

The Effects of Culture, Economic Freedom, and Oil Price Volatility Spillover on Tax Avoidance in Iran, Considering the Threshold Role of Government Governance Quality

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ABSTRACT

Taxation is the most acceptable and appropriate instrument for financing government revenues from an economic perspective. In many countries, tax revenues are more important than other major sources of public income. Moreover, taxation serves as an effective tool for implementing economic policies, including distributive and fiscal policies, as well as guiding the economy toward macroeconomic objectives such as economic stabilization, employment generation, economic growth, and the improvement of social welfare. In other words, comparison of this important revenue source with alternative sources indicates that the greater the share of taxes in financing government expenditures, the lower the adverse economic consequences. For this reason, unlike developing countries, taxes play a highly significant role in financing government expenditures in developed economies, where the majority of public spending is financed through tax revenues. This study investigates the effects of culture, economic freedom, and oil volatility spillovers on tax avoidance in Iran, considering the threshold role of government governance quality. From the perspective of purpose, the study is applied research, and in terms of nature, it is a descriptive-analytical study classified as ex post facto research. The research model was specified as a time-series model for Iran covering the period from 1991 to 2024 and was estimated using the Logistic Smooth Transition Regression (LSTR) approach. Based on the results of the linearity test, government governance quality was selected as the transition variable. The estimation results of the nonlinear component of the model (the second regime) indicate a negative relationship between the culture index, economic freedom, and governance quality with the tax avoidance index. Furthermore, the oil volatility spillover variable has a positive and statistically significant effect on tax avoidance at the 95% confidence level.

Keywords: Culture Index; Economic Freedom; Oil Volatility Spillovers; Tax Avoidance in Iran; Government Governance Quality.

Introduction

Tax avoidance has become one of the central challenges of fiscal governance, especially in economies where public finance depends simultaneously on tax revenues, natural-resource income, and institutional capacity. In contemporary economic management, taxation is not merely a mechanism for collecting government revenue; it is also a policy instrument for redistribution, stabilization, investment guidance, public service provision, and strengthening the accountability relationship between citizens and the state. When tax avoidance expands, this relationship weakens because individuals and firms reduce their tax liabilities through legal or quasi-legal strategies



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that exploit weaknesses, ambiguities, or loopholes in the tax system. Although tax avoidance is usually distinguished from tax evasion because it may occur within the formal boundaries of law, its macroeconomic and managerial consequences can be similarly damaging. It reduces the effective tax base, undermines fiscal sustainability, distorts investment decisions, creates inequity among taxpayers, and limits the government's capacity to finance development priorities. In countries such as Iran, where oil revenues have historically played a major role in government finance, tax avoidance becomes even more important because dependence on resource income can weaken incentives for both tax compliance and tax administration reform. Therefore, examining the determinants of tax avoidance in Iran requires attention not only to firm-level financial behavior but also to cultural, institutional, macroeconomic, and resource-based factors.

The literature on tax avoidance has increasingly emphasized that firms' tax behavior is shaped by strategic financial motivations, governance structures, audit mechanisms, reputational concerns, and investment incentives. Tax avoidance may be used by firms to increase internal resources, improve short-term liquidity, or influence reported financial outcomes, but it can also generate agency problems and reputational risks. Alavian's study on the relationship between tax avoidance and investment efficiency indicates that tax avoidance cannot be analyzed separately from firms' investment behavior, because reducing tax payments may provide additional financial resources while also creating distortions in managerial decision-making and capital allocation (1). Similarly, Moradi's work on tax avoidance motivations, stakeholder power, and reputation risk shows that tax avoidance is not only a technical accounting decision but also a strategic managerial behavior influenced by external pressure, stakeholder expectations, and the potential cost of reputational damage (2). This perspective is important for the present study because tax avoidance in Iran is shaped by both economic incentives and the broader institutional environment in which firms operate.

Audit quality and reporting processes are also central to understanding tax avoidance. When audit quality is weak or when firms can delay or obscure reporting information, opportunities for aggressive tax planning may increase. Hooshyareh's study on tax avoidance, audit quality, and financial performance among firms listed on the Tehran Stock Exchange highlights the relevance of monitoring mechanisms in limiting opportunistic behavior and improving the reliability of financial outcomes (3). In a related line of inquiry, Alipour, Azimi, and Talebalelm examine the effect of tax avoidance on audit report lag while considering the moderating role of auditor size, suggesting that tax avoidance may complicate the audit process and increase the time required for auditors to issue reports, especially when tax strategies are complex or opaque (4). These findings imply that tax avoidance is closely related to transparency, disclosure quality, and institutional oversight, all of which are connected to the broader concept of governance quality.

In oil-based economies, however, tax avoidance cannot be fully explained by firm-level behavior alone. Oil revenues affect fiscal policy, public expenditure, exchange-rate conditions, investment cycles, and expectations about the government's need for taxation. Oil price fluctuations may increase uncertainty in government revenues and create volatility in economic planning. Parsafard and Sheikhi's research on the effect of oil price fluctuations and stock returns on corporate investment shows that oil price instability can influence corporate investment behavior and create uncertainty in financial decision-making (5). Moradkhani's work on financial risk management in petrochemical industry development projects also emphasizes the importance of hedging models against currency and oil price volatility, indicating that oil-related uncertainty can significantly affect large-scale economic

projects and financial planning (6). These studies support the argument that oil volatility spillovers may influence tax behavior by affecting corporate profitability, investment expectations, liquidity, and government fiscal pressure.

The Iranian economy provides a particularly important context for this issue because the oil and gas sector has historically shaped the structure of public finance, development planning, and macroeconomic policy. Mohammadian and Heshmati's study on sustainable development in Iran's oil and gas sector identifies integrated economic, environmental, and social challenges in this sector and emphasizes that sustainable development requires coordinated institutional and policy solutions (7). In such a setting, fluctuations in oil revenue may weaken the stability of fiscal planning and alter the relationship between taxpayers and the state. When oil revenues are high, governments may feel less pressure to broaden the tax base or improve tax enforcement. When oil revenues fall or become volatile, governments may attempt to increase tax collection, but taxpayers may resist if institutional trust, transparency, and service delivery are weak. Therefore, oil volatility spillovers may increase tax avoidance both directly, through economic uncertainty, and indirectly, through their effects on governance, public expectations, and fiscal policy.

Culture is another key factor in tax avoidance. Tax behavior is embedded in social norms, civic values, perceptions of fairness, and trust in public institutions. A society in which taxation is perceived as legitimate, fair, and connected to public welfare is likely to experience greater tax compliance. Conversely, when citizens and firms perceive taxation as unfair, inefficient, or disconnected from public benefit, avoidance behavior may become more socially tolerated. Cultural indicators such as education, media participation, cultural consumption, and access to information can affect citizens' understanding of taxation and their willingness to participate in collective financing. In the present study, culture is conceptualized through indicators such as employed labor force, university education, cinema capacity use, and the number of publications and periodicals. These indicators reflect broader dimensions of social participation, awareness, information circulation, and civic development. From a management perspective, cultural capacity can influence the quality of economic behavior because informed and socially engaged citizens may be more likely to evaluate the legitimacy of fiscal policies and respond to institutional incentives.

The role of culture in economic behavior can also be understood through the broader literature on governance, development, and resource management. Although several of the supplied references focus on forest governance and bioeconomy rather than taxation, they are useful because they show how cultural, institutional, and local governance conditions shape economic outcomes in resource-dependent systems. Arts, Brockhaus, Giessen, and McDermott examine global forest governance from three contrasting perspectives and show that governance performance depends on institutional design, actor coordination, legitimacy, and the ability to translate policy goals into practical outcomes (8). This insight is relevant to tax governance because tax systems also require legitimacy, coordination, compliance mechanisms, and public trust. Similarly, Rosenfeld, Pokorny, Marcovitch, and Poschen's systematic review of non-timber forest product-based bioeconomy in the Brazilian Amazon shows that development strategies based on natural resources may remain underutilized or become ineffective when institutional and market conditions are weak (9). In the context of Iran, this supports the idea that natural-resource wealth alone cannot ensure sustainable development unless it is accompanied by effective institutions and accountable governance.

Economic freedom is also an important determinant of tax avoidance. Economic freedom generally refers to the degree to which individuals and firms can engage in economic activity through secure property rights, regulatory transparency, open trade, monetary stability, and limited arbitrary intervention. Higher economic freedom may

reduce tax avoidance by increasing transparency, formalization, predictability, and trust in the economic system. However, if economic freedom is not accompanied by strong governance, it may also create opportunities for aggressive tax planning, capital shifting, and regulatory arbitrage. Therefore, its effect on tax avoidance is likely to be conditional rather than uniform. The Iranian context is characterized by regulatory complexity, state intervention, sanctions-related constraints, oil dependence, and institutional limitations, making the relationship between economic freedom and tax avoidance especially dependent on governance quality.

The broader resource-governance literature supports the importance of examining economic freedom and governance together. Smith-Hall, Piplani, and Pyakurel theorize forest-based bioeconomy through a global production network lens and show that economic outcomes are shaped by the interaction of local production systems, governance arrangements, market structures, and global value chains (10). Tahvanainen and colleagues, in their study of the growing pulp industry in Uruguay, demonstrate that local regime actors' perspectives influence industrial development pathways and reveal how institutional lock-in and sectoral dependence can shape economic transformation (11). Sinaga's decolonial feminist analysis of land relations in Indonesian oil palm plantations further shows that economic production systems are inseparable from power relations, institutional arrangements, and social inequalities (12). These studies collectively reinforce the argument that economic behavior in resource-related contexts must be analyzed through the interaction of markets, governance, power, and institutional quality.

Governance quality is therefore a central variable in explaining tax avoidance. Governance quality includes transparency, accountability, rule of law, regulatory effectiveness, control of corruption, and the ability of public institutions to implement policies fairly and efficiently. In the context of taxation, good governance can reduce avoidance by limiting loopholes, strengthening enforcement, improving taxpayer trust, increasing public-sector accountability, and ensuring that tax revenues are visibly converted into public goods. Poor governance, by contrast, can increase tax avoidance by weakening trust, encouraging rent-seeking, reducing compliance norms, and allowing unequal enforcement. For this reason, governance quality may not only have a direct effect on tax avoidance but may also act as a threshold variable that changes the magnitude and direction of the effects of culture, economic freedom, and oil volatility spillovers.

The threshold role of governance quality is particularly important because the effects of economic and cultural variables are unlikely to be linear across all institutional conditions. At low levels of governance quality, improvements in culture or economic freedom may not substantially reduce tax avoidance because institutional trust and enforcement remain weak. Similarly, oil volatility may have stronger negative consequences when governance quality is low because governments may lack the capacity to manage fiscal shocks effectively. At higher levels of governance quality, however, cultural development and economic freedom may be more likely to support tax compliance, while oil volatility may be better managed through transparent fiscal rules, stabilization mechanisms, and stronger public accountability. Thus, the LSTR approach used in this study is appropriate because it allows the relationship between explanatory variables and tax avoidance to change across regimes depending on the level of governance quality.

The inclusion of oil volatility spillovers also reflects the need to connect tax avoidance with macroeconomic instability. In oil-exporting economies, oil shocks may affect fiscal deficits, inflation, exchange rates, investment behavior, and corporate earnings. These changes may alter both the ability and willingness of firms to pay taxes. When uncertainty increases, firms may seek to preserve liquidity by reducing tax liabilities. When government revenue becomes unstable, tax authorities may increase pressure on taxpayers, potentially encouraging more

complex avoidance behavior. The studies by Parsafard and Sheikhi and Moradkhani support this macro-financial perspective by showing that oil price fluctuations and oil-related risks influence corporate investment and financial risk management in Iran's economic environment (5, 6). Accordingly, oil volatility spillovers should be considered not merely as an external shock but as a structural factor that interacts with institutional quality and tax behavior.

The management implications of this issue are broad. For policymakers, reducing tax avoidance requires more than stricter tax rules; it requires strengthening governance quality, improving transparency, simplifying regulations, increasing economic predictability, and building a culture of fiscal responsibility. For firms, tax avoidance may create short-term financial advantages, but it can also increase audit risk, reputational exposure, reporting delays, and stakeholder distrust (2, 4). For the national economy, widespread tax avoidance weakens the ability of the government to reduce dependence on oil revenues and move toward sustainable public finance. This is especially important in Iran's oil and gas sector, where sustainable development requires integrated economic, environmental, and social solutions (7). Even studies outside the direct field of taxation, such as Martviset et al.'s biomedical research, illustrate the broader scientific principle that complex outcomes often result from the interaction of multiple biological, institutional, or environmental mechanisms rather than a single isolated factor; by analogy, tax avoidance must also be understood as a multidimensional phenomenon shaped by interacting cultural, economic, volatility-related, and governance-related mechanisms (13).

Overall, the theoretical and empirical background suggests that tax avoidance in Iran is the result of a complex interaction among cultural development, economic freedom, oil volatility spillovers, and governance quality. Firm-level studies emphasize the importance of investment efficiency, audit quality, financial performance, auditor size, stakeholder power, and reputation risk in shaping tax avoidance behavior (1-4). Oil-related studies highlight the significance of oil price fluctuations, stock returns, petrochemical risk management, and sustainable development in the oil and gas sector (5-7). Governance and bioeconomy studies further demonstrate that resource-dependent development outcomes are shaped by institutional performance, actor networks, power relations, and governance capacity (8-12). Therefore, the present study is positioned at the intersection of tax management, institutional economics, resource-based macroeconomic volatility, and governance analysis.

The aim of this study is to investigate the effects of culture, economic freedom, and oil volatility spillovers on tax avoidance in Iran during 1991–2024, with emphasis on the threshold role of government governance quality.

Methods and Materials

From the perspective of purpose, the present study is applied research, and in terms of nature, it is descriptive-analytical. It is also classified as ex post facto research. The objective of this article is to examine the effects of culture, economic freedom, and oil volatility spillovers on tax avoidance in Iran, considering the threshold role of government governance quality. The research model was specified as a time-series model for Iran over the period from 1991 to 2024 and was estimated using the Logistic Smooth Transition Regression (LSTR) approach. In this study, following Senouris (2024), Alam et al. (2023), and Mazaheri (2017), the model of the present study is specified as follows:

$$SHADO_t = \alpha_0 + \beta_1 L_t + \beta_2 H_t + \beta_3 CI_t + \beta_4 M_t + \beta_5 FREED_t + \beta_6 GS_t + \beta_7 PF_t + (\theta_1 L_t + \theta_2 H_t + \theta_3 CI_t + \theta_4 M_t + \theta_5 FREED_t + \theta_6 GS_t + \theta_7 PF_t)F(S_t, \gamma, c) + u_t$$

where the transition function F is as follows:

$$F(S_t, \gamma, c) = (1 + \exp\{-\gamma(s_t - c)\})^{-1}, \gamma > 0$$

To examine the characteristics of the LSTR model with a logistic transition function based on the model of Van Dijk (1999), it is assumed that the dependent variable *SHADO* is only a function of its own lagged values. Accordingly, assuming a two-regime transition function, the following relationship is obtained:

$$SHADO_t = (\theta_0 + \theta_1 SHADO_{t-1} + \dots + \theta_p SHADO_{t-p}) + (\phi_0 + \phi_1 SHADO_{t-1} + \dots + \phi_p SHADO_{t-p}) G(GS_t, \gamma, c) + u_t$$

$$G(GS_t, \gamma, c) = \frac{1}{1 + \exp\{-\gamma(GS_t - c)\}}$$

The results of this model are referred to as a two-regime LSTR model, in which the location parameter *c* indicates the transition point between the two limiting regimes $G(SHADO_t, \gamma, c) = 0$ and $G(SHADO_t, \gamma, c) = 1$, where $G(SHADO_t, \gamma, c) = 0.5$. The parameter γ represents the speed of transition between regimes, and higher values of γ indicate a faster regime shift.

Dependent variable: tax avoidance

Due to the difficulty of accessing tax avoidance data, many researchers have used different methods to calculate it, some of which estimate tax avoidance and tax evasion directly, while others do so indirectly. In the present study, the Tanzi monetary demand approach is used to estimate the volume of tax avoidance and tax evasion. According to Tanzi's idea in the monetary approach, the basic assumption is that in the informal economy, all transactions are conducted in cash in order to remain hidden. Therefore, to estimate the size of the informal economy using this approach and based on the autoregressive distributed lag approach, the ratio of cash to liquidity is estimated in the presence of the tax burden variable through Equation (1):

$$\left(\frac{C}{M_2}\right)_t = \beta_0 + \beta_1 TaxBar_t + \beta_2 RGDPG_t + \epsilon_t$$

where (C/M_2) is the ratio of currency in circulation to the volume of liquidity and is considered the dependent variable. *TaxBar* denotes the tax burden and is equal to the ratio of total tax revenues to gross domestic product. *RGDPG* represents economic growth. After estimating the ratio of cash to liquidity $(C/M_2)_t$, without changing the coefficients of the regression model, the coefficient of the tax burden variable is set equal to zero, and the ratio of cash to liquidity in the absence of tax burden $(C/M_2)_{WTAX}$ is calculated. In the next step, illegal money (*IM*) is obtained by multiplying the difference between the two above ratios by the volume of liquidity, based on Equation (2):

$$IM = \left[\left(\frac{C}{M_2}\right)_{TAX} - \left(\frac{C}{M_2}\right)_{WTAX} \right] \times M_2$$

Then, by subtracting the obtained result from the volume of money (M_2), legal money (*LM*) is obtained, and using Equation (3), the velocity of money circulation is calculated according to the quantity theory of money:

$$V = \frac{GNP}{LM}$$

Subsequently, assuming that the velocity of money circulation is equal in the formal and informal sectors of the economy, the volume of tax avoidance and tax evasion (*Shado*) is estimated by multiplying the volume of money in the informal economy, namely illegal money, by the velocity of money circulation, based on Equation (4):

$$Shado = IM \times V$$

Explanatory variables:

Culture:

The following variables are used to measure culture.

L: employed labor force: the employed labor force refers to all employed individuals aged 10 years and above.

H: university education level, as a cultural index.

CI: the rate of use of cinema capacity, considered as the cinema index, as a cultural index.

M: the number of published journals and newspapers per one million people, as a cultural index.

Economic freedom:

Economic freedom, or the right to economic freedom, indicates the ability of members of a society to engage in economic actions. This term is used in economics, policy debates, and the philosophy of political economy. Similar to freedom itself, there are multiple definitions of economic freedom, but there is no single universally accepted definition. The Fraser economic freedom index is a weighted index composed of five indicators: size of government; legal structure and security of property rights; access to sound money; freedom of international trade; and regulation of credit, labor, and business.

$$Freed_{i,t}$$

is the index used to measure economic freedom. To calculate it, the “Gwartney” index is used, which includes economic quantities within five major variables: size of government, property rights, monetary stability, foreign trade, which includes the subcomponents of duties on foreign trade, legal barriers to trade, the real size of the trade sector, the difference between the official and black-market exchange rates, control over the international capital market, and bureaucracy. The range of variation for each of these variables is between zero and 10, where a lower value indicates lower economic freedom and a higher value indicates greater economic freedom.

Oil price volatility spillovers (*PF*): the ARCH-GARCH method is used to calculate oil price volatility.

Governance quality:

GS: average governance quality index. To measure governance quality, five different groups or subindices are combined: (1) size of government, (2) legal system and property rights, (3) accountability and transparency, (4) freedom of international trade, and (5) regulation of credit, labor, and business. The main components exist within these five areas, and these components include subcomponents that lead to the overall index of the independent variables. The Fraser Institute uses a scale for each category and calculates the average of these five indicators to obtain a complete index for each country. In this index, zero represents the lowest governance value, while 10 represents the highest governance quality.

Findings and Results

First, oil price volatility spillovers are measured using ARCH and GARCH models.

Measurement of oil price volatility spillovers:

To calculate oil price volatility spillovers in accordance with the existing literature on volatility models, oil prices must first be modeled using ARMA models, and the lags related to oil prices must be identified. For this purpose, the Box-Jenkins methodology was used, and the result obtained from oil price modeling is shown in the following table.

Table 1. Estimation of the oil price model

Variable	Coefficient	Standard Error	Z-Statistic	Probability Value
AR(1)	1.003883	0.000469	2142.666	0.0000
MA(1)	-0.113128	0.031363	-3.607082	0.0003

Based on the above model, oil price is related to its value one period earlier through $AR(1)$ and to its disturbance term one period earlier through $MA(1)$.

ARCH test:

To examine the existence of conditional heteroskedasticity in oil prices, the ARCH test must be used. The result of this test is presented in Table 2.

Table 2. ARCH test

Heteroskedasticity Test: ARCH	Value	Probability
F-statistic	3.198927	Prob. F(1,33) = 0.0277
Obs*R-squared	3.210755	Prob. Chi-Square(1) = 0.0271

According to the obtained probability value, the null hypothesis of no conditional heteroskedasticity in oil prices is rejected. Therefore, oil prices exhibit conditional heteroskedasticity.

Finally, to obtain oil price volatility spillovers, the EGARCH model proposed by Nelson (1991) is used. One of the important limitations of the ARCH and GARCH methods concerns their symmetry; that is, the effects of negative and positive shocks of the same magnitude on volatility are assumed to be equal, whereas volatility in the government debt ratio does not respond equally to the type of news, namely negative and positive shocks. Therefore, to overcome this problem and analyze the volatility behavior of the series, it is necessary to use an asymmetric model (Verbeek, 2005).

$$\ln \sigma_t^2 = \alpha_0 + \alpha_1 \frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} + \beta \ln \sigma_{t-1}^2 + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}}, \alpha_0 = \omega - \alpha \sqrt{\frac{2}{\pi}}, \alpha_1 = \alpha$$

This model has several advantages. First, in this model, the dependent variable, namely σ_t^2 , is expressed logarithmically; therefore, the coefficients of the right-hand-side variables can be positive or negative, while σ_t^2 remains positive in either case. Thus, there is no need to impose non-negativity restrictions on the coefficients. Second, this model also accounts for the effect of asymmetric shocks, because γ is the coefficient of u_{t-1} , and u_{t-1} can be positive or negative. The parameter γ represents the effect of positive and negative shocks, while α is the coefficient that only considers the absolute value $|u_{t-1}|$. If $\gamma = 0$, the model is symmetric; otherwise, it is asymmetric. The effect of positive shocks is equal to $\alpha + \gamma$, and the effect of negative shocks is equal to $\alpha - \gamma$. If γ is negative, it indicates that the effect of negative shocks is greater than the effect of positive shocks, and vice versa.

Table 3. EGARCH model for oil prices

Dependent Variable	OIL			
Method	ML ARCH - Normal distribution (BFGS / Marquardt steps)			
Variance Equation	$\text{LOG}(\text{GARCH}) = \text{C}(3) + \text{C}(4) \cdot \text{ABS}(\text{RESID}(-1)/\text{SQRT}(\text{GARCH}(-1))) + \text{C}(5) \cdot \text{RESID}(-1)/\text{SQRT}(\text{GARCH}(-1)) + \text{C}(6) \cdot \text{LOG}(\text{GARCH}(-1))$			
Variable	Coefficient	Standard Error	Z-Statistic	Probability Value
AR(1)	1.003883	0.000469	2142.666	0.0000
MA(1)	-0.113128	0.031363	-3.607082	0.0003
Variance Equation				
C(3)	0.347601	4.2E-104	8.4E+102	0.0000
C(4)	-0.863386	0.048117	-17.94366	0.0000
C(5)	-0.452962	0.010840	-41.78519	0.0000
C(6)	0.740037	0.040186	18.41519	0.0000

At this stage, the volatility resulting from oil prices has been calculated. To use this measure in the main model, which is estimated through the panel data pattern, this measure is converted into a variable. For this purpose, the “Make variance GARCH” command must be used, and this volatility must be transformed into an independent variable.

Subsequently, to ensure the absence of spurious regression, unit root and cointegration tests are used.

If there is co-movement among time series, then this co-movement indicates the possible existence of a long-term equilibrium relationship. In other words, for two time-series variables that move together, it is likely possible to specify a long-term equilibrium relationship. In this case, they are said to be cointegrated. In simple terms, cointegration occurs when two time series move approximately on the same wavelength. In economic analyses, it is assumed that there is a long-term and equilibrium relationship among the variables proposed in an economic theory. In applied econometric analyses, to estimate long-term relationships among variables, their mean and variance are considered constant over time and independent of the time factor; consequently, behavioral stability is implicitly assumed for them. However, applied studies have shown that in most cases, behavioral stability of time-series variables is not achieved.

Therefore, the classical *F* and *t* tests obtained from estimation methods in which behavioral stability or stationarity of the variables has not been achieved are not valid and may lead to misleading results. This problem is known as spurious regression. Consequently, to ensure the validity of the obtained results, researchers revise their estimation methods and systematically examine the stationarity of variables and convergence among them.

Cointegration analysis has been recognized as one of the most revolutionary advances in econometrics since the mid-1980s. In simple terms, cointegration analysis examines the association and co-movement of variables, even though these variables may not be stationary and may move upward or downward over time. Therefore, their collective movement causes a linear relationship among these variables to be established in the long run and equilibrium relationships to emerge among them. As a result, if no linear relationship exists among them in the long run, these variables are said not to be cointegrated or convergent.

In general, cointegration analysis is a method for estimating long-term and equilibrium parameters in relationships in which the variables are not stationary. Therefore, it is considered a modern method for specifying, estimating, and testing dynamic models, and consequently, it can be used to test the validity of economic theories. In addition, cointegration analysis can also be used to estimate disequilibrium or short-term economic parameters. This is because these parameters can be estimated using the long-term parameters obtained from cointegration

analysis. These models are called error correction models. Error correction models link short-term fluctuations of variables to their long-term equilibrium values.

By definition, a time series such as x_t is called strictly stationary or strongly stationary if its joint probability density function, for any given value of k , is not a function of t . In this case, the distribution of x_t , and consequently its moments, including mean and variance, are independent of time.

However, examining this issue in practice is complex. Moreover, in time-series analyses, it is generally not necessary to assume strong stationarity. Instead, it is more often necessary to examine the stationarity of a time series in its weak sense.

If the following conditions hold, the time series x_t is called weakly stationary:

$$\begin{aligned} E(x_t) &= \mu \\ \text{Var}(x_t) &= E(x_t - \mu)^2 = \sigma^2 \\ \text{Cov}(x_t, x_{t-k}) &= E[(x_t - \mu)(x_{t-k} - \mu)] = \gamma_k \end{aligned}$$

As can be seen, the mean of the time series x_t must be constant, and its autocovariance function for any given value of k must not depend on t . For this reason, a weakly stationary time series is also called covariance stationary. It should be noted that the value of γ_0 , for $k = 0$, is the variance of the time series x_t , which is also independent of time. Hereafter, the term stationarity is used in the sense of weak stationarity.

The importance of stationarity or stability of a series in economics is related to the fact that a stationary series will not carry the effect of a shock forever. If a shock enters it, the shock will not be permanent and will eventually dissipate.

This issue is of particular importance in cointegration analysis.

Nonstationary time series are generated in two ways. In the first method, the series x_t is a function of the time variable t , as follows:

$$x_t = f(t) + u_t$$

where u_t is a stationary disturbance term. If $f(t)$ is a first-degree polynomial in time, we will have:

$$x_t = \alpha + \beta t + u_t$$

The mean of x_t is a function of time and is therefore nonstationary. In the second method, x_t is generated from the following model:

$$x_t = x_{t-1} + u_t$$

where u_t is a stationary series with zero mean and variance σ^2 . The above model is known as a random walk process. Through successive substitutions, the relationship can be transformed as follows.

Assuming x_0 is known:

$$x_t = x_0 + \sum_{i=1}^t u_i$$

In this case, the variance of x_t is not independent of time. However, both models show a linear trend. In the deterministic trend model, u_t is a temporary shock, while in the random walk model, it is considered a permanent shock.

If an economic variable is affected by permanent shocks, the random walk model is used for it. These models are respectively called the deterministic trend model and the stochastic trend model. In both models, the variable x_t increases at a given rate. x_t can be considered in logarithmic form, in which case the coefficient represents its growth rate. However, in the first model, shocks are temporary, while in the second model, they are permanent. In the second model, the intercept term is called the drift term or trend term. Deterministic trends, unlike stochastic trends, do not create any problem for valid statistical inferences and cointegration analyses. Their effects only need to be controlled by including the trend term t in the model. Therefore, in cointegration analyses, we are only concerned with stochastic trends.

For some purposes, we may wish to detrend time series. For this purpose, in the deterministic trend model, it is sufficient to regress x_t on time. In this case, the residuals obtained from this regression will be trend-free. In addition, through differencing, a stationary series can also be obtained as follows:

$$\Delta x_t = x_t - x_{t-1}$$

In the random walk model, a stationary series with a given mean can also be obtained by first differencing, because:

$$\Delta x_t = \delta + u_t$$

The deterministic-trend stationary model is called trend-stationary, and the first-difference stationary model is called difference-stationary. This terminology was introduced by Nelson and Plosser.

Cointegration analyses relate to difference-stationary processes, or DSPs.

For this purpose, consider the following equations:

$$\begin{aligned} x_t &= \rho x_{t-1} + u_t \\ \Delta x_t &= (\rho - 1)x_{t-1} + u_t \end{aligned}$$

where u_t terms are independently and identically distributed.

To examine stationarity, we consider the null hypothesis (H_0) of nonstationarity and its alternative hypothesis (H_1) as follows:

$$\begin{aligned} H_0: \rho &= 1 \\ H_1: \rho &< 1 \end{aligned}$$

If $\rho = 1$ in the above equations, then the series is nonstationary, and it is said that the series has a unit root. If $\rho < 1$, then the nonstationarity of the series is rejected, and the series is said to be integrated of order zero:

$$x_t \sim I(0)$$

If the series is nonstationary, it can be made stationary by differencing. If the series becomes stationary after one differencing, it is called integrated of order one:

$$x_t \sim I(1)$$

If the series becomes stationary after d differencings, it is called integrated of order d :

$$x_t \sim I(d)$$

If k time series $x_{1t}, x_{2t}, \dots, x_{kt}$ are all integrated of order d , and a linear relationship such as $z_t = \alpha_1 x_{1t} + \alpha_2 x_{2t} + \dots + \alpha_k x_{kt}$ exists among them, then they are considered cointegrated of order $(d-b)$, provided that $b > 0$. The mathematical expression of this definition is as follows:

$$x_t \sim CI(d, b)$$

Therefore, if:

$$x_t \sim I(d)$$

and:

$$\alpha' x_t \sim I(d - b)$$

then the variables are cointegrated. If several time series are integrated of different orders, their linear combination will be integrated of the highest order. In this study, the common Phillips-Perron test was used.

Table 4. Results of the PP test on the model variables

Variable	Test Statistic	Probability Value	Order of Integration
CI	1.578582	0.9256	Nonstationary
D(CI)	-20.23391	0.0001	I(1)
FREED	-2.673015	0.2534	Nonstationary
D(FREED)	-12.55062	0.0000	I(1)
GS	-0.398189	0.3661	Nonstationary
D(GS)	-20.03276	0.0001	I(1)
H	-2.788042	0.2113	Nonstationary
D(H)	-8.711121	0.0000	I(1)
L	-2.564378	0.2977	Nonstationary
D(L)	-6.284333	0.0001	I(1)
M	-2.664393	0.2567	Nonstationary
D(M)	-5.596445	0.0004	I(1)
PF	0.570455	0.5566	Nonstationary
D(PF)	-7.625807	0.0000	I(1)
SHADOO	-0.986237	0.2633	Nonstationary
D(SHADOO)	-43.62595	0.0000	I(1)

Considering the theoretical foundations of stationarity tests, the null hypothesis H_0 in these tests is defined as the nonstationarity of the variable. Based on the test results, it can be stated that all variables of the model are stationary at the first-difference level, $I(1)$.

Since the variables of the model have the same order of integration, $I(1)$, the cointegration test was used to identify the existence of a long-term equilibrium relationship among the model variables, and the Johansen-Juselius method was employed to conduct this test. To implement this test, it is necessary to determine the number of cointegration vectors. To examine the results of the cointegration test, the appropriate model must be selected with regard to the presence or absence of a time trend and intercept in the cointegration vector. In this regard, five

models are proposed: the first model without intercept and time trend; the second model with restricted intercept and no time trend; the third model with unrestricted intercept and no time trend; the fourth model with unrestricted intercept and restricted time trend; and the fifth model with unrestricted intercept and unrestricted time trend. These five models are estimated for the variables from the most restricted model, namely the first model, to the most unrestricted model, namely the fifth model. Then, the null hypothesis of no cointegration vector against the existence of one cointegration vector is tested, followed by the hypothesis of at most one cointegration vector against two vectors. This test continues up to the existence of $n - 1$ cointegration vectors, where n is the number of variables. A summary of the results of the trace test (λ_{Trace}) and maximum eigenvalue test (λ_{Max}) regarding the number of cointegration vectors based on the five mentioned models is presented in Table 5. As observed, the null hypothesis of no cointegration vector against the existence of one cointegration vector among the variables in the model is rejected. Therefore, there is at least one cointegration vector among the variables under study.

Table 5. Summary of the results for the number of cointegration vectors

Test	Model 1	Model 2	Model 3	Model 4	Model 5
Trace test	4	5	2	3	4
Maximum eigenvalue test	2	3	1	1	2

The results of model estimation and the cointegration tests related to the third model are reported as an example in the table below. Based on the results, the trace test confirms the existence of two cointegration vectors, while the maximum eigenvalue test confirms the existence of one cointegration vector at the 5% level.

Table 6. Results of the cointegration test

Maximum Eigenvalue Test Statistic	Critical Value at 95%	Probability Value	Trace Test Statistic	Critical Value at 95%	Probability Value	H_1	H_0
72.04374	52.36261	0.0002	203.0655	159.5297	0.0000	$r = 1$	$r = 0$
37.52044	46.23142	0.3124	131.0217	125.6154	0.0225	$r = 2$	$r \leq 1$
33.79118	40.07757	0.2150	93.50127	95.75366	0.0708	$r = 3$	$r \leq 2$
22.02895	33.87687	0.6054	59.71009	69.81889	0.2444	$r = 4$	$r \leq 3$
16.22132	27.58434	0.6470	37.68114	47.85613	0.3161	$r = 5$	$r \leq 4$
10.63456	21.13162	0.6836	21.45982	29.79707	0.3296	$r = 6$	$r \leq 5$
8.335401	14.26460	0.3456	10.82526	15.49471	0.2224	$r = 7$	$r \leq 6$
2.489861	3.841466	0.1146	2.489861	3.841466	0.1146	$r = 8$	$r \leq 7$

Given the limitations of linear models, many studies have recommended the use of various nonlinear models to specify the nonlinear behavior present in time series. In this study, to model the nonlinear behavior of the effects of culture, economic freedom, and oil volatility spillovers on tax avoidance in Iran, considering the threshold role of government governance quality, the Smooth Transition Regression model is used, which was developed by Teräsvirta and Anderson (1992) and Teräsvirta (1994). Unlike TAR models, which use an indicator function to control the regime-switching process, STAR models use exponential and logistic functions for this purpose. According to Van Dijk and Teräsvirta (2002), these models are highly suitable for analyzing asymmetric cycles of variables, and many studies have shown that they fit the regime-switching mechanism well for examining the nonlinear dynamics of variables. In fact, the STAR model uses a transition variable and the value of the slope

parameter to model the nonlinear relationship among variables continuously. Teräsvirta's Smooth Transition Regression model is specified as the following general regression:

$$y_t = \pi' z_t + \theta' z_t F(s_t, \gamma, c) + u_t$$

where z_t is a vector containing the exogenous variables of the model; π is the vector of linear parameters; θ is the vector of nonlinear parameters of the model; and u_t is the residual component, which is assumed to be independently and identically distributed with zero mean and constant variance. In addition, the transition function F can be specified in logistic or exponential form as follows:

$$F(s_t, \gamma, c) = [1 + \exp\{-\gamma(s_t - c)\}]^{-1}, \gamma > 0$$

$$F(s_t, \gamma, c) = 1 - \exp\{-\gamma(s_t - c)^2\}, \gamma > 0$$

Equation (2) represents the logistic transition function, and Equation (3) represents the exponential transition function. In the above functions, s_t denotes the transition variable; γ represents the slope parameter; and c indicates the threshold limit or the location of regime change. If the slope parameter γ , which indicates the speed of transition from one regime to another, tends toward infinity, the STAR model turns into a TAR threshold model. This means that if the transition variable is greater than the threshold limit ($c < s_t$), the transition function becomes equal to one ($F = 1$). Conversely, if ($c > s_t$), the value of the transition function becomes equal to zero ($F = 0$). Furthermore, if the slope parameter tends toward zero, the STAR model becomes a linear model.

The estimation process of the Smooth Transition Autoregressive model, STAR, is as follows. In the first step, the dynamic pattern of the model or the optimal number of lags is selected. Then, the existence of a nonlinear relationship among the variables under study is tested, and based on this, the transition variable and the number of regime changes are selected. In the second step, using the Newton-Raphson algorithm and the maximum likelihood method, the selected STAR model is estimated. Finally, diagnostic tests are conducted to ensure the reliability of the obtained results.

To estimate the Smooth Transition Regression model and select the transition variable, all variables included in the model were tested using the Phillips-Perron (PP) test, and all study variables became stationary at the first difference, $I(1)$. In addition, all variables included in the model were tested to select the transition variable. Among the tested variables, the variable that rejects the null hypothesis of linearity with the highest probability is selected as the transition variable. It should be noted that the STAR model proposed by the selected transition variable is chosen as the optimal model for estimating the effects of culture, economic freedom, and oil volatility spillovers on tax avoidance in Iran, considering the threshold role of government governance quality. The results of Table 7 indicate that the transition variable in the estimated model is the government governance quality index. The null hypothesis of model linearity is rejected, and the first-order LSTR model is confirmed. Therefore, the main emphasis of the study is placed on the results of the nonlinear section.

Table 7. Linearity test, transition-variable selection, and model type

Variable	F-Statistic	F4-Statistic	F3-Statistic	F2-Statistic	Proposed Model
GS(t)	0.8958	0.7745	0.5425	0.3896	LSTR1

In the next stage, using an LSTR1 model in which the transition variable is the government governance quality index, the function for analyzing the effects of culture, economic freedom, and oil volatility spillovers on tax avoidance in Iran, considering the threshold role of government governance quality, is modeled. For this purpose, initial values are first selected for the threshold value of the transition variable (C) and the slope parameter (γ).

Then, using these initial values and the Newton-Raphson algorithm, the model parameters are estimated through maximum likelihood maximization. The results are reported in the table below.

Based on the estimation results of the linearity test, government governance quality was selected as the transition variable. The estimation results of the nonlinear part of the model, namely the second regime, indicate a negative relationship between the culture index, economic freedom, and governance quality variables and the tax avoidance index. Moreover, the oil volatility spillover variable has a positive and statistically significant effect on tax avoidance at the 95% confidence level.

In the economic and financial literature, tax avoidance has been regarded as one of the major challenges of tax systems. Tax avoidance refers to the legal or quasi-legal efforts of individuals and firms to reduce the amount of tax payable. Unlike tax evasion, it occurs within the framework of laws and regulations but through the exploitation of legal gaps and weaknesses. This phenomenon has broad economic, social, and political consequences and can affect public resources, social justice, government efficiency, and the sustainability of the tax system. In Iran, which is considered an oil-rich country, tax avoidance has added importance due to the government's dependence on oil revenues, because oil resources can reduce the motivation of both the government and citizens to comply with taxation and create a cycle of dependence on windfall revenues.

Tax culture and economic beliefs play a key role in shaping the tax behavior of people and companies. Studies have shown that society's attitude toward tax justice, trust in government, and sense of social responsibility determine the level of tax avoidance. In Iran, historical experience indicates that a culture of rent-seeking and exploitation of natural resources has become institutionalized in some sectors, which reduces the motivation to pay taxes. On the other hand, societies in which tax education, a culture of social participation, and civic responsibility have been strengthened show greater compliance with tax payment. This relationship shows that tax avoidance is not merely an economic issue but the product of a complex cultural and institutional interaction that, in Iran, has been shaped by the specific characteristics of the oil economy and its political structure.

Economic freedom, as a set of policies and regulations that guarantee private ownership, freedom of trade and investment, and reduced government intervention, has an important effect on tax avoidance. The experience of different countries shows that increased economic freedom is usually associated with greater transparency and reduced economic instability, and it can increase the motivation to comply with tax laws. In Iran, despite some economic reforms and improvements in the business environment, restrictions and complex regulations continue to affect economic activities. Therefore, the effect of economic freedom on tax avoidance in Iran cannot be analyzed without considering governance quality and government supervision, because the absence of efficient institutions can increase tax avoidance even under conditions of economic freedom.

One of the specific characteristics of Iran's economy is the volatility of oil revenues and their spillover effects on the economy and tax behavior. Oil volatility spillovers refer to the transmission of the positive and negative effects of oil price changes to other economic sectors, government revenues, and the tax behavior of citizens. Unexpected oil revenues in Iran have caused the government to pay less attention to developing the non-oil tax base, and citizens, expecting to receive windfall resources, have had less motivation to pay taxes. These conditions create a cycle of tax avoidance in which dependence on oil resources and reduced reciprocal tax participation expose the economy to vulnerability.

Government governance in Iran plays an intermediary and moderating role in this process. Institutional quality, transparency, accountability, and control of corruption are factors that can reduce the effects of culture, economic

freedom, and oil volatility on tax avoidance. Iran's experience shows that weak institutions and low transparency, even when oil revenues are stable or increasing, reduce the motivation to pay taxes and increase tax avoidance. The use of smart tax policy instruments, management of oil resources through national development funds, and strengthening transparency in government revenues and expenditures can reduce these negative effects and reinforce the tax base. Empirical evidence in Iran indicates that oil volatility and the economy's dependence on natural resources, in the absence of effective governance, have a negative effect on the collection of direct and indirect taxes. When oil prices decline or their volatility increases, the government faces financial resource constraints, and citizens' motivation to pay taxes decreases. In addition, insufficient tax education and limited trust in government intensify the level of tax avoidance. Studies indicate that increasing transparency, strengthening tax institutions, and improving tax culture can play an important moderating role in reducing tax avoidance.

The theoretical foundations show that the interaction of culture, economic freedom, oil volatility spillovers, and government governance shapes tax avoidance in Iran as a complex and multidimensional process. Tax culture and belief in justice, economic freedom and regulatory transparency, oil volatility spillovers, and the quality of governance institutions all jointly affect the tax behavior of individuals and firms. Oil volatility can intensify this behavior, but effective and transparent governance can act as a moderating factor and reduce the negative effects of tax avoidance.

From a policymaking perspective, reducing tax avoidance and strengthening the tax base in Iran require a comprehensive and multidimensional approach that includes improving tax education and tax culture, strengthening trust in government and institutions, increasing regulatory transparency, and intelligently managing oil resources. Without such an approach, tax avoidance can become a structural challenge that threatens both social welfare and macroeconomic sustainability.

Within the theoretical framework, analyzing tax avoidance in Iran requires simultaneous attention to four dimensions: culture and tax beliefs, economic freedom and regulatory transparency, oil volatility spillovers, and governance institutions. These four factors interact with one another to shape the economic behavior of citizens and firms and, in the long run, affect the tax base and economic development. Therefore, tax and economic policies in Iran will face serious limitations if these factors are not taken into account.

Ultimately, the combination of these factors shows that achieving a sustainable tax system and reducing tax avoidance in Iran require a coordinated cultural, institutional, and economic approach. This approach must intelligently manage oil resources, increase transparency in institutions and regulations, and strengthen citizens' trust and participation in tax payment in order to create a strong and sustainable tax base and protect the country's economy from the negative effects of dependence on oil resources and tax avoidance.

Table 8. Model estimation using the LSTR model

Variable	Coefficient	Standard Error	t-Statistic	Probability Value
CONSTANT	0.606596	0.052468	11.56128	0.0000
C	-0.105587	0.049589	-2.129247	0.0345
L	-0.022701	0.054364	-0.417576	0.6766
H	-0.083179	0.038798	-2.143912	0.0331
CI	-0.068757	0.014853	-4.629124	0.0000
M	-0.073317	0.058397	-1.255494	0.2107
FREED	-0.072988	0.040778	-1.789885	0.0749
GS	-0.092592	0.039749	-2.329430	0.0207
PF	0.499005	0.268939	1.855461	0.0764

Variable	Coefficient	Standard Error	t-Statistic	Probability Value
CONSTANT	0.530693	0.136269	3.894459	0.0001
L	-0.112306	0.028029	-4.006816	0.0001
H	-0.265475	0.078286	-3.391090	0.0008
CI	-0.110433	0.028554	-3.867560	0.0001
M	-0.197885	0.085146	-2.324058	0.0201
FREED	-0.104390	0.041223	-2.532328	0.0121
GS	-0.797051	0.305234	-2.611280	0.0156
PF	0.642607	0.230948	2.782475	0.0070
Threshold limit (C)	0.217254	0.009450	22.98900	0.0000
Slope parameter (γ)	0.618469	0.056286	10.98804	0.0000
Adjusted coefficient of determination (R^2)	0.88			

The comparison of coefficients in two different regimes is conducted based on the transition variable and its values, and the value of the transition variable can determine the transition function and, consequently, the prevailing regime. In the above estimation, the transition variable is government governance quality, and the estimated threshold value for this variable is equal to 0.21. Based on the distance of governance quality from this threshold value, the model follows two different limiting regimes. By comparing the model coefficients in the two different regimes, it is observed that after government governance quality crosses the threshold limit of 0.21, that is, after transition from the linear part to the nonlinear part, the response of tax avoidance to changes in this variable increases substantially.

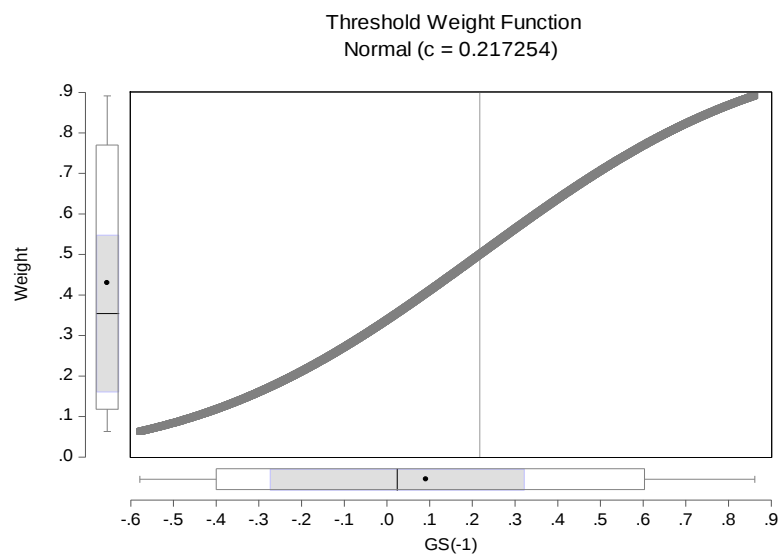


Figure 1. Relationship between the transition function and the transition variable of government governance quality

According to the estimation, there is no autocorrelation or heteroskedasticity in the estimated LSTR1 model. The no remaining nonlinearity test also shows that the LSTR1 model has specified all nonlinear behaviors present in the model.

Table 9. Results of diagnostic tests

Test	F-Value	P-Value
ARCH LM-test	0.9748	0.6525
No remaining nonlinearity test	1.4525	0.4785
Parameters constancy test	1.5414	0.3968

The results of the parameter constancy test across different regimes also show that the null hypothesis of the test, which states that the model coefficients and parameters are stable across the two different regimes, is rejected. This result means that the coefficients of the explanatory variables in the two different regimes are acceptable, and asymmetric effects on the dependent variable, namely tax avoidance, are confirmed. Therefore, based on the estimated results of the model and the diagnostic tests conducted, it appears that the LSTR1 model is an appropriate model for analyzing the effects of culture, economic freedom, and oil volatility spillovers on tax avoidance in Iran, considering the threshold role of government governance quality, and the results obtained from the estimation of this model can be considered reliable.

Discussion and Conclusion

The findings of the present study demonstrated that government governance quality functions as the threshold variable in explaining the relationship between culture, economic freedom, oil volatility spillovers, and tax avoidance in Iran. The results of the LSTR model confirmed the existence of a nonlinear relationship among the variables, indicating that the effects of the explanatory variables vary across different governance regimes. Specifically, in the nonlinear regime, cultural indicators, economic freedom, and governance quality exerted significant negative effects on tax avoidance, whereas oil volatility spillovers had a positive and statistically significant effect on tax avoidance. Furthermore, the estimated threshold value for governance quality indicated that once governance quality surpasses a specific level, the sensitivity of tax avoidance to changes in institutional and economic variables increases substantially. These findings suggest that tax avoidance in Iran is not solely determined by firm-level financial considerations but is strongly conditioned by the broader institutional environment and macroeconomic context.

One of the principal findings of this study is the negative effect of cultural indicators on tax avoidance. The results imply that improvements in educational attainment, labor-force participation, media dissemination, and cultural engagement contribute to reducing tax avoidance behavior. This finding can be explained by the role of culture in shaping civic responsibility, perceptions of fairness, and trust in public institutions. In societies where educational and cultural development is stronger, citizens and firms tend to possess a greater understanding of the social importance of taxation and are more willing to comply with fiscal obligations. Tax compliance is fundamentally linked to social norms and collective beliefs regarding the legitimacy of government authority. When cultural capital expands, individuals become more aware of the relationship between taxation and public goods provision, thereby reducing incentives for avoidance. This interpretation is consistent with the broader governance literature emphasizing that institutional performance depends heavily on social legitimacy, collective engagement, and public trust (8). The finding is also compatible with studies highlighting the importance of stakeholder perceptions and reputation concerns in shaping economic behavior. Firms operating within environments characterized by stronger social awareness are likely to face greater reputational costs from aggressive tax strategies, thereby reducing tax avoidance incentives (2).

Another important result concerns the negative relationship between economic freedom and tax avoidance. The findings indicate that improvements in economic freedom reduce tax avoidance in Iran, particularly when governance quality exceeds the estimated threshold level. This result may initially appear counterintuitive because economic freedom can create greater flexibility for firms to engage in sophisticated tax planning. However, in practice, economic freedom is closely associated with stronger property rights, greater regulatory transparency,

improved market efficiency, and reduced bureaucratic complexity. When economic actors operate within a predictable institutional environment, incentives for concealment and avoidance decline because compliance costs are lower and trust in economic institutions is higher. In this regard, economic freedom enhances formal economic participation and reduces the attractiveness of informal arrangements. The result aligns with studies emphasizing the importance of institutional frameworks in shaping economic behavior and resource allocation (10, 11). Furthermore, the finding is consistent with evidence suggesting that transparency and accountability mechanisms improve the quality of financial reporting and reduce opportunities for opportunistic managerial behavior (3, 4). Therefore, economic freedom appears to contribute to tax compliance when supported by effective governance structures.

The negative coefficient of governance quality itself represents one of the most important findings of this research. Governance quality reflects the effectiveness of public institutions, accountability mechanisms, regulatory quality, transparency, and control of corruption. The results indicate that improvements in governance quality significantly reduce tax avoidance behavior. This finding supports the theoretical argument that taxation is fundamentally a governance issue rather than merely a fiscal issue. Taxpayers are more likely to comply when they perceive public institutions as transparent, accountable, and efficient. Improved governance reduces opportunities for regulatory arbitrage, limits rent-seeking behavior, strengthens enforcement capacity, and increases confidence that tax revenues are used effectively. Consequently, firms and individuals become less motivated to engage in avoidance activities. This result is strongly supported by governance studies emphasizing that institutional effectiveness is a critical determinant of policy performance and economic outcomes (8). It is also consistent with findings indicating that sustainable development in resource-dependent economies requires robust institutional arrangements capable of balancing economic efficiency and public accountability (7). The threshold role of governance quality observed in this study further suggests that institutional development not only has a direct effect on tax avoidance but also alters the effectiveness of other determinants.

The nonlinear structure identified by the LSTR model provides additional insights into the governance-tax avoidance relationship. The estimated threshold value indicates that governance quality changes the intensity of relationships among the variables. Below the threshold, institutional weaknesses constrain the effectiveness of cultural development and economic freedom in reducing tax avoidance. Above the threshold, however, these factors become significantly more effective. This finding supports the notion that institutional quality functions as an enabling condition. Cultural awareness and economic liberalization alone may not generate substantial improvements in tax compliance unless accompanied by adequate governance capacity. This interpretation is consistent with institutional theories emphasizing that economic and social reforms achieve greater effectiveness when embedded within stable governance structures (10, 12). In practical terms, the results imply that policy initiatives focused solely on economic liberalization or public education may have limited success unless governance reforms are implemented simultaneously.

The positive and significant effect of oil volatility spillovers on tax avoidance represents another major finding of the study. The results indicate that increases in oil-price volatility contribute to higher levels of tax avoidance in Iran. This relationship can be explained through several channels. First, oil-price volatility generates macroeconomic uncertainty, affecting business profitability, investment planning, exchange rates, inflation expectations, and fiscal stability. In uncertain environments, firms often seek to preserve liquidity and reduce financial obligations, including tax liabilities. Second, fluctuations in oil revenues affect government fiscal capacity and can alter the relationship

between taxpayers and the state. During periods of revenue instability, governments may increase tax collection efforts, while taxpayers may become more resistant to compliance due to concerns about economic uncertainty. Third, oil dependence may weaken the long-term development of tax institutions because governments rely heavily on resource revenues rather than broad-based taxation. These mechanisms collectively create conditions that encourage tax avoidance.

This finding strongly aligns with research emphasizing the macroeconomic consequences of oil-price fluctuations. Parsafard and Sheikhi demonstrate that oil-price fluctuations significantly influence investment decisions and financial behavior among firms, indicating that oil-related uncertainty affects broader economic decision-making processes (5). Similarly, Moradkhani highlights the importance of managing risks associated with oil-price volatility in development projects, emphasizing that fluctuations in oil markets create significant uncertainty for economic actors (6). The present findings extend this literature by demonstrating that oil volatility not only affects investment and risk management but also influences tax behavior. This contribution is particularly important for oil-exporting economies where resource revenues remain a dominant component of public finance.

The positive relationship between oil volatility spillovers and tax avoidance also supports the broader resource-dependence perspective. Resource-rich economies often experience weaker incentives for tax system development because governments can rely on natural-resource revenues. Consequently, citizens may perceive a weaker connection between taxation and public services, reducing compliance motivation. This dynamic can become particularly pronounced during periods of volatile resource income. Studies on resource-based development emphasize that natural-resource wealth does not automatically translate into effective governance or sustainable economic outcomes. Instead, institutional quality plays a decisive role in determining whether resource revenues contribute to development or create dependency and inefficiency (9, 12). The present findings reinforce this argument by demonstrating that oil volatility increases tax avoidance, particularly in institutional environments where governance capacity remains insufficient.

The estimated coefficients further suggest that the effects of governance quality become substantially stronger in the nonlinear regime. The magnitude of the governance coefficient increases considerably after the threshold level is surpassed, indicating that improvements in governance quality have progressively larger effects on reducing tax avoidance once a critical institutional level is achieved. This result is theoretically meaningful because governance reforms often exhibit cumulative effects. Initial reforms may generate only limited improvements, but once institutional credibility reaches a certain threshold, taxpayers respond more positively because confidence in public institutions increases. Similar nonlinear institutional dynamics have been documented in studies examining governance performance, resource management, and economic transformation processes (8, 11). Therefore, the findings suggest that governance reforms should be viewed as long-term investments whose benefits may accelerate once institutional maturity is reached.

The findings also contribute to the literature on corporate behavior and tax management. Previous studies have shown that tax avoidance is associated with investment efficiency, financial performance, audit quality, and reputational considerations (1-3). The present study complements this firm-level perspective by demonstrating that macroeconomic and institutional factors significantly influence tax avoidance behavior. While firms may pursue tax avoidance for financial reasons, the broader environment determines the extent to which such behavior becomes attractive or feasible. Strong governance, cultural development, and economic freedom reduce incentives for avoidance, whereas economic uncertainty generated by oil-price volatility increases those incentives.

Consequently, tax avoidance should be understood as a multidimensional phenomenon resulting from the interaction of firm-level motivations and systemic institutional conditions.

Overall, the findings demonstrate that tax avoidance in Iran is shaped by a complex interaction among cultural development, economic freedom, governance quality, and oil volatility spillovers. Governance quality emerges as the key moderating and threshold factor that determines the effectiveness of other variables. Cultural development and economic freedom reduce tax avoidance, but their effects become stronger when governance quality improves. Conversely, oil volatility spillovers increase tax avoidance by generating uncertainty and reinforcing resource-dependence dynamics. These findings highlight the importance of adopting an integrated policy framework that simultaneously addresses institutional quality, economic liberalization, cultural development, and resource-revenue management. Such an approach is necessary to strengthen tax compliance, enhance fiscal sustainability, and reduce the vulnerabilities associated with dependence on oil revenues.

One limitation of the present study is that it focuses exclusively on Iran and therefore the findings may not be directly generalizable to other resource-dependent economies with different institutional structures and fiscal systems. In addition, some cultural variables were measured using macro-level indicators, which may not fully capture the complexity of tax culture and taxpayer attitudes. The study also relies on annual time-series data, which limits the ability to examine short-term behavioral responses to policy changes or economic shocks. Furthermore, tax avoidance was estimated indirectly, and alternative measurement approaches might yield somewhat different results.

Future research could expand the analysis by conducting comparative studies across oil-exporting and non-oil-exporting countries to investigate whether the threshold effects of governance quality differ across institutional contexts. Researchers may also examine additional governance dimensions such as corruption control, political stability, government effectiveness, and regulatory quality separately rather than through a composite index. The incorporation of firm-level data, survey-based measures of tax morale, and regional-level indicators could provide a more comprehensive understanding of the mechanisms linking governance, culture, and tax avoidance. Future studies may also explore asymmetric effects of positive and negative oil shocks and employ alternative nonlinear econometric techniques to test the robustness of the results.

From a practical perspective, policymakers should prioritize strengthening governance quality as the cornerstone of tax compliance strategies. Efforts to improve transparency, accountability, regulatory effectiveness, and anti-corruption mechanisms can significantly reduce tax avoidance and enhance the effectiveness of other policy measures. Public investment in education, cultural development, and taxpayer awareness programs can further reinforce compliance by improving citizens' understanding of the social value of taxation. Simplifying business regulations and expanding economic freedom within a transparent institutional framework may reduce incentives for avoidance while supporting economic growth. Finally, reducing dependence on volatile oil revenues through economic diversification and prudent fiscal management can decrease uncertainty and contribute to the development of a more sustainable and resilient tax system.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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