Examining the Nonlinear Asymmetric Effects of Tax Revenues on Financial Development in Iran: Hatemi-J Asymmetric Causality and NARDL Analysis

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Abstract: The financial system plays a pivotal role in investment and saving decisions, thereby exerting a significant influence on economic growth. Consequently, identifying the determinants of financial development has attracted considerable attention from researchers and policymakers. At the same time, tax revenue, as a primary source of government income, is of critical importance due to its effects on public investment, social services, debt financing, and budget deficit management. Given the crucial role of government tax revenue in shaping both public and private investment decisions, the present study investigates the asymmetric causality between tax revenue and financial development in Iran over the period 1970–2024. To this end, the Hatemi-J asymmetric causality test and the Nonlinear Autoregressive Distributed Lag (NARDL) model are employed. The results reveal a unidirectional asymmetric causal relationship running from tax revenue to financial development. Specifically, positive shocks in tax revenue exert a negative impact on financial development, while negative shocks exert a positive impact, confirming the presence of asymmetry. Moreover, economic growth and government expenditure have positive and statistically significant effects on financial development, whereas inflation exerts a negative and significant impact. The error correction term coefficient is estimated at −0.50, indicating that approximately 50 percent of short-run deviations from the long-run equilibrium are corrected within each period.

Keywords: Financial development, Tax revenue, Asymmetric causality, Nonlinear ARDL (NARDL), Hatemi-J test

1. Introduction

Financial development has long been recognized as one of the principal drivers of economic growth, macroeconomic stability, and structural transformation in both developed and developing economies. The financial system performs critical functions by mobilizing savings, allocating capital efficiently, facilitating investment, diversifying risk, and improving resource distribution across productive sectors. Through these mechanisms, financial development contributes to higher productivity, technological innovation, and sustainable economic expansion [1-3]. Theoretical foundations emphasizing the role of financial deepening in economic development emerged prominently with the pioneering works of Shaw and McKinnon, who argued that efficient and liberalized financial systems promote

savings accumulation and investment growth, thereby accelerating economic development [1]. Subsequently, endogenous growth theories further strengthened this perspective by emphasizing the central role of financial intermediation in fostering innovation, human capital formation, and long-run growth dynamics [3, 4].

The relationship between financial development and macroeconomic performance has therefore become one of the most widely investigated topics in modern economics. Levine [2, 3] argued that financial systems enhance economic performance by reducing transaction costs, facilitating information acquisition, improving corporate governance, and enabling risk management. Likewise, Lucas [4] emphasized that capital accumulation and financial efficiency are crucial determinants of long-term economic prosperity. Financial development also improves the efficiency of monetary transmission mechanisms and increases resilience against external shocks, making it a central component of macroeconomic policy frameworks. Consequently, identifying the factors that promote or hinder financial development has become a priority for policymakers and researchers worldwide.

Among the numerous determinants of financial development, fiscal policy occupies a particularly important position. Fiscal policy influences aggregate demand, private investment, public expenditure allocation, income distribution, and macroeconomic stability. Tax revenue, as the principal source of government income, plays a crucial role in financing public services, infrastructure, social welfare programs, and development projects. At the same time, taxation directly and indirectly affects household consumption, business investment decisions, capital accumulation, and financial market activities. Because of these multidimensional effects, the interaction between tax revenue and financial development has attracted growing attention in the empirical and theoretical literature [5-7].

Tax revenue can influence financial development through several transmission channels. First, effective taxation systems increase government capacity to provide public infrastructure and institutional support necessary for financial market expansion. Efficient tax systems may strengthen investor confidence, improve institutional quality, and facilitate financial deepening. Second, taxation affects disposable income and savings behavior, thereby influencing the supply of financial resources available for intermediation. Third, tax structures influence investment incentives and corporate profitability, which subsequently affect credit demand, stock market participation, and financial market performance [5, 8]. In this regard, taxation can either stimulate or constrain financial development depending on the nature of the tax system, institutional quality, and macroeconomic conditions.

Theoretical perspectives regarding the relationship between taxation and financial development are not entirely uniform. Classical and neoclassical approaches generally emphasize the distortionary effects of excessive taxation on private investment and economic efficiency. High tax burdens may reduce corporate profitability, discourage entrepreneurship, and lower incentives for productive investment, thereby negatively affecting financial sector activities. From this perspective, excessive taxation may weaken financial development by reducing savings, investment, and demand for financial services [4, 9]. Conversely, Keynesian and institutional approaches argue that tax revenues enable governments to finance infrastructure, education, healthcare, and institutional reforms that are essential for economic and financial development. In this framework, efficient fiscal systems may strengthen financial markets by promoting macroeconomic stability and institutional capacity [10, 11].

Endogenous growth theory further suggests that fiscal policy can permanently affect economic growth and financial development through its impact on capital accumulation, technological innovation, and productivity growth [4]. Taxes influence labor supply decisions, investment behavior, and savings patterns, thereby shaping the long-run trajectory of economic development. Financial systems respond to these changes by adjusting credit

allocation, investment financing, and financial intermediation activities. Consequently, tax policy becomes an important determinant of financial sector expansion and efficiency.

Another theoretical channel linking taxation and financial development is the demand-following hypothesis. According to this view, financial development emerges as a response to increased economic activity and rising demand for financial services generated by economic growth. Improvements in production, trade, and investment stimulate demand for credit, insurance, payment systems, and capital market instruments, leading to financial deepening [1, 2]. Since taxation affects economic growth through investment incentives and income distribution mechanisms, it indirectly shapes financial development dynamics as well.

Inflation and macroeconomic instability also play important roles in the taxation-financial development nexus. High inflation reduces the real value of financial assets, increases uncertainty, weakens savings incentives, and distorts credit allocation mechanisms. Huybens and Smith [12] demonstrated that inflation-induced financial frictions can significantly constrain capital accumulation and financial market performance. Similarly, Boyd et al. [13] argued that inflation negatively affects banking sector development and overall financial efficiency. Since tax revenue collection and fiscal sustainability are closely related to inflationary pressures and monetary conditions, understanding these interactions is essential for evaluating financial development processes.

Government expenditure represents another critical factor influencing financial development. On one hand, expansionary government spending can crowd out private investment and reduce credit availability for the private sector, thereby negatively affecting financial market development [14]. On the other hand, productive government expenditure on infrastructure, education, and institutional development may enhance financial market efficiency and deepen financial intermediation [10, 11]. These contrasting theoretical perspectives suggest that the impact of fiscal variables on financial development may depend on country-specific institutional and structural conditions.

International trade and financial integration further complicate the relationship between taxation and financial development. Trade openness can stimulate financial market expansion by increasing demand for trade financing, foreign investment, and risk management instruments [15]. However, the effects of globalization and trade liberalization may vary between developed and developing economies depending on institutional quality and industrial structure [16]. Financial integration may enhance access to external capital and financial technology while simultaneously exposing domestic financial systems to external vulnerabilities and volatility.

Empirical evidence regarding the relationship between tax revenue and financial development remains mixed and sometimes contradictory. Several studies report positive effects of taxation on financial development. Taha et al. [6] found that financial system activities significantly influence tax revenues in Malaysia, highlighting the interdependence between fiscal and financial sectors. Similarly, Okon [17] reported a positive relationship between financial sector development and tax revenue in Nigeria. Omodero and Iyoha [7] also demonstrated that tax revenue positively affects financial development in emerging markets by improving government capacity and economic stability.

Recent studies have further expanded the literature by emphasizing nonlinear and asymmetric relationships. Tsaurai [18] investigated emerging markets and found that tax revenue significantly affects financial development, particularly when interacting with foreign direct investment. Karaş and Saygili [8] examined Türkiye using the ARDL framework and concluded that both direct and indirect taxes positively affect financial development in the short and long run. Cilek [19] employed Hatemi-J asymmetric causality analysis and demonstrated that positive and negative shocks in tax revenues may exert different effects on financial development. These findings suggest that linear models may be insufficient to capture the true dynamics between fiscal variables and financial systems.

The growing attention toward asymmetric relationships in macroeconomics stems from the recognition that economic agents often respond differently to positive and negative shocks. Hatemi-J [20] argued that positive and negative changes in macroeconomic variables may generate asymmetric reactions due to behavioral, institutional, and market frictions. In financial markets, investor expectations, uncertainty, and adjustment costs frequently produce nonlinear responses to fiscal and monetary policy shocks. Consequently, examining asymmetric effects provides deeper insights into the underlying mechanisms governing financial development.

In the context of developing economies, these issues become even more significant. Many developing countries suffer from weak tax systems, limited institutional capacity, high inflation, financial fragility, and excessive dependence on natural resource revenues. Iran represents a particularly important case in this regard. The Iranian economy has historically relied heavily on oil revenues, making fiscal sustainability vulnerable to external shocks and commodity price fluctuations. This dependence has reduced incentives for tax reform and weakened the development of efficient fiscal institutions. At the same time, Iran's financial system has faced persistent structural challenges, including inflationary pressures, limited financial market depth, banking sector inefficiencies, and macroeconomic instability [21, 22].

Strengthening tax revenues and improving fiscal efficiency are therefore considered essential components of economic reform and financial sector development in Iran. Abbaszadeh and Shamsoddini [23] found significant relationships between fiscal policy variables and capital market efficiency in Iran. Sotoudeh et al. [24] also demonstrated that fiscal policy variables significantly affect stock market performance in oil-exporting economies. Moreover, Shams Gharaneh et al. [25] highlighted the importance of economic growth in promoting financial development across developed and developing countries.

Despite the growing body of literature, several important research gaps remain unresolved. First, most existing studies focus primarily on linear relationships and fail to account for potential asymmetries between positive and negative tax shocks. Second, empirical evidence for Iran remains relatively limited, particularly regarding nonlinear dynamics between tax revenue and financial development. Third, previous studies have often examined either fiscal policy or financial development independently without integrating broader macroeconomic variables such as inflation, government expenditure, trade openness, and economic growth into a unified asymmetric framework. Finally, given the unique institutional and structural characteristics of the Iranian economy, country-specific analysis is necessary to generate effective policy recommendations.

Addressing these gaps is particularly important because asymmetric responses may imply that increases and decreases in tax revenues generate fundamentally different consequences for financial development. Positive tax shocks may reduce private sector liquidity and investment incentives, whereas negative tax shocks may stimulate market activity and financial intermediation through enhanced private sector participation. Understanding these nonlinear effects can help policymakers design more balanced fiscal strategies that support sustainable financial development while maintaining fiscal stability.

Methodologically, advanced econometric approaches such as the Hatemi-J asymmetric causality test and the Nonlinear Autoregressive Distributed Lag (NARDL) model provide powerful tools for capturing these complex dynamics [20, 26]. The Hatemi-J framework allows researchers to decompose positive and negative shocks and examine their distinct causal effects, while the NARDL approach captures both short-run and long-run asymmetries within a cointegration framework. These methods are particularly suitable for economies characterized by structural changes, volatility, and nonlinear macroeconomic relationships.

Therefore, considering the theoretical importance of fiscal policy in financial sector development, the mixed empirical evidence in previous studies, the importance of asymmetric relationships, and the structural characteristics of the Iranian economy, the present study aims to investigate the nonlinear asymmetric effects of tax revenues on financial development in Iran using the Hatemi-J asymmetric causality test and the NARDL approach over the period 1970–2024.

2. Methodology

Based on prior theoretical and empirical studies, it is reasonable to expect that positive and negative shocks to tax revenue exert differential effects on financial development. Drawing upon the framework proposed by Chilke (2024), this study posits an asymmetric causal relationship between financial development and tax revenue. The empirical model for financial development is an extended version of the specification introduced by Omodero and Iweha (2021), further adjusted in line with Mohammadi et al. (2014). The general form of the model is presented as follows:

$$FD_t = \beta_0 + \beta_1 TR_t + \beta_2 FDI_t + \beta_3 INF_t + \beta_4 GDP_t + \beta_5 OP_t + \beta_6 GE_t + \varepsilon_t \qquad (1)$$

where FD_t denotes the financial development index, TR_t represents government tax revenue, FDI_t is foreign direct investment, INF_t is the inflation rate, GDP_t is economic growth, OP_t is trade openness, and GE_t stands for government expenditure. The study covers the Iranian economy over the period 1970–2024.

Financial development is measured by the composite index published by the Global Financial Development Database, calculated as the average of financial access, depth, and efficiency across both financial markets and financial institutions. Tax revenue is defined as the natural logarithm of total government tax revenue, sourced from the same database. Foreign direct investment is measured as the ratio of net FDI inflows to GDP (World Bank data). Inflation is the annual growth rate of the consumer price index. Economic growth is the natural logarithm of real GDP (constant 2015 prices). Trade openness is the ratio of the sum of exports and imports to GDP, and government expenditure is the ratio of government spending to GDP. All remaining variables are obtained from the World Bank databases.

To examine asymmetric causality, the study employs the Hatemi-J (2012) asymmetric causality test. This test can be viewed as an extended version of the Toda-Yamamoto (1995) causality approach, which itself is a modified form of the Granger (1969) causality test. The procedure explicitly accounts for differential impacts of positive and negative shocks. Hatemi-J (2012) argues that economic agents in real-world settings respond differently to positive and negative shocks. In particular, financial market participants do not react symmetrically to random positive and negative shocks. Therefore, the effects of positive and negative shocks should be analyzed separately.

Consider two time series x and y, defined as:

$$x_t = x_{t-1} + \varepsilon_{1t} = x_0 + \sum_{t=1}^{T} \varepsilon_{1t}, y_t = y_{t-1} + \varepsilon_{2t} = y_0 + \sum_{t=1}^{T} \varepsilon_{2t} \qquad (2)$$

where x_0 and y_0 are initial values, and ε_{1t} and ε_{2t} are white noise error terms. The positive and negative shocks are decomposed as:

$$\varepsilon_{1i}^{+} = \max(\varepsilon_{1t}, 0), \varepsilon_{2i}^{+} = \max(\varepsilon_{2t}, 0), \varepsilon_{1i}^{-} = \min(\varepsilon_{1t}, 0), \varepsilon_{2i}^{-} = \min(\varepsilon_{2t}, 0) \qquad (3)$$

with $\varepsilon_{1t} = \varepsilon_{1i}^{+} + \varepsilon_{1i}^{-}$ and $\varepsilon_{2t} = \varepsilon_{2i}^{+} + \varepsilon_{2i}^{-}$. Equation (2) can thus be rewritten as:

$$x_t = x_0 + \sum_{t=1}^{T} \varepsilon_{1i}^{+} + \sum_{t=1}^{T} \varepsilon_{1i}^{-}, y_t = y_0 + \sum_{t=1}^{T} \varepsilon_{2i}^{+} + \sum_{t=1}^{T} \varepsilon_{2i}^{-} \quad (4)$$

The cumulative positive and negative shocks are defined as:

$$x_t^{+} = \sum_{t=1}^{T} \varepsilon_{1i}^{+}, x_t^{-} = \sum_{t=1}^{T} \varepsilon_{1i}^{-}, y_t^{+} = \sum_{t=1}^{T} \varepsilon_{2i}^{+}, y_t^{-} = \sum_{t=1}^{T} \varepsilon_{2i}^{-} \quad (5)$$

Asymmetric causality can be tested by examining positive and negative shocks separately.

In the second stage, conditional on the presence of asymmetric causality running from tax revenue to financial development, the Nonlinear Autoregressive Distributed Lag (NARDL) model developed by Shin et al. (2014) is employed. This approach is particularly suitable for capturing both short- and long-run asymmetries and allows for a combination of I(0) and I(1) variables. It also facilitates testing for cointegration and estimating both long-run equilibrium relationships and short-run asymmetric dynamics through an error correction mechanism (ECM).

The NARDL specification for financial development, based on the theoretical framework of Omodero and Iweha (2021) and adjusted according to Mohammadi et al. (2014), is formulated as:

$$\begin{aligned} FD_t = \beta_0 &+ \sum_{i=1}^{q} \alpha_i FD_{t-i} + \sum_{i=0}^{p1} \beta_{11i} TR_{t-i}^{+} + \sum_{i=0}^{p1} \beta_{2i} TR_{t-i}^{-} \\ &+ \sum_{i=0}^{p2} \beta_{2i} FDI_{t-i} + \sum_{i=0}^{p3} \beta_{3i} INF_{t-i} + \sum_{i=0}^{p4} \beta_{4i} GDP_{t-i} \\ &+ \sum_{i=0}^{p5} \beta_{5i} OP_{t-i} + \sum_{i=0}^{p6} \beta_{6i} GE_{t-i} \\ &+ \lambda_1 TR_{t-1} + \lambda_2 FDI_{t-1} + \lambda_3 INF_{t-1} + \lambda_4 GDP_{t-1} \\ &+ \lambda_5 OP_{t-1} + \lambda_6 GE_{t-1} + \varepsilon_t \end{aligned} \quad (6)$$

3. Findings and Results

Prior to estimating the financial development model, descriptive statistics for the variables are examined. Table 1 presents the mean, standard deviation, minimum, and maximum values of each variable.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
Financial Development	0.2898	0.0832	0.1665	0.5220
Tax Revenue (log)	13.0211	1.1736	11.0310	14.4803
Economic Growth (log)	0.1290	0.3667	-0.2295	2.0733
Trade Openness	19.7968	11.0013	1.6668	49.6559
FDI	11.1855	0.4103	10.0404	11.8089
Government Expenditure	43.3794	11.5284	14.1448	76.1156
Inflation	13.6134	1.4568	11.1602	16.2653

The average value of the financial development index in Iran is 0.2898, with the lowest value (0.1665) recorded in 1970 and the highest (0.5220) in 2021. The logarithm of government tax revenue averaged 13.0211 over 1970–2024, ranging from 11.0310 (1970) to 14.4803 (2009). Both financial development and tax revenue exhibit a generally upward trend with moderate fluctuations during the sample period.

Prior to conducting the asymmetric causality test and estimating the NARDL model, the stationarity properties of the variables are examined. Table 2 reports the results of the Augmented Dickey-Fuller (ADF) unit root test.

Table 2: Unit Root Test Results (ADF)

Variable	I(0) Statistic	p-value	I(1) Statistic	p-value
Financial Development	-3.506	0.0078	-	-
Tax Revenue	-3.909	0.0020	-	-
Economic Growth	-2.468	0.1233	-7.602	0.0000
Trade Openness	-2.003	0.2855	-2.907	0.0445
FDI	-4.413	0.0003	-	-
Government Expenditure	-4.744	0.0001	-	-
Inflation	-3.681	0.0044	-	-

All variables are either stationary at levels I(0) or become stationary after first differencing I(1). This mixed order of integration confirms the suitability of the NARDL approach.

Table 3 presents the results of the Toda-Yamamoto symmetric Granger causality test. Tax revenue Granger-causes financial development, while the reverse causality is not supported. Thus, a unidirectional causal relationship runs from tax revenue to financial development, consistent with findings such as Karaş and Saygili (2024).

Table 3: Symmetric Granger Causality Test Results

Null Hypothesis	Chi^2 Statistic	p-value
Financial development does not Granger-cause tax revenue	8.66	0.1236
Tax revenue does not Granger-cause financial development	9.37	0.0247

Table 4 reports the Hatemi-J (2012) asymmetric causality test results. The presence of asymmetric causality from tax revenue to financial development is confirmed in three out of four cases.

Table 4: Asymmetric Causality Test Results (Hatemi-J)

Null Hypothesis	Chi^2 Statistic	p-value
Positive shock in tax revenue does not cause positive shock in FD	14.96	0.0105
Negative shock in tax revenue does not cause positive shock in FD	5.93	0.0149
Positive shock in tax revenue does not cause negative shock in FD	4.35	0.0371
Negative shock in tax revenue does not cause negative shock in FD	8.42	0.0380

Given the confirmed asymmetric causality, the Nonlinear ARDL (NARDL) model is estimated. Table 5 presents the long-run and short-run coefficients of the ARDL(1,3,2,3,2,3,3) specification.

Table 5: Long-run and Short-run NARDL Estimation Results

Long-run Coefficients

Variable	Coefficient	Std. Error	p-value
Positive tax shock	-0.0310	0.0114	0.0124
Negative tax shock	0.0654	0.0334	0.0623
Economic Growth	0.0314	0.0169	0.0769
Trade Openness	-0.0001	0.0002	0.7025
FDI	0.0105	0.0113	0.3644
Government Expenditure	0.0597	0.0163	0.0013
Inflation	-0.0008	0.0003	0.0090
Error Correction Term	-0.5002	0.1335	0.0011
R^2	0.7687	-	-
F-statistic	2.8315	-	0.0067

Short-run Coefficients

Variable	Coefficient	Std. Error	p-value
Positive tax shock	0.0084	0.0252	0.7407
Positive tax shock (Lag 1)	0.0253	0.0283	0.3806
Positive tax shock (Lag 2)	0.0375	0.0312	0.2427
Negative tax shock	0.0099	0.0293	0.7378
Negative tax shock (Lag 1)	-0.0286	0.0313	0.3706
Negative tax shock (Lag 2)	-0.1102	0.0348	0.0043
Economic growth	0.0123	0.0222	0.5850
Economic growth (Lag 1)	-0.0530	0.0262	0.0547
Economic growth (Lag 2)	-0.0785	0.0224	0.0020
Trade openness	-0.0006	0.0003	0.0650
Trade openness (Lag 1)	0.0009	0.0003	0.0079
Trade openness (Lag 2)	-0.0005	0.0002	0.0714
Foreign direct investment (FDI)	-0.0120	0.0076	0.1287
Foreign direct investment (FDI, Lag 1)	-0.0213	0.0057	0.0012
Government expenditure	0.0392	0.0166	0.0275
Government expenditure (Lag 1)	-0.1131	0.0317	0.0017
Government expenditure (Lag 2)	-0.0328	0.0314	0.3063
Inflation	-0.0006	0.0002	0.0072
Inflation (Lag 1)	0.0003	0.0002	0.1237

The results indicate that a positive shock in tax revenue has a negative and significant long-run effect on financial development, whereas a negative shock exerts a positive and significant effect. The magnitude of the negative shock is approximately twice that of the positive shock, confirming strong asymmetry. This inverse relationship aligns with endogenous growth theory (Lucas, 1990), demand-following theory (Robinson, 1952), and prior empirical studies (Taha et al., 2013; Akram, 2016). The underlying mechanism is that higher tax revenue reduces corporate profitability and private investment incentives, lowers the marginal productivity of capital, and weakens economic growth, ultimately reducing demand for financial services.

Economic growth and government expenditure exert positive and significant long-run effects on financial development, consistent with demand-following theory and Keynesian perspectives. Inflation has a negative and significant impact, supporting findings by Boyd et al. (2001) and Huybens and Smith (1998). The effects of FDI and trade openness are statistically insignificant in the long run.

The error correction term (-0.5002) is negative and highly significant, indicating that approximately 50% of short-run disequilibria are corrected within one period. The high R^2, significant F-statistic, and negative ECT confirm the model's validity and stability.

In the short run, tax shocks are insignificant, suggesting that the impact of taxation on financial development materializes primarily in the long run. Several lagged terms of economic growth, trade openness, FDI, and government expenditure are statistically significant.

Table 6 reports the Wald test for coefficient symmetry. The null hypothesis of symmetry is rejected in both long-run and short-run horizons, confirming the asymmetric nature of tax revenue shocks on financial development.

Table 6: Wald Test for Asymmetry

Model	F-statistic	p-value
Long-run	5.6890	0.0257
Short-run	4.9873	0.0356
Combined (long & short)	3.4833	0.0477

The ARDL bounds test (Table 7) yields an F-statistic of 5.402, which exceeds the upper bound critical value at the 1% significance level, confirming the existence of a stable long-run cointegrating relationship.

Table 7: ARDL Bounds Test

Significance	I(0)	I(1)
1%	2.099	3.181
5%	2.457	3.650
10%	3.282	4.730
F-statistic	5.402	

The Breusch-Godfrey test (Table 8) fails to reject the null of no serial correlation. The Breusch-Pagan test (Table 9) indicates homoscedasticity. The Jarque-Bera test (Table 10) confirms that residuals are normally distributed.

Table 8: Breusch-Godfrey Serial Correlation Test

F-statistic	p-value
0.5699	0.4583

Table 9: Heteroskedasticity Test (Breusch-Pagan)

F-statistic	p-value
1.0086	0.4958

Table 10: Jarque-Bera Normality Test

Model	JB Statistic	p-value
Long-run	0.9089	0.6347

Finally, the CUSUM plot (Figure 1) lies within the 5% critical bounds, indicating parameter stability and no structural breaks over the sample period.

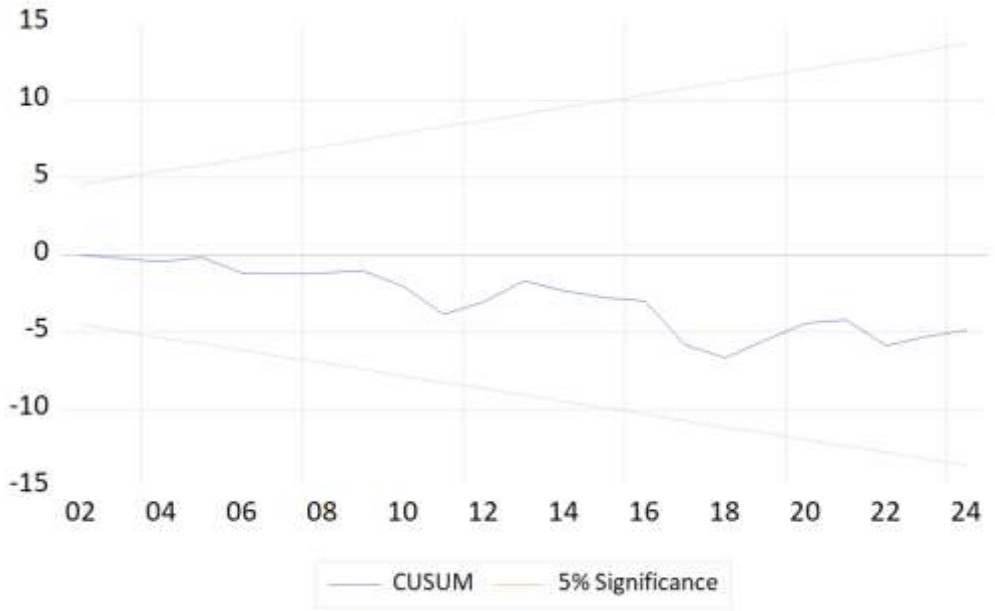

Figure 1: CUSUM plot

4. Discussion and Conclusion

The present study investigated the nonlinear asymmetric effects of tax revenues on financial development in Iran during the period 1970–2024 using the Hatemi-J asymmetric causality test and the Nonlinear Autoregressive Distributed Lag (NARDL) approach. The findings revealed the existence of a unidirectional asymmetric causal relationship running from tax revenue to financial development. More specifically, positive shocks in tax revenues exerted a negative and statistically significant long-run effect on financial development, whereas negative tax shocks produced a positive effect. The results also demonstrated that economic growth and government expenditure positively influence financial development, while inflation negatively affects it. Furthermore, the Wald tests confirmed the existence of both short-run and long-run asymmetries, indicating that positive and negative changes in tax revenue do not affect financial development uniformly. These findings contribute to the growing literature emphasizing the nonlinear and asymmetric nature of fiscal-financial relationships in developing economies [19, 20, 27].

One of the most important findings of this study is the confirmation of asymmetric causality from tax revenue to financial development. The Hatemi-J causality results indicated that positive and negative shocks in tax revenues generate significantly different responses in the financial system. This finding is highly consistent with the theoretical arguments advanced by Hatemi-J [20], who emphasized that economic agents react differently to favorable and unfavorable shocks because of uncertainty, adjustment costs, institutional rigidities, and behavioral considerations. In financial markets, asymmetric responses are particularly common because investors, banks, and firms tend to adjust their expectations and portfolio decisions differently under expansionary and contractionary fiscal conditions. Therefore, the observed asymmetry in the Iranian economy reflects the sensitivity of financial markets to changes in fiscal conditions and government revenue structures.

The finding that positive tax shocks negatively affect financial development in the long run can be explained through several theoretical channels. From the perspective of endogenous growth theory, increases in taxation may reduce private sector profitability, weaken incentives for investment, and lower capital accumulation, thereby reducing the demand for financial intermediation and financial services [4]. Higher taxes can diminish firms' retained earnings and discourage entrepreneurial activities, resulting in lower borrowing, reduced stock market participation, and slower financial deepening. This interpretation is strongly aligned with the arguments proposed by Akram [5], who emphasized that taxation influences financial development through its effects on the profitability of loans, securities, and corporate financial activities.

The negative effect of positive tax shocks on financial development is also consistent with the demand-following hypothesis. According to this theory, financial development emerges as a consequence of increased economic activity and higher demand for financial services. If higher taxes reduce production incentives and suppress private investment, the resulting slowdown in economic activity reduces demand for banking services, credit facilities, and capital market instruments [2, 3]. In developing economies such as Iran, where the private sector already faces structural challenges and financing constraints, increased tax pressure may further weaken private sector participation in financial markets. Consequently, positive tax shocks may ultimately constrain financial sector expansion.

Another possible explanation relates to the structure of Iran's fiscal system and institutional environment. In economies heavily dependent on government revenues and public sector dominance, increases in tax revenues may strengthen government intervention in financial markets and crowd out private investment activities.

Expansionary fiscal interventions financed through taxation can reduce liquidity available to the private sector and weaken the role of market-based financial intermediation. This interpretation is partially supported by Shetta and Kamaly [14], who argued that increased government involvement may crowd out private credit and reduce private sector participation in financial systems.

Conversely, the results demonstrated that negative tax shocks exert a positive impact on financial development. This finding suggests that reductions in tax burdens may stimulate private sector activity, increase corporate profitability, and improve investment incentives. Lower taxes enhance disposable income and increase liquidity within the private sector, which may encourage greater use of financial services, banking facilities, and capital market instruments. In this context, tax reductions can promote financial deepening by stimulating economic activity and improving private sector confidence. This interpretation is consistent with the findings of Karaş and Saygili [8], who highlighted the significant role of tax structures in shaping financial development dynamics.

The asymmetric nature of the results further indicates that financial systems respond more strongly to tax reductions than to tax increases. The larger magnitude associated with negative tax shocks implies that tax relief policies may produce stronger stimulative effects on financial markets than the contractionary effects generated by tax increases. Such asymmetry may arise because economic agents react more rapidly to improved profitability and liquidity conditions than to gradual fiscal tightening measures. Moreover, in economies characterized by uncertainty and inflationary pressures, private investors may interpret tax reductions as positive signals regarding future economic conditions and government support for private sector development.

The findings of the present study are also broadly consistent with previous empirical literature examining the relationship between taxation and financial development. Omodero and Iyoha [7] reported a positive association between financial development and tax revenues in emerging markets, emphasizing the importance of efficient fiscal systems in promoting financial sector growth. Similarly, Okon [17] demonstrated that financial sector development contributes significantly to tax revenue generation in Nigeria. While these studies primarily identified positive linear relationships, the present study extends the literature by revealing that the relationship is asymmetric and nonlinear in the Iranian context.

The findings also align with the results reported by Tsaurai [18], who found significant interactions between tax revenue and financial development in emerging markets using nonlinear estimation techniques. Likewise, Cilek [19] demonstrated the presence of asymmetric causality between tax revenues and financial development in Türkiye using the Hatemi-J methodology. These similarities suggest that asymmetric fiscal-financial relationships may be a common feature among developing and emerging economies characterized by institutional imperfections, macroeconomic volatility, and structural rigidities.

The present study further found that economic growth exerts a positive and statistically significant effect on financial development. This result strongly supports the demand-following hypothesis proposed by Robinson and later expanded in financial development literature [1, 2]. Economic growth increases production, trade, investment, and household income, thereby generating greater demand for financial services and instruments. Expanding economic activity encourages banks and financial institutions to increase lending, improve financial products, and deepen financial intermediation processes. This finding is consistent with the results of Shams Gharaneh et al. [25], who found that economic growth positively influences financial development across developed and developing economies.

The positive role of economic growth can also be interpreted through endogenous growth frameworks. Higher economic growth improves savings rates, capital accumulation, and investment opportunities, thereby

strengthening the financial sector's ability to mobilize and allocate resources efficiently [3, 4]. In the Iranian economy, where financial institutions often face resource allocation inefficiencies, economic expansion may improve liquidity conditions and stimulate financial market participation.

Another important finding concerns the positive effect of government expenditure on financial development. This result supports Keynesian perspectives emphasizing the constructive role of government intervention in promoting economic and financial development. Government expenditure on infrastructure, transportation, education, healthcare, and institutional reforms can reduce transaction costs, improve market efficiency, and create favorable conditions for financial market expansion [10, 11]. Productive public expenditure may also enhance investor confidence and stimulate private investment, thereby increasing demand for financial services.

The positive relationship between government expenditure and financial development observed in this study is also consistent with the findings of Kagochi [28] and Afonso et al. [10], who argued that public expenditure and government debt markets can contribute to financial infrastructure development. Government securities markets often provide benchmark interest rates, improve liquidity, and facilitate the development of broader financial instruments. In developing economies such as Iran, where financial markets are still evolving, public sector investment may play an especially important role in supporting financial market expansion.

However, the results contrast with studies emphasizing crowding-out effects associated with government spending [14]. This discrepancy may reflect differences in institutional structures, fiscal management quality, and economic conditions across countries. In Iran, government expenditure may have contributed positively to financial development because of the state's central role in infrastructure financing and economic coordination. Nevertheless, the long-term effectiveness of such spending depends critically on expenditure efficiency, transparency, and macroeconomic discipline.

The negative and statistically significant effect of inflation on financial development constitutes another important finding of the study. Inflation undermines financial sector performance by reducing the real returns on financial assets, increasing uncertainty, weakening savings incentives, and distorting credit allocation mechanisms. High inflation also reduces the efficiency of financial intermediation because lenders and investors become reluctant to engage in long-term financial contracts under unstable price conditions [12]. Consequently, inflation discourages financial deepening and limits financial market development.

This result is highly consistent with previous theoretical and empirical studies. Boyd et al. [13] demonstrated that inflation negatively affects financial market performance and banking sector efficiency. Huybens and Smith [12] similarly argued that inflation intensifies financial market frictions and reduces capital accumulation. Salimifar et al. [21] also found that inflation adversely affects financial market performance in Iran. Given Iran's historical experience with inflationary pressures and macroeconomic instability, the negative impact of inflation on financial development observed in this study is both theoretically and empirically plausible.

The insignificance of trade openness and foreign direct investment in the long run suggests that external sector variables may play a more limited role in shaping financial development in Iran compared to domestic fiscal and macroeconomic factors. Structural sanctions, institutional barriers, financial restrictions, and limitations in international integration may have reduced the effectiveness of external economic channels in promoting financial deepening. Although trade openness and FDI are often considered important drivers of financial development in open economies [15, 16], their influence may remain constrained in economies facing persistent geopolitical and institutional challenges.

The significant and negative error correction term further confirms the existence of a stable long-run equilibrium relationship among the variables. The estimated coefficient indicates that approximately half of short-run disequilibria are corrected within each period, suggesting a relatively moderate speed of adjustment toward long-run equilibrium. This finding highlights the stability of the estimated NARDL model and confirms the appropriateness of incorporating asymmetric dynamics into the analysis.

Overall, the findings of this study underscore the importance of considering nonlinear and asymmetric fiscal-financial relationships in developing economies. The results demonstrate that tax policy can exert substantial but asymmetric effects on financial development depending on the direction of fiscal shocks. Consequently, policymakers should avoid assuming that increases and decreases in taxation generate symmetric outcomes. Instead, fiscal policy design should carefully account for the differential responses of financial markets to positive and negative tax changes. The findings also emphasize the importance of maintaining macroeconomic stability, promoting economic growth, and controlling inflation to support sustainable financial development in Iran [1-30].

One limitation of the present study is that the analysis focused exclusively on aggregate tax revenues rather than distinguishing between different types of taxation such as direct taxes, indirect taxes, corporate taxes, and consumption taxes. Different tax categories may exert heterogeneous effects on financial development due to their distinct impacts on investment behavior, savings decisions, and financial market participation. Additionally, the study examined only the Iranian economy, which may limit the generalizability of the findings to other developing or emerging economies with different institutional and macroeconomic conditions. Another limitation concerns the availability and quality of long-term macroeconomic data for the period 1970–2024, particularly during periods characterized by structural changes, sanctions, and economic instability.

Future research could extend the present analysis by examining the asymmetric effects of different tax components separately and comparing their impacts on various dimensions of financial development, including banking sector development, stock market capitalization, and financial inclusion. Comparative cross-country studies among oil-exporting and non-oil-exporting economies could also provide valuable insights into the role of institutional structures and fiscal dependence in shaping financial development. Moreover, future studies may incorporate additional variables such as institutional quality, political stability, exchange rate volatility, and monetary policy indicators to develop more comprehensive models of financial development dynamics. The application of alternative nonlinear econometric approaches and regime-switching models may further improve understanding of asymmetric fiscal-financial relationships.

From a practical perspective, the findings suggest that policymakers should adopt balanced and growth-oriented tax policies that minimize adverse effects on private sector activity and financial market development. Improving tax system efficiency, reducing excessive tax burdens on productive sectors, and expanding tax bases without discouraging investment may contribute positively to financial deepening. Maintaining macroeconomic stability and controlling inflation should also remain central policy priorities because inflation significantly undermines financial sector performance. Furthermore, directing government expenditures toward productive infrastructure, institutional reforms, and financial market modernization can strengthen the foundations of sustainable financial development. Finally, enhancing transparency, improving institutional quality, and increasing investor confidence are essential for promoting long-term financial sector resilience and economic growth.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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