, capital, natural resources, and entrepreneurial activities. Income distribution, on the other hand, refers to how the national income produced in an economy is distributed among individuals, social groups, factors of production, sectors, or regions during a specific period (Pehlivan, 2009: 23; Acar, 2015: 44). As an indicator of how economic well-being is shared within society, income distribution constitutes an important economic and social measure. In the literature, income distribution is generally divided into four categories: personal income distribution, regional income distribution, functional income distribution, and sectoral income distribution.

Personal income distribution refers to the distribution of income among individuals or households. This type of distribution reveals differences in income levels across society and is widely used to measure income inequality (Demir, 2015: 273). In contrast, regional or geographic income distribution describes the distribution of income or wealth among different regions within a country and serves as a significant indicator of regional development inequalities (Bronfenbrenner, 1971: 27).

Functional income distribution refers to the shares of national income received by factors of production – namely labor, capital, natural resources, and entrepreneurship – as a result of their participation in the production process (Ulusoy, 2015: 307). This type of distribution is important because it shows the extent to which different factors of production benefit from economic growth. Sectoral income distribution, on the other hand, reflects how national income is distributed among major economic sectors such as agriculture, industry, and services (Türk, 2008: 314).

The factors affecting income distribution are numerous and multifaceted. The distribution of income-generating assets and factors of production within society, access to public services such as education and healthcare, the scope and structure of transfer payments, and the design of the tax system are among the key determinants of income distribution (Edwards, 1974: 8; Yumuşak & Bilen, 2000: 82). Taxation and public spending policies, in particular, are considered the most important fiscal tools that governments can use to influence income distribution. Income inequality stems from various economic, social, and institutional factors. Differences in individual abilities and skills, inequalities in educational opportunities, differences in human capital accumulation, unequal access to opportunities, intergenerational transfer of wealth and inheritance, labor market

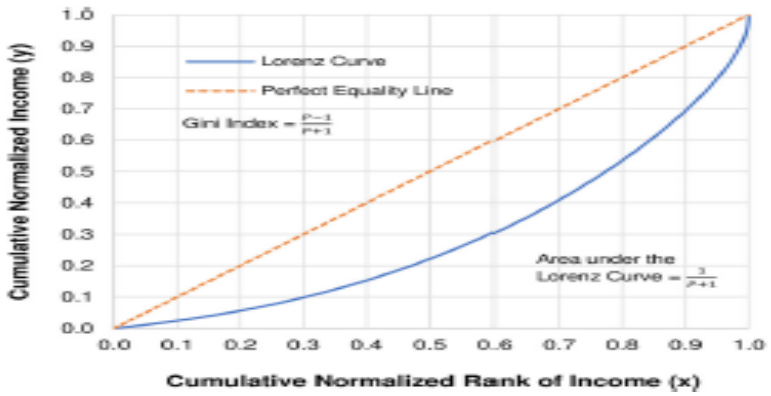
defects, wars, and natural disasters are among the main causes of income inequality (Şen & Sağbaş, 2016: 413–414). In addition, contemporary developments such as globalization, technological progress, and digital transformation have become increasingly important determinants of income distribution. In this context, income distribution is not only an economic indicator but also a fundamental measure of social justice, equality of opportunity, and societal welfare. Consequently, reducing income inequality has become one of the main goals of fiscal and social policies in many countries around the world.

Taxes are one of the primary fiscal policy tools used by governments to promote equality in the economy and redistribute income (Demir, 2015: 274). In the absence of government intervention, the distribution of income generated by factors of production is called primary income distribution. Following this initial distribution, governments intervene to correct emerging inequalities through fiscal policy tools, particularly taxation. This process is called secondary (or redistributive) income distribution (Şen & Sağbaş, 2016: 411–412).

The effect of taxation on income distribution varies depending on the structure, type, and rate of the taxes. Generally, income and wealth taxes, classified as direct taxes, are considered to have a progressive and equalizing effect on income distribution. In contrast, consumption-based taxes, classified as indirect taxes, are generally argued to have a regressive effect and therefore may increase income inequality (Karaş, 2025: 175). Accordingly, the distributional effect of taxation depends significantly on the composition of the tax system.

A number of statistical methods are used to measure income distribution. Among the most commonly used are the Gini coefficient and the Lorenz curve; however, alternative measures such as the Kuznets curve, Pareto distribution, Theil index, and Atkinson index are also widely used in the literature (Akdağ, 2020: 27). The Lorenz curve, introduced by Max Lorenz in 1905, is a graphical representation used to measure income inequality (Özdemir, 2017: 98–99; Akşehirli, 2024: 405). It plots the cumulative share of income against the cumulative share of the population. The 45-degree line represents perfect equality, where every percentage of the population receives an equal share of income.

Figure 1. Lorenz Curve



Source: Sitthiyot, & Holasut, 2021:3

The Gini coefficient, developed by Corrado Gini in 1912, is a coefficient derived from the Lorenz curve. It is defined as the ratio of the area between the line of perfect equality and the Lorenz curve to the total area under the line of equality. The Gini coefficient ranges from 0 to 1; values closer to 0 indicate perfect equality, while values closer to 1 indicate greater inequality (Şen & Sağbaş, 2016: 416).

Table 1 shows the structure of Türkiye's tax system, total tax revenues, direct taxes, indirect taxes and their shares in total revenue during the period 1998-2026. The table shows that both direct and indirect tax revenues have increased significantly over time. However, indirect taxes have consistently accounted for a larger share of total tax revenues than direct taxes throughout the sample period.

Table 1. Türkiye's Direct and Indirect Tax Structure

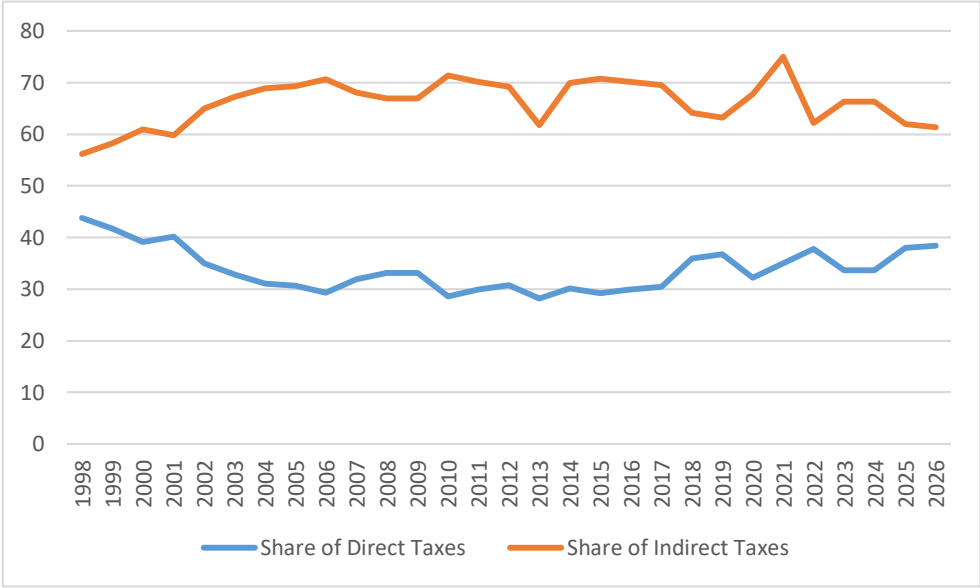
Years	*Total tax revenue (Thousand TL)*	*Indirect taxes (Thousand TL)*	*Direct taxes (Thousand TL)*	*Share of direct taxes (%)*	*Share of indirect taxes (%)*
1998	10.901.408	4.775.833	6.125.575	43,8	56,2
1999	17.085.011	7.218.904	9.866.108	41,7	58,3
2000	29.672.993	11.617.058	18.055.935	39,1	60,9
2001	44.734.695	18.004.249	26.730.446	40,2	59,8
2002	59.760.470	20.937.790	38.822.680	35	65
2003	80.666.997	26.471.282	54.195.715	32,8	67,2
2004	97.720.188	30.395.535	67.324.653	31,1	68,9
2005	116.908.385	35.933.217	80.975.168	30,7	69,3
2006	137.317.192	40.254.028	97.063.164	29,3	70,7
2007	151.376.532	48.396.503	102.980.029	31,9	68,1
2008	166.150.061	55.012.962	111.137.099	33,1	66,9
2009	168.608.895	55.815.239	112.793.655	33,1	66,9
2010	206.749.025	59.322.440	147.426.585	28,6	71,4
2011	249.914.444	74.754.414	175.160.030	29,9	70,1
2012	274.805.198	84.667.634	190.137.564	30,8	69,2
2013	322.005.343	90.890.131	231.115.212	28,2	61,8
2014	348.822.725	105.144.753	243.677.972	30,1	69,9
2015	403.535.110	117.851.648	285.683.462	29,2	70,8
2016	449.881.507	134.780.942	315.100.565	29,9	70,1
2017	528.991.787	161.735.861	367.255.927	30,5	69,5
2018	607.525.671	218.102.850	389.422.821	35,9	64,1
2019	659.182.059	242.774.096	416.407.963	36,8	63,2
2020	816.046.269	263.372.302	552.673.966	32,2	67,8
2021	1.143.691.880	400.483.061	743.208.819	35	75
2022	2.339.405.120	885.469.902	1.453.935.218	37,8	62,2
2023	4.416.297.883	1.488.562.770	2.927.735.113	33,7	66,3
2024	7.216.102.732	2.438.900.929	4.777.201.803	33,7	66,3
2025	10.612.645.933	4.034.630.968	6.578.014.964	38	62
2026	13.664.020.355	5.254.777.336	8.409.243.019	38,4	61,4

Source: Presidency of Strategy and Budget. (2026)

Figure 2 shows the proportional distribution of direct and indirect taxes within total tax revenues during the same period. Although there are fluctuations between

years, the dominance of indirect taxes in the overall tax structure remains evident. This consistent structure demonstrates that the Turkish tax system is largely based on consumption-based taxation, and that this can have significant consequences for income distribution and fiscal justice.

Figure 2. Distribution of Direct and Indirect Taxes Within Total Tax Revenues



Source: Composed by the author

3. Literature

Prasad (2008) used two OLS models to estimate the impact of consumption taxes on GDP per capita, given that 47% of Kenya's population lives below the poverty line, and how these taxes could be used to reduce poverty. The findings showed that consumption taxes are regressive and positively correlated with GDP per capita. In a joint study by Kozuharov et al. (2015), the impact of taxes on income distribution in Macedonia was analyzed using regression and correlation econometric models with data from 1998-2013. The findings concluded that the largest factor contributing to income inequality in Macedonia is personal income tax, which falls under the category of direct taxes. In a study by Obaretin et al. (2017), the relationship between taxes and income distribution was analyzed using time series data from Nigeria from 1981-2014. According to the findings, it was concluded that all tax variants did not have a significant effect on income inequality observed with the Gini at the 5% level. Consequently, it was understood that taxes are ineffective in reducing income inequality in Nigeria.

In the study conducted by Demirgil (2018), the long-term relationship between direct and indirect taxes and the Gini coefficient was analyzed using ARDL bounds tests with data from Türkiye for the years 1980-2014. The results showed a cointegration relationship between the series, with an increase in indirect taxes increasing the Gini coefficient, while an increase in direct taxes decreasing the Gini

coefficient. In the study conducted by Günel (2019), the effect of direct and indirect taxes on income distribution was analyzed using Johansen cointegration tests with data from Türkiye for the years 1987-2016. The results showed a long-term relationship between direct and indirect taxes and income distribution. Furthermore, it was found that direct taxes positively affect income distribution in Türkiye, while indirect taxes negatively affect it. According to the Granger causality test, a unidirectional causality from direct and indirect taxes to income distribution was found.

Utilizing panel cointegration and causality frameworks, Köstekçi & Sandalcı (2019) analyzed the distributional effects of tax structures in 26 OECD countries between 2000 and 2017, concluding that the series were cointegrated, and that there is a unidirectional causal relationship from the Gini coefficient to direct and indirect taxes. In a joint study by Kanca & Bayrak (2019), the effect of direct and indirect taxes on income distribution was analyzed using panel data analysis method with data from Türkiye and 35 OECD countries for the years 1990-2017. The analysis revealed a positive and statistically significant long-term relationship between direct and indirect taxes and the Gini coefficient. It was determined that the increase in taxes (direct and indirect taxes) in the countries in question during the period of analysis negatively affected income distribution.

In a joint study by Eser & Genç (2020), the impact of income and wealth taxes on income distribution was analyzed using panel data reaction estimations with data from OECD member countries for the years 1990-2017. The findings showed that income and wealth taxes positively impacted income distribution equity. In a study by Karabulut (2020), the impact of indirect taxes on income distribution in Türkiye was analyzed using Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Autoregressive Distributed Lag (ARDL) Bounds Tests with data from 1990-2017. The analysis concluded that indirect taxes negatively affected income distribution. Israel & Ebimobowei (2021), in their joint study, analyzed the effect of taxes on income inequality using data from Nigeria for the period 1980-2018 and Dickey-Fuller cointegration and error correction mechanisms. The results showed a significant negative relationship between income tax and corporate tax and income inequality; and a negative but statistically insignificant relationship between VAT and income inequality. It was concluded that taxes play a significant role in income distribution in Nigeria. In the study conducted by Polat (2021), the effect of direct and indirect taxes on income distribution was analyzed using next-generation panel data analysis method with data from Türkiye and 28 EU countries for the years 2006-2018. According to the findings, it was observed that increasing the share of direct taxes in total tax revenues reduces income inequality, while increasing the share of indirect taxes in total tax revenues increases income inequality.

In the joint study conducted by Gürler Hazman et al. (2021), the effect of direct and indirect taxes on income distribution was analyzed using panel data analysis method with data from Türkiye and 25 EU member countries for the years 2006-

2018. As a result of the test, it was concluded that indirect taxes increase income inequality, while direct taxes decrease it. In addition to these findings, according to the causality test result, there is a unidirectional relationship from direct and indirect taxes to income distribution. Özden et al. (2023), in their joint study, aimed to examine how direct and indirect taxes affect income distribution in the Turkish economy. Using data from Türkiye for the years 1992-2021, they used long-term and short-term estimation methods to investigate the relationship between direct and indirect taxes, income inequality, and economic growth. These two models were tested using the ARDL test and other models. As a result of the analyses, it was determined that direct taxes reduce income inequality, while indirect taxes increase income inequality. In a joint study by Olufemi et al. (2023), using data from Nigeria for the years 1999-2022, the effect of direct taxes on income distribution was analyzed using the Ex-Post Facto method. According to the findings, it was concluded that the effect of profit tax on oil revenues and corporate tax on government expenditures was negative and significant. In a study by Tabar (2023), using data from Türkiye and 29 OECD countries for the years 2008-2018, the impact of direct and indirect taxes on income distribution was analyzed using panel data analysis. The analysis concluded that direct taxes have a positive impact on income distribution, while indirect taxes have a negative impact.

In the study conducted by Akşehirli (2024), the causal relationship between taxes and income distribution was analyzed using time series data from Türkiye for the years 2006-2023. The Toda-Yamamoto test was used for causality testing, while the stationarity of the series was analyzed using the Augmented Dickey-Fuller and Phillips-Perron tests. According to the findings, a unidirectional causal relationship was found from both direct and indirect taxes to income distribution. In his study, Jolaıya (2024) analyzed the relationship between indirect taxes and income inequality using error correction model, a time series method, with data from Nigeria for the years 1990-2021. According to the findings, a positive relationship was found between value-added tax and income inequality. It was concluded that stamp duty, another indirect tax, has a negative effect on the Gini coefficient. Customs and consumption taxes were observed to have a positive relationship with the Gini coefficient.

In a collaborative study by Razzaque et al. (2024), the impact of Bangladesh's indirect taxes on income distribution, poverty, and economic growth was investigated. The study used Household Income and Expenditure Survey data from 2000, 2005, 2010, and 2016, as well as data from the World Bank, and tested them using panel data analysis. According to the regression results, a 1% increase in indirect taxes leads to a significant increase of 0.92% in poverty. It was found that countries with high indirect tax revenues have higher levels of poverty and income inequality. In a study by Koç et al. (2024), the relationship between different tax types and income distribution in the Turkish tax system was analyzed using Markov regime transition analysis with data from 2002-2022. The study concluded that indirect taxes have a positive effect on income distribution, while self-declaration-based taxes have a negative effect. Karaş (2025) analyzed the impact of direct and

indirect taxes on income distribution using data from Türkiye between 1994 and 2023, employing the Autoregressive Distributed Lag (ARDL) Bounds Test. The analysis revealed that in the long term, indirect taxes have a negative impact on income distribution, while direct taxes have a positive impact. However, in the short term, both direct and indirect taxes have a negative impact on income distribution. In a joint study by Fernandes et al. (2025), the relationship between direct taxes and income distribution was tested using the GMM method with data from 53 countries (OECD member countries and non-OECD member countries) between 2000 and 2012. The findings showed that direct taxes are more significant in the tax system and are associated with lower levels of income inequality in both developed and developing countries.

4. Empirical Design

4.1. Data

This study uses annual time series data for Türkiye covering the period 1988–2024, representing the longest available time frame for the variables used in the analysis. All variables are expressed as a percentage of GDP. Table 1 presents the definitions of the variables and their respective data sources. Descriptive statistics and correlation coefficients for the main variables are reported in Tables A1 and A2 in the Appendix, respectively. Furthermore, Figure 1 shows the graphical behavior of the variables throughout the study period.

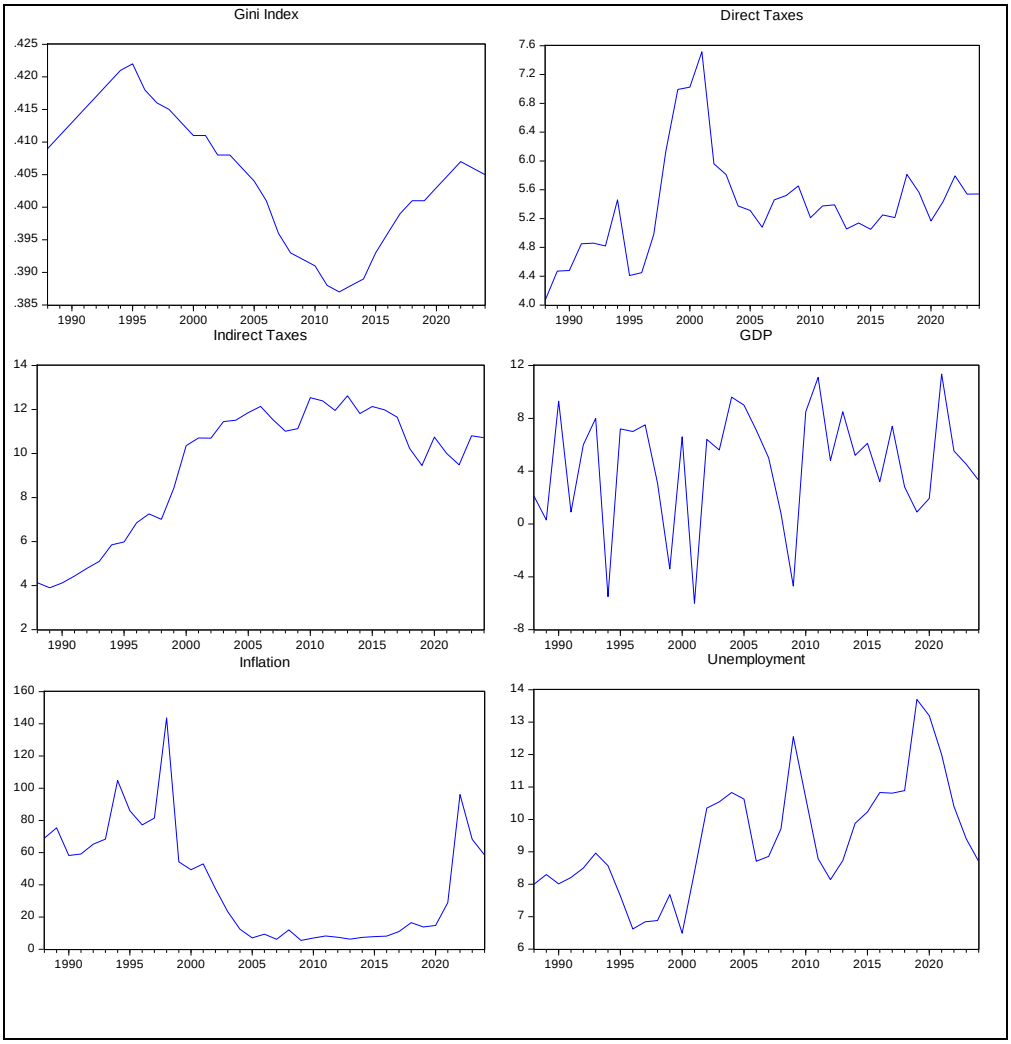
Table 2. Variable Definitions and Data Sources

Variable	Definition	Data Source
Gini Index	Gini Index	Solt, F. (2024). *Standardized World Income Inequality Database (SWIID)* [Data set]. Harvard Dataverse. https://doi.org/10.7910/DVN/LM4OWF[1]
Direct Taxes	Direct Tax Revenues as a Percentage of GDP (%)	Republic of Türkiye Ministry of Treasury and Finance. (2026). *Budget magnitudes and budget realizations*. General Directorate of Public Accounts.[2]
Indirect Taxes	Indirect Tax Revenues as a Percentage of GDP (%)	Republic of Türkiye Ministry of Treasury and Finance. (2026). Budget magnitudes and budget realizations. General Directorate of Public Accounts.[3]
GDP	Annual percentage growth rate of real GDP	World Bank (2026)[4]
Inflation	Inflation rate, annual percentage change in the Consumer Price Index (CPI)	World Bank (2026)[5]

[1] https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/LM4OWF
[2] https://www.hmb.gov.tr/bumko-butce-buyuklukleri-ve-butce-gerceklesmeleri
[3] https://www.hmb.gov.tr/bumko-butce-buyuklukleri-ve-butce-gerceklesmeleri
[4] https://databank.worldbank.org/source/world-development-indicators
[5] https://databank.worldbank.org/source/world-development-indicators

Unemployment	Unemployment rate (national estimate, total, %)	World Bank (2026)[6]

Figure 3. Graphical Representation of Variables, 1988-2024



4.2 Methodology

To examine the short-term and long-term relationship between tax structure and income distribution in Türkiye, the stationarity properties of the variables were first investigated using the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski et al., 1992). Secondly, the existence of a long-term equilibrium relationship between income distribution, direct taxes, indirect taxes, economic growth, inflation, and unemployment was evaluated using the Autoregressive Distributed Lag (ARDL) bounds test approach developed by Pesaran et al. (2001). The ARDL method is

[6] https://databank.worldbank.org/source/world-development-indicators

suitable for this study because it can be applied when the variables are stationary at order zero (I(0)) and order one (I(1)), provided that none of the variables are stationary at order two (I(2)). In addition, the ARDL test performs better in small samples and allows for the simultaneous estimation of both long-term and short-term changes. Finally, the Toda-Yamamoto (1995) causality test was used to determine the direction of causality between the variables.

5. Empirical Results

5.1. Unit Root Test Results

Tables 3 and 4 show the results of the ADF and KPSS unit root tests conducted to examine the stationarity properties of the variables. The findings from the ADF and KPSS tests show that the variables are stationary at the I(0) and I(1) levels, while none of the series are stationary at the second degree (I(2)).

Table 3. Unit Root Test Results, 1988-2024, Level

ADF unit root test						
Series	**Level**	**Critical Values**		**Level**	**Critical Values**	
	Constant	**5%**	**1%**	**Constant and Trend**	**5%**	**1%**
Gini Index	-1.65(1)	-2.94	-3.63	-1.77(1)	-3.54	-4.24
Direct Taxes	-3.11(2)**	-2.95	-3.63	-3.17(7)	-3.57	-4.30
Indirect Taxes	-1.82(8)	-2.97	-3.68	-0.65(8)	-3.58	-4.32
GDP	-6.38(0)***	-2.94	-3.62	-6.37(0)***	-3.54	-4.23
Inflation	-2.13(0)	-2.94	-3.62	-2.14(0)	-3.54	-4.23
Unemployment	-2.59(1)	-2.94	-3.63	-3.52(1)*	-3.54	-4.24
KPSS unit root test						
Series	**Level**	**Critical Values**		**Level**	**Critical Values**	
	Constant	**5%**	**1%**	**Constant and Trend**	**5%**	**1%**
Gini Index	0.40**	0.46	0.73	0.12**	0.14	0.21
Direct Taxes	0.15**	0.46	0.73	0.11**	0.14	0.21
Indirect Taxes	0.50***	0.46	0.73	0.18***	0.14	0.21
GDP	0.28**	0.46	0.73	0.15***	0.14	0.21
Inflation	0.34***	0.46	0.73	0.15***	0.14	0.21
Unemployment	0.53***	0.46	0.73	0.10**	0.14	0.21

Note: Values in parentheses indicate the optimal lag lengths selected according to the Akaike Information Criterion (AIC). For the ADF test, *, **, and *** indicate the rejection of the unit root hypothesis at the 10%, 5%, and 1% significance levels, respectively. For the KPSS test, the null hypothesis is stationarity. Test statistics exceeding the corresponding critical values indicate that the stationarity null hypothesis is rejected.

Table 4. Unit Root Test Results, 1988-2024, First Difference

ADF unit root test						
Series	**First Difference Constant**	**Critical Values**		**First Difference Constant and Trend**	**Critical Values**	
		5%	**1%**		**5%**	**1%**
D(Gini Index)	-2.55(0)	-2.94	-3.63	-2.57(0)	-3.54	-4.24
D(Direct Taxes)	-5.76(0)***	-2.94	-3.63	-5.71(0)***	-3.54	-4.24
D(Indirect Taxes)	-2.02(7)	-2.97	-3.68	-3.09(8)	-3.58	-4.33
D(GDP)	-3.76(9)***	-2.98	-3.71	-3.68(9)**	-3.59	-4.35
D(Inflation)	-7.68(0)***	-2.94	-3.63	-4.10(2)**	-3.55	-4.26
D(Unemployment)	-2.01(9)	-2.98	-3.71	-4.27(2)***	-3.55	-4.26
KPSS unit root test						
Series	**First Difference Constant**	**Critical Values**		**First Difference Constant**	**First Difference Constant and Trend**	**Critical Values**
		5%	**1%**			**5%**	**1%**
D(Gini Index)	0.16**	0.16**		0.16**	0.16**	0.16**	0.16**
D(Direct Taxes)	0.10**	0.10**		0.10**	0.10**	0.10**	0.10**
D(Indirect Taxes)	0.37**	0.37**		0.37**	0.37**	0.37**	0.37**
D(GDP)	0.18**	0.18**		0.18**	0.18**	0.18**	0.18**
D(Inflation)	0.17**	0.17**		0.17**	0.17**	0.17**	0.17**
D(Unemployment)	0.22**	0.22**		0.22**	0.22**	0.22**	0.22**

Note: Values in parentheses indicate the optimal lag lengths selected according to the Akaike Information Criterion (AIC). For the ADF test, *, **, and *** indicate the rejection of the unit root hypothesis at the 10%, 5%, and 1% significance levels, respectively. For the KPSS test, the null hypothesis is stationarity. Test statistics exceeding the corresponding critical values indicate that the stationarity null hypothesis is rejected.

5.2. ARDL Bounds Test Results

To examine the long-term and short-term cointegration relationships between the variables used in the analysis, the ARDL bounds test developed by Pesaran et al. (2001) was used. The following equation was used to determine this relationship:

$$\begin{aligned}\Delta \mathrm{Gini}_t = \beta_0 &+ \sum_{i=1}^{n} \beta_{1i}\, \Delta \mathrm{Gini}_{t-i} + \sum_{i=0}^{n} \beta_{2i}\, \Delta \mathrm{Direct}_{t-i} + \sum_{i=0}^{n} \beta_{3i}\, \Delta \mathrm{Indirect}_{t-i} \\ &+ + \sum_{i=0}^{n} \beta_{4i}\, \Delta \mathrm{GDP}_{t-i} + \sum_{i=0}^{n} \beta_{5i}\, \Delta \mathrm{Inflation}_{t-i} \\ &+ \sum_{i=0}^{n} \beta_{6i}\, \Delta \mathrm{Unemployment}_{t-i} + \beta_7 \mathrm{Gini}_{t-1} + \beta_8 \mathrm{Direct}_{t-1} \\ &+ \beta_9 \mathrm{Indirect}_{t-1} + \beta_{10} \mathrm{GDP}_{t-1} + \beta_{11} \mathrm{Inflation}_{t-1} \\ &+ \beta_{12} \mathrm{Unemployment}_{t-1} + \mathrm{K}_t + \mu_t \end{aligned} \quad (1)$$

Accordingly, the following hypotheses are used to determine the existence of a cointegration relationship in the ARDL model established:

$$H_0: \begin{bmatrix} \beta_7 \\ \beta_8 \\ \beta_9 \\ \beta_{10} \\ \beta_{11} \\ \beta_{12} \end{bmatrix} = 0_{6\times 1}$$

$H_1: \beta_7 \neq 0$, $H_1: \beta_8 \neq 0$, $H_1: \beta_9 \neq 0$, $H_1: \beta_{10} \neq 0$, $H_1: \beta_{11} \neq 0$ or $H_1: \beta_{12} \neq 0$

The analysis yielded an F-statistic of 15.649, and since this value exceeds the upper limit of 4.68 at the 1% significance level, Table 5 indicates a cointegration relationship between the variables.

Table 5. F-Bounds Test Results (Null Hypothesis: No Level Relationship)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	**15.649**	10%	2.26	3.35
k	5	5%	2.62	3.79
		1%	3.41	4.68

After identifying cointegration relationships between the variables, the ARDL (4, 3, 4, 4, 4, 4) model was selected and constructed according to the Akaike Information criteria to examine the long-term relationship between them.

Table 6 shows the long-term coefficient estimates for this model, where the dependent variable is the Gini Index. The estimated coefficients reveal that direct taxes do not have a statistically significant long-term effect on income inequality. Indirect taxes, however, have a statistically significant and negative coefficient at the 1% significance level; this indicates that a 1% increase in indirect tax revenues reduces income inequality by 0.002% in the long run. On the other hand, GDP has a positive and statistically significant effect on the Gini Index at the 5% level; this indicates that a 1% increase in economic growth increases income inequality by 0.002% in the long run. This result suggests that the benefits of economic growth may not be equally distributed among income groups. Unemployment has a positive and statistically significant coefficient at the 1% level; this indicates that a 1% increase in the unemployment rate increases income inequality by 0.005% in the long run. An autocorrelation problem was identified in the model. This problem was solved using the HAC (Heteroskedasticity and Autocorrelation Consistent) estimator. No heteroskedasticity problem was found in the model, and the model exhibits a normal distribution.

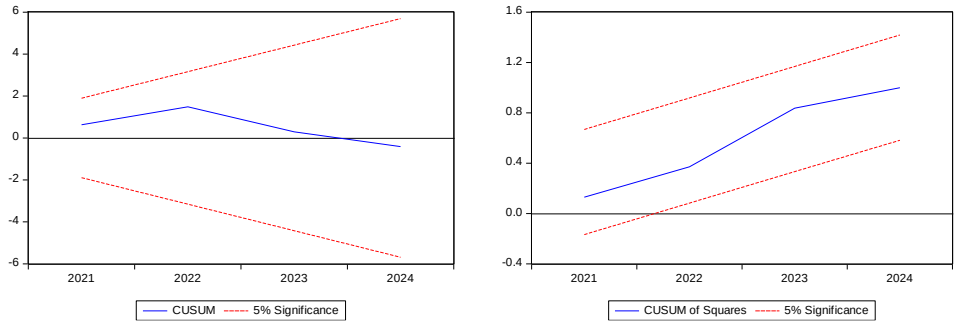
Table 6. ARDL(4, 3, 4, 4, 4, 4) Long-Term Forecast Results

Dependent Variable: Gini Index	
Variable	(1)
Direct Taxes	0.000
	(0.125)
Indirect Taxes	-0.002***
	(-6.639)
GDP	0.002**
	(3.979)
Inflation	0.000**
	(3.258)
Unemployment	0.005***
	(5.104)
Constant	0.190**
	(4.292)
Diagnostic Test Results	
Autocorrelation (LM)	24.243 (0.000)
Heteroskedasticity (Breusch-Pagan-Godfrey)	32.817 (0.242)
Jarque-Bera Normality	0.012 (0.993)
R^2	0.99
Adjusted R^2	0.99
Observations	33

Note: *, *, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The results of the CUSUM and CUSUMQ tests, known as stability tests for long-term relationships between variables, are also given in Figure 4. According to these results, the CUSUM test values remain within the critical range. In other words, there is no structural break in the model, and the coefficients are stable.

Figure 4. CUSUM and CUSUMQ Tests for Long Run



Then, in order to examine the short-term relationship between the variables, the ARDL (4, 3, 4, 4, 4, 4) Error Correction Model (ECM) was derived.

The coefficient of the error correction term is negative and statistically significant at the 1% significance level, confirming the existence of a stable long-term equilibrium relationship. The estimated coefficient indicates that approximately 53.4% of short-term deviations from equilibrium are corrected within one year, indicating a relatively rapid adjustment process. Additionally, direct tax revenues

were found to be statistically significant in both simultaneous and two-lagged values in the short term, as opposed to the long term. Accordingly, a 1% increase in direct tax revenues leads to a 0.001% increase in income inequality in the short term, both simultaneously and with two lags. For indirect tax revenues, the one, two, and three-lagged coefficients are positive and statistically significant; indicating that a 1% increase in indirect tax revenues leads to a 0.003% increase in income inequality with one and three lags, and a 0.004% increase with two lags. Inflation shows strong short-term volatility effects. The simultaneous and three-lagged inflation coefficients are positive and statistically significant. This also shows that inflationary pressures tend to worsen income inequality in the short term. Unemployment has a positive and statistically significant effect on income inequality at all lags, confirming that labor market deterioration intensifies distributive inequality. Finally, an autocorrelation problem was identified in the model. This problem was solved using the HAC (Heteroskedasticity and Autocorrelation Consistent) estimator. No heteroskedasticity problem was found in the model, and the model exhibits a normal distribution.

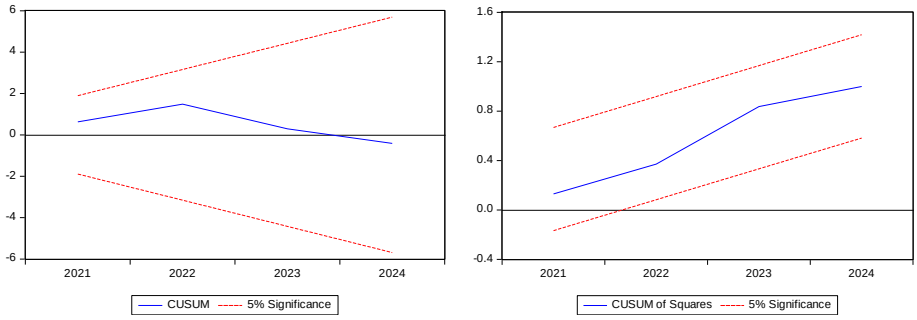
Table 7. ARDL(4, 3, 4, 4, 4, 4) ECM Estimation Results

Variable	Coefficient
C	0.190***
	(14.535)
D(GINI_INDEX(-1))	0.075
	(1.178)
D(GINI_INDEX(-2))	-0.072
	(-1.119)
D(GINI_INDEX(-3))	0.487***
	(7.184)
D(DIRECT_TAXES_GDP)	0.001***
	(5.496)
D(DIRECT_TAXES_GDP(-1))	-0.000
	(-1.910)
D(DIRECT_TAXES_GDP(-2))	0.001***
	(4.841)
D(INDIRECT_TAXES_GDP)	-0.000
	(-1.860)
D(INDIRECT_TAXES_GDP(-1))	0.003***
	(11.207)
D(INDIRECT_TAXES_GDP(-2))	0.004***
	(14.811)
D(INDIRECT_TAXES_GDP(-3))	0.003***
	(11.121)
D(GDP)	0.000***
	(10.398)
D(GDP(-1))	-0.001***
	(-12.197)
D(GDP(-2))	-0.000***
	(-8.577)
D(GDP(-3))	-0.000***
	(-7.662)

D(INFLATION)	3.20***
	(6.593)
D(INFLATION(-1))	-2.54**
	(-4.426)
D(INFLATION(-2))	4.14
	(0.720)
D(INFLATION(-3))	9.01***
	(13.123)
D(UNEMPLOYMENT)	0.001***
	(10.501)
D(UNEMPLOYMENT(-1))	0.001***
	(9.142)
D(UNEMPLOYMENT(-2))	0.000*
	(2.242)
D(UNEMPLOYMENT(-3))	0.000***
	(4.648)
CointEq(-1)*	-0.534***
	(-14.535)
Diagnostic Test Results	
Autocorrelation (LM)	24.243 (0.000)
Heteroskedasticity (Breusch-Pagan-Godfrey)	30.811 (0.325)
Jarque-Bera Normality	0.012 (0.993)
R^2	0.99
Adjusted R^2	0.97
Observations	33

The results of the CUSUM and CUSUMQ tests, known as stability tests for long-term relationships between variables, are also given in Figure 5. According to these results, the CUSUM test values remain within the critical range. In other words, there is no structural break in the model, and the coefficients are stable.

Figure 5. CUSUM and CUSUMQ Tests for Short Run



5.3. Toda–Yamamoto Causality Results

The Toda–Yamamoto (1995) Granger causality approach consists of three steps. First, the maximum order of integration of the variables (dmax) is determined using unit root tests such as the ADF and KPSS tests. Second, the optimal lag length of the VAR model (m) is identified based on lag selection criteria. Finally, causality is tested using the Modified Wald (MWALD) test applied to the augmented VAR model, where the optimal lag order is specified as k = (m + dmax). The MWALD statistic

follows an asymptotic chi-square distribution with m degrees of freedom (Amiri & Ventelou, 2012; Dembure & Ziramba, 2016).

The optimal lag length for the Toda-Yamamoto causality analysis was determined to be 1, using data from Table 8.

Table 8. Optimal Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-187.6323	NA	0.030695	13.50778	15.39328	14.15079
1	-81.03264	131.6819*	0.000595*	9.354861	12.85651*	10.54902*
2	-44.76167	32.00379	0.001091	9.338922*	14.45672	11.08424

The findings of the Toda-Yamamoto Causality Test are presented in Table 9. The findings reveal a unidirectional causal relationship from GDP to the Gini Index at a 10% significance level, indicating that any change in economic growth affects income inequality in Türkiye. A unidirectional causal relationship from unemployment to income inequality was also found at a 5% significance level, suggesting that changes in the labor market cause changes in income distribution. Furthermore, this complements the ARDL findings, which also indicate that unemployment has a positive and statistically significant effect on income inequality. A bidirectional causal relationship was identified between gross domestic product (GDP) and direct taxes; however, the causal effect from direct taxes to GDP is only significant at the 10% level. On the one hand, economic expansion increases taxable income, thereby raising direct tax revenues, while on the other hand, changes in direct taxation appear to affect economic activity through fiscal transmission mechanisms.

Table 9. Toda Yamamoto Test Results

Direction of Causal Relationship	***Null Hypothesis***	***Chi-sq.***	***Prob.***	***Granger Causality***
GDP → Gini Index	GDP does not granger cause Gini Index	3.691	0.054*	Unidirectional Causality GDP → Gini Index
Unemployment → Gini Index	Unemployment does not granger cause Gini Index	3.995	0.045**	Unidirectional Causality Unemployment → Gini Index
GDP → Direct Taxes	GDP does not granger cause Direct Taxes	13.430	0.000***	Bidirectional Causality
Direct Taxes → GDP	Direct Taxes does not granger cause GDP	3.531	0.060*	GDP↔ Direct Taxes
Gini Index → Indirect Taxes	Gini Index does not granger cause Indirect Taxes	7.349	0.006***	Unidirectional Causality Gini Index → Indirect Taxes
Inflation→ Indirect Taxes	Inflation does not granger cause Indirect Taxes	3.205	0.073*	Unidirectional Causality Inflation → Indirect Taxes

Note: *, *, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The results also show a unidirectional causal relationship from the Gini Index to indirect taxes, suggesting that changes in income distribution may affect the structure or collection capacity of indirect taxation. Furthermore, a 10% causal relationship was found from inflation to indirect taxes; this result indicates that changes in the price level can affect indirect tax revenues through their impact on nominal consumption expenditures and tax bases.

6. Conclusion

This study examines the relationship between indirect and direct tax revenues and income distribution in Türkiye during the period 1988-2024 using the ARDL bounds test and Toda-Yamamoto causality tests. The analysis findings indicate the existence of a cointegration relationship between indirect and direct tax revenues and income distribution in Türkiye during the period studied, and that deviations from short-term equilibrium are corrected in the long term. When examining the long-term relationship between the variables, it is observed that direct tax revenues do not have a statistically significant effect on income distribution. However, it is concluded that a 1% increase in indirect tax revenues reduces income inequality by 0.002% in the long term. Short-term results show that direct tax revenues are statistically significant in both simultaneous and two-lagged values, but this is not the case in the long term. Accordingly, a 1% increase in direct tax revenues leads to a 0.001% increase in income inequality in the short term, both simultaneously and with two lags. A 1% increase in indirect tax revenues leads to a 0.003% increase in income inequality with one and three lags, and a 0.004% increase with two lags. Causality analysis results indicate a unidirectional causal relationship between the Gini Index and indirect taxes. This relationship means that any change in income distribution will cause a change in indirect tax revenues.

From a fiscal policy perspective, the findings suggest that reducing income inequality in Türkiye is possible not only through taxation but also through a comprehensive policy design that considers the redistributive role of public expenditures. A key finding of this study is that, contrary to the traditional view that direct taxes are inherently fairer, indirect taxes reduce income inequality in the long run. This conclusion does not mean that indirect taxation is fairer, but rather may reflect the redistributive role of public expenditures financed by indirect tax revenues and the relatively high revenue-generating capacity of indirect taxes in Türkiye. If indirect tax revenues are effectively allocated to social transfers, education, healthcare, and other public services that benefit low-income households, the disequitable effect of indirect tax revenues can be offset over time. Therefore, the redistributive effect of indirect taxation depends not only on the tax burden on households but also on the composition and effectiveness of public expenditures financed by these revenues. Finally, this study has some limitations. The analysis focuses on total direct and indirect tax categories and does not evaluate subcategories separately. Future research, by including public expenditure variables in the analysis and disaggregating tax components, could provide more

in-depth insights, contributing to a better understanding of the interaction between taxation, fiscal policy, and income inequality.

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Appendix

Table A1. Descriptive Statistics

	Gini Index	Direct Taxes	Indirect Taxes	GDP	Inflation	Unemployment
Mean	0.40	5.38	9.42	4.51	41.04	9.39
Maximum	0.42	7.51	12.61	11.35	143.63	13.70
Minimum	0.38	4.07	3.90	-6.00	5.44	6.49
Std. Dev.	0.01	0.71	2.86	4.38	35.55	1.77
Skewness	-0.19	1.01	-0.77	-0.82	0.80	0.50
Kurtosis	1.98	4.63	2.10	3.16	2.97	2.80
Jarque-Bera	1.81	10.45	4.96	4.24	4.01	1.66
Probability	0.40	0.00	0.08	0.11	0.13	0.43

Table A2. Correlation Matrix of The Variables

	Gini Index	Direct Taxes	Indirect Taxes	GDP	Inflation	Unemployment
Gini Index	1					
Direct Taxes	-0.04	1				
Indirect Taxes	-0.78	0.40	1			
GDP	-0.14	-0.38	0.18	1		
Inflation	0.80	-0.02	-0.74	-0.20	1	
Unemployment	-0.45	0.02	0.46	-0.03	-0.58	1