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Ranking the Factors Affecting the Level of Tax Compliance within the Framework of Comprehensive Tax Plan

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Abstract

According to this study, one of the most significant information technology projects of Iran's National Tax Administration (INTA) is the comprehensive tax plan, which considers the factors influencing tax compliance. In this research, the factors affecting tax compliance, including accounting variables (internal factors) and environmental conditions (external factors), were evaluated and ranked using decision tree algorithms. This study employed a longitudinal firm–year dataset (panel data) and analyzed it using machine-learning techniques rather than panel econometric models. The comparison of decision tree models revealed that the variables influencing tax compliance, in descending order of importance, were disclosure quality, board remuneration, the percentage of free-float shares, government ownership and influence in firms, cash-holding level, income smoothing, and firm size. The ranking of influential variables in this study provided valuable guidance for regulatory and supervisory institutions seeking to enhance tax compliance. Moreover, the findings indicated an evaluative indicator of the implementation level of the comprehensive tax plan, which can be used to assess the performance of the Iranian National Tax Administration and for future research.

Keywords:
Disclosure Quality, Financial Reporting Transparency, Tax burden; Tax compliance, Tax Plan

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1. Introduction

One of the main ways the government makes money is through taxes. This is a strategic, fundamental, and evolving subject that receives significant attention to achieve development goals, boost economic growth, ensure fair income distribution, expand public services, and stabilize social welfare. In a situation of falling oil revenues, the country depends on it; therefore, it is essential to maximize tax collection. In addition, higher-level national policy documents, particularly the economic transformation plan, Five-Year development programs, and the Twenty-year vision document, have emphasized that more tax revenue should be raised to reduce the share of oil income in government current expenditure (INTA, 2014). One of the essential tax indicators is taxpayer compliance, which measures people's willingness to pay taxes or evade them. Based on the national comprehensive tax plan, it is possible to determine and prioritize tax compliance based on collection amount, collection time, and collection expenses. The primary gain from paying one's fair share of taxes is the additional revenue that accrues to the government.

Higher tax compliance improves the efficiency of the tax system by increasing voluntary tax payments, enhancing tax revenues relative to GDP and budget targets, and reducing tax collection costs. As a result of higher compliance, taxes are collected more quickly, since they are less likely to be disputed and enforced, which is particularly important in inflationary situations (Kirchler et al., 2008; OECD, 2022). Among the three important tax indicators is taxpayer compliance, which indicates whether people are willing and able to pay their taxes. Moreover, higher compliance mitigates tax evasion and strengthens perceptions of fairness within the tax system, thereby preventing negative spillover effects among taxpayers (Torgler, 2007; INTA, 2014).

In its pursuit of a more contemporary tax system, the Iranian National Tax Administration has embarked on several large-scale information technology projects, including the comprehensive tax plan. Taxpayer operations, including registration, return filing, tax payment, auditing, and tax calculation, are performed entirely digitally. Proponents of this idea also claim that it will lead to less tax evasion, more tax compliance, and better tax equality, all of which will make taxpayers happier.

According to the plan’s designers, three primary objectives have been envisioned for the comprehensive tax plan. To increase tax revenues, the first goal is to prevent tax evasion, improve tax compliance, and eliminate unnecessary tax exemptions (Allingham and Sandmo, 1972; Alm and Torgler, 2011). The second goal is to lower operational expenses by making processes more efficient and automating them in the Iranian National Tax Administration. The third goal is to make it easier for stakeholders to work with the organization, which will help make tax fairness more likely and increase taxpayer respect and happiness (Torgler, 2007; INTA, 2014).

One of the main reasons for making the comprehensive tax plan was that taxpayers weren't following the rules and paying their taxes. This shows that tax compliance remains a major concern for both the government and the Iranian National Tax Administration.

There are 32 projects in the comprehensive tax plan, which are divided into five main areas: the integrated tax system, infrastructure, human resources, stakeholders, and project management. Since 2009, this strategy has been gradually implemented, and the country's tax system has undergone numerous changes.

The purpose of this study is to seek an answer to the following question: What motivates individuals to pay their taxes without protest? Several factors have been linked to taxpayers' propensity to pay their fair share of taxes. These include taxpayers' faith in the government, the severity of corruption, the taxpayers' financial situation, the openness of financial reporting, the relationship between tax rates, disclosure of tax information, and corporate governance practices, taxpayers' prior interactions with public services, taxpayers' religious beliefs, the degree to which the tax system is integrated, and many more. The magnitudes of these characteristics differ, though.

Financial openness, disclosure quality, firm size, cash holdings, ownership structure, income smoothing, and other firm-level characteristics are considered internal factors in this study. Managerial decisions and internal corporate policies largely determine these factors.

Institutional and environmental variables that are not internal to individual businesses but are influenced by the larger regulatory and tax climate are known as external factors. Examples of such variables include the total tax burden, the extent to which the Comprehensive Tax Plan has been implemented, and the degree to which individual firms have been impacted. Previous research on tax compliance in Iran has mostly examined its causes in isolation rather than within the institutional framework of the Comprehensive Tax Plan, despite a growing body of literature on the topic. To be more specific, no study has yet used an integrated analytical model to rank the factors that influence tax compliance or to separate internal firm-level elements from external macroeconomic and institutional ones. There has also been a lack of quantitative measurement and the inclusion of the Comprehensive Tax Plan's implementation timeline and extent as an explanatory variable in previous empirical research. This study addresses these gaps by developing a comprehensive framework that integrates internal and external determinants of tax compliance alongside a novel, data-driven measure of the implementation of the Comprehensive Tax Plan, thereby providing a multidimensional and context-specific analysis of tax compliance in Iran. This study contributes to the literature in several ways. From a scientific perspective, the study provides one of the first integrated empirical frameworks that combines internal corporate governance and financial variables with an externally constructed, time-varying indicator of the Comprehensive Tax Plan. Using data mining and decision-tree techniques, the study uncovers nonlinear correlations and variable ranks that are difficult to capture with standard methods, thereby going beyond average impact estimates. The results support more targeted and efficient enforcement and policy design by providing practical insights for tax authorities and policymakers and identifying which firm-level and institutional factors are most informative about tax compliance behavior. The remainder of the article is structured as follows. Section 2 reviews the theoretical foundations and related empirical literature on tax compliance. Section 3 describes the research design, data sources, variable construction, and modeling framework. Section 4 presents the empirical results and compares the performance of the applied models. Section 5 concludes the study by discussing the results, outlining the limitations, and offering some final thoughts and suggestions for further study. Panel data collected from businesses between 2009 and 2022 are used for the empirical analysis.

2. Theoretical foundations

The Iranian National Tax Administration, along with the parliament and the government, has been working on policies, regulations, and digital systems to address taxpayer noncompliance and the high cost of tax collection. These efforts aim to increase overall tax revenues, decrease the cost of tax evasion, and improve taxpayer compliance (INTA, 2014). In particular, due to economic sanctions, revenues from sources such as oil and petroleum product sales have declined substantially, thereby making reliance on taxation increasingly critical.

To improve tax compliance, it is necessary to identify and understand the factors that influence taxpayers' attitudes and tendencies towards paying taxes. Tax compliance is influenced by several determinants, as discussed in the following sections.

2.1. The economic theory of crime

The comprehensive tax plan is one of the most important factors affecting people's willingness to

pay their taxes. It is argued that people have to choose between getting caught and paying the costs of being caught, or not getting caught and getting the advantages of not getting caught. Portfolio theory suggests that in the "tax evasion game," smart people aim to achieve the best possible return. So, the potential financial benefits of breaking the rules or not paying taxes are weighed against the potential losses from getting caught and punished. People pay their taxes because they are terrified of getting caught and penalized, according to this way of thinking. In other words, how many audits there are and how likely it is that someone will "win" or not get caught affect how many people pay their taxes. The amount of the fine if caught also matters (Allingham and Sandmo, 1972). The model assumes that a person has a steady income and has to choose how much of it to report to the government (R) and how much to keep secret. The person pays a proportional tax rate t on each recorded unit of income. There is no tax on unreported income, but there is a steady chance (p) that the person will be audited. If that happens, they will have to pay a fine (f) for each unit of unreported income, in addition to the tax they owe.
The individual's net income, if underreported income is detected, is given by *Equation (1).*

Equation (1). $IC = I - tR - f[t(I - R)]$

The individual's net income when unreported income is not detected is given by the following equation: IN = I – tR. It is assumed that the individual chooses the level of reported income (R) to maximize expected utility. Accordingly, the individual's optimal expected income function is expressed as Equation (2).

Where I is actual income, p shows the probability of detection, f denotes the penalty rate, R presents reported income, and t indicates the tax rate.

Equation (2). $EU(I) = pU(I_C) + (1 - p)U(I_N)$

The economic theory of crime postulates that the likelihood of detection (p) and the severity of punishments (f) are the primary determinants of tax compliance. Because of its emphasis on digitization and information system integration, the Comprehensive Tax Plan has an operational impact on both criteria. The economic theory of crime postulates that the likelihood of detection (p) and the severity of punishments (f) are the primary determinants of tax compliance. Because of its emphasis on digitization and information system integration, the Comprehensive Tax Plan has an operational impact on both criteria. In addition, real-time data access and systematic documentation improve the enforceability of tax regulations, thereby raising the expected cost of non-compliance by strengthening the credibility and application of penalties (f). Consequently, the Comprehensive Tax Plan functions as an institutional mechanism that directly links digital infrastructure to the core determinants of tax compliance in the Allingham and Sandmo (1972) framework. The economic theory of crime, through comparative statistical analysis, demonstrates that reported income (compliance) increases with higher probabilities of detection or higher penalty rates. This approach further concludes that individuals pay taxes primarily due to the economic consequences of detection and punishment.

A wide range of instruments and approaches has been developed to enhance the likelihood of detecting tax evasion. One of the most important developments in this area has been the use of technology in tax administration, implemented gradually through several programs.

This process has been going on in Iran since 2009 as part of the comprehensive tax plan.

2.2. The slippery slope model

The tax rate is another subject that affects how well people pay their taxes. Figure 1 shows that the slippery slope model of tax compliance uses both economic reasoning and human psychology to explain why people choose to follow tax rules, either willingly or out of necessity. The approach is based on two basic ideas: how much people trust the government and how strong they think the

government is. People's ideas about how much power the government has are shaped by things like how high taxes are, how likely they are to be audited, and how rigorous the punishments are. Kirchler et al. (2008) found that psychological factors like taxpayers' perception of fairness affect the amount of trust they have in authority (Kirchler et al., 2008). In the slippery slope paradigm, taxpayers may view an increase in the tax rate as unjust, thereby reducing tax compliance. However, when confidence is high, such gains are seen as community consensus (Kirchler et al., 2008). Tax compliance behavior is not directly tested in the empirical model; instead, the economic and institutional mechanisms underlying it are captured through observable proxies.

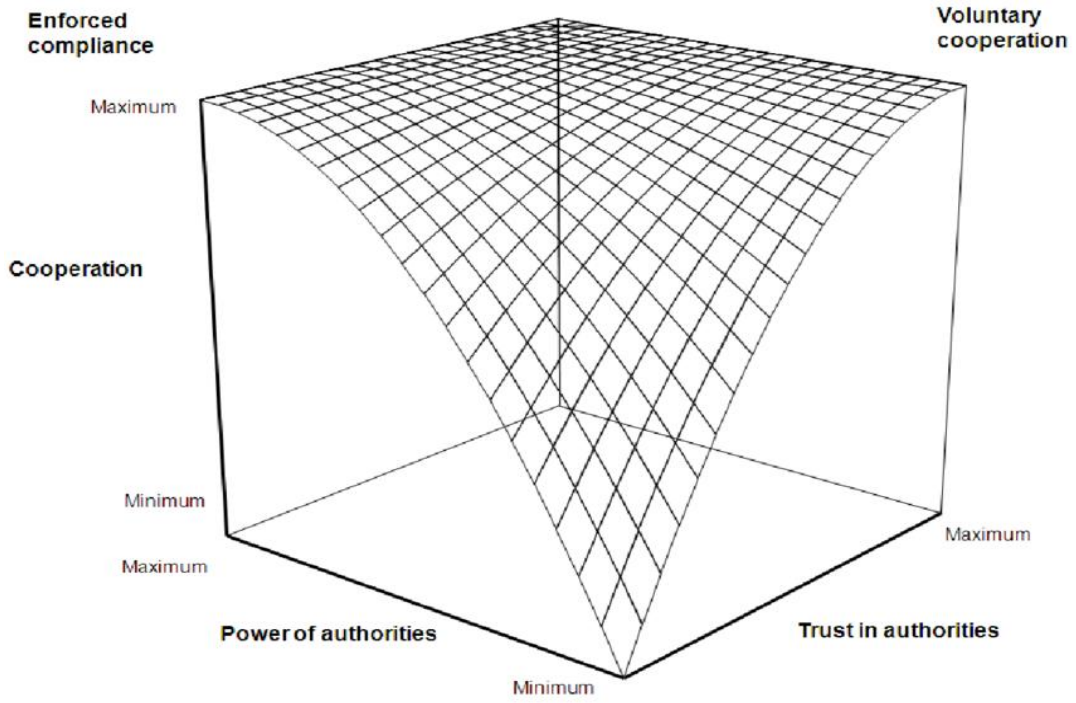

Figure 1. Relationship between the level of compliance (voluntary and enforced) and trust or power of authorities (Kirchler et al., 2008)

2.3.The tax burden

The tax burden is an economic constraint imposed on business entities through tax deductions from their budgets. This implies that taxation takes a particular portion of income that could otherwise be allocated to development activities by corporations or individual entrepreneurs. The concept of the tax burden should therefore be defined at both the macroeconomic and microeconomic levels. At the firm level, the tax burden is generally divided into two categories: tax on profit and tax on value added. As the tax burden increases, tax compliance among businesses is expected to decrease, as they seek to preserve conditions conducive to growth and entrepreneurship. In this study, since other research variables are already related to profit taxation and following Block (2016), the value-added tax rate and charges are employed as measures of the tax burden.

2.4. Corporate governance

Corporate governance is another internal factor that affects tax compliance, and corporate policy can be considered as a range. The narrow approach to corporate governance looks at the firm's relationship with its owners. The broad approach, on the other hand, looks at everyone's rights.

Companies have responsibilities to more than just the people who currently have a stake in them. They also have these responsibilities to future generations, society as a whole, and the environment. The broader strategy is consistent with stakeholder theory, whereas the narrower strategy is consistent with agency theory. Among the many major players in the limited approach is the government. Thus, before distributing any further profit, a company should determine and set aside the portion that goes to the government, which is primarily derived from taxes (Slemrod, 2019; Kerr et al., 2016; Duhoon and Singh, 2023). Any company that does not want to be responsible for other people's rights is still legally required to respect the government's rights by determining and paying the correct amount of tax. From a narrow perspective, the interests of those who prepare information may not align with those of other parties, such as the government, which stands to gain the most, due to a lack of transparency and weak corporate governance. In these situations, businesses see their responsibility only as staying out of trouble with the law and paying their taxes. On the other hand, more general meanings of corporate governance stress that the company has many connections with many different groups of people who have a stake in it. From this point of view, corporations are responsible for more than just their shareholders. They are also responsible for other groups affected by their actions. This method is based on principles such as openness, fairness, and the protection of stakeholders' rights. Accountability is considered an essential part of corporate governance in this way of thinking. Firms should follow their social responsibility by paying their taxes, as part of their overall duty to society (Abdelfattah and Aboud, 2020).

2.5.Quality of disclosure

The quality of disclosure and financial reporting also affects tax compliance. Agency theory suggests that tax decisions may be made in managers' best interests when ownership and management are independent. Thus, reducing tax avoidance-related agency costs is crucial for owners. According to managerial opportunism (Balakrishnan et al., 2019), managers evade taxes to hide their opportunistic actions. Improving transparency can save agency costs and fill information gaps. An organization's transparency is proportional to the quality of its financial reporting and disclosure policies. Company managers and outside investors are already at a disadvantage due to the lack of transparency that results from aggressive tax methods, which further compounds the problem. Tax avoidance activities could provide managers with tools for dishonest behavior, such as changing wages, doing business with related parties, and diverting resources (Zhang et al., 2025). While tax avoidance strategies may save the company money on taxes, they also complicate the company's finances and organization. Often, this makes it harder to communicate with external parties such as investors, creditors, and analysts, thereby making financial reporting less clear. That is, less transparency makes it worse because investors, shareholders, creditors, and managers do not have the same amount of knowledge. One possible cost of tax planning is that it can make a company's financial reports less clear (Balakrishnan et al., 2019). Balakrishnan et al. (2019) stated that firms have to pay a high price when there is insufficient transparency. These costs include higher costs of capital (both stock and debt), worsening governance problems, and less efficient investment. Because of this, the better the exposure, the less tax avoidance there is, which causes problems for the government.

2.6. Cash holdings

The taxpayers' ability to pay their taxes is another internal factor that affects their obedience. If managers have no conflicts of interest, they seek to increase the company's value and maintain an appropriate level of cash on hand for two main reasons: the transaction motive and the precautionary motive (Opler et al., 2001). The transaction motive holds that companies that keep cash on hand can

meet their current obligations without borrowing from outside sources or selling assets, which can be expensive. The precautionary motive, on the other hand, holds that companies should keep cash on hand to take advantage of investment opportunities that could generate returns. The opportunity costs of holding cash, such as the lost returns from investing in long-term investments, are weighed against these benefits. According to this theory, there should not be a clear link between a company's decision to avoid paying taxes and its cash holdings, as long as the optimal level of cash is determined by comparing the marginal benefits and costs of liquidity. When ownership and management are kept separate, managers may make choices that are not in the best interests of shareholders. Cash and other easily spent assets can be easily abused by managers who only care about themselves. Therefore, ownership disputes can accelerate the spending of a company's cash assets. Thus, it stands to reason that managers might avoid paying taxes to keep cash on hand within the company (Foley et al., 2007). In turn, this behavior makes them less likely to fulfill their tax obligations, since doing so would reduce the cash they have available.

2.7. Theoretical background and empirical implications

In this study, an integrated framework that connects the empirical decision tree and ranking analysis to the factors determining tax compliance is constructed by synthesizing multiple theoretical viewpoints. Allingham and Sandmo's (1972) economic model of crime serves as a basis for incorporating enforcement-related elements into the Comprehensive Tax Plan's digitalization, thereby raising the likelihood of detection and the anticipated cost of non-compliance. Second, the slippery slope paradigm emphasizes institutional credibility and transparency, highlighting the importance of trust and perceived legitimacy. The tax burden theory explains how higher effective tax pressure may weaken voluntary compliance, justifying the inclusion of tax burden indicators as external determinants. Fourth, corporate governance theory emphasizes that stronger governance mechanisms and ownership structures hinder opportunistic behavior, leading to higher compliance. Fifth, transparency and disclosure theories suggest that improved information quality reduces information asymmetry and aggressive tax behavior. Finally, the cash holdings theory posits that firms with greater liquidity may face different compliance incentives due to increased monitoring capacity and opportunity costs. Together, these theoretical blocks motivate the selection of internal and external variables and form the basis for the decision tree analysis, which ranks the relative importance of determinants based on their explanatory power for tax compliance.

2.7.1. Empirical background

2.7.1.1. Behavioral & psychological factors

This study examines noncompliance with business income tax and ranks the factors influencing it. The report is published by Kaghazloo and Borrego (2022). The Analytic Hierarchy Process (AHP) method was used to analyze data gathered via a grid questionnaire using the Saaty pairwise comparison technique. The findings showed that knowledge inequality, behavior based on reference groups, and third-party reporting were the most important factors leading to tax evasion.

Bani-Khalid et al. (2022) investigated the determinants of tax compliance among small and medium-sized enterprises (SMEs) in Jordan, focusing on the Theory of Planned Behavior (TPB) as the theoretical framework. An analysis of 385 valid responses was obtained from 660 questionnaires distributed to managers and owners of manufacturing SMEs in Jordan using a systematic random sampling method. To evaluate the measurement and structural models and assess the hypothesized correlations within the proposed framework, the research utilized Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings indicated that attitude toward behavior, subjective norms, perceived behavioral control, and patriotism were significant determinants of the intention to

comply with tax obligations among the surveyed firms. While these studies primarily emphasize behavioral and perceptual factors, the present study captures their empirical implications using observable firm-level and institutional proxies such as governance, transparency, tax burden, and enforcement mechanisms thereby enabling these influences to be systematically ranked within a decision-tree framework.

Taing and Chang (2021), in their study titled "Determinants of tax compliance: a focus on the theory of planned behavior," applied the theory of planned behavior (TPB) to examine citizens' intention to comply with tax obligations in Phnom Penh, Cambodia. The TPB posits that three key components underlie behavioral intention: attitude, subjective norms, and perceived behavioral control. Based on these constructs, seven determinants were selected for the study: tax morale, tax fairness and trust in government, perceived power, tax complexity, tax information, and tax awareness. To investigate these determinants, the authors collected survey data from 402 respondents in 2016. The results of this study supported the view that tax morale, tax fairness, and tax complexity have significant effects on citizens' intention to comply with tax obligations. On the other hand, authority power, trust in government, and tax information and awareness were not statistically significantly related.

Mebratu (2024) examined the theoretical basis of studies on tax compliance in some developing countries. This study examined prior research on tax compliance in developing countries worldwide from 1998 to 2022, both by topic and by time period. The goal was to identify the most widely studied factors affecting tax compliance. The study stressed that long-term tax compliance can only be achieved when fiscal policy takes into account the key factors that influence people's decisions to comply. One of the biggest problems in tax management, especially in developing countries, is getting people to pay their taxes. The review found that taxpayers' attitudes and perceptions of tax fairness were each identified six times as major determinants of compliance. In addition, tax information, how people are expected to act, and subjective norms were each mentioned four times. Three times, income sources, tax law complexity, moral sensitivity, and religious understanding were named as important factors. Two times, perceived tax system structure and perceived usefulness were named as factors.

Alm and Torgler (2011) investigated the role of ethics and cultural values in shaping tax compliance behavior. Using comparative data from different countries, they showed that moral and normative factors affect taxpayer behavior as strongly as, or more strongly than, economic factors. A high rate of tax compliance is indicative of a society with strong ethical standards and a high level of social trust. If people do not trust the government or believe many institutions are corrupt, even when there are strict tax laws, they will comply with them less (Alm and Torgler, 2011).

2.7.1.2. Trust, Fairness & Tax Morale

Bartha and Boda (2024) conducted an international comparison and studied the effects of corruption scandals and political legitimacy crises on tax morale in Hungary. Results suggest that if public trust is substantially undermined, tougher enforcement methods, such as greater audits or penalties, may not effectively improve compliance. The paper also distinguishes between compliant behavior, which is enforced. deriving from fear of sanctions, coping with a lack of trust and perceived fairness, vis-à-vis compliance essentially being voluntary; when corruption exists, then voluntary compliance tends towards zero (Bartha and Boda, 2024). These findings justify the inclusion of external institutional variables related to transparency, enforcement intensity, and the probability of detection in the present study's ranking of tax compliance determinants.

Mohammed and Tangl (2023) employed an analytical approach and identified major determinants of tax compliance, with attention to tax justice, transparency, and the quality of government–taxpayer

relations. Results indicate that tax legislation and administrative procedures are overly complex, leading to decreased compliance. Additionally, collectivist attitudes toward the tax burden and taxes, in the form of a weight sense among taxpayers, also influence willingness to comply. This study suggests that policymakers should use a multi-faceted strategy for enforcement, including punitive measures and tax education, to increase institutional credibility (Mohammed and Tangl, 2023). This evidence supports the inclusion of tax burden, transparency, and institutional quality as key external determinants in the empirical model and motivates their joint evaluation in the ranking analysis.

2.7.1.3 Enforcement, Audits & Policy Interventions

Nwokoye et al. (2023) examined how financial rewards affect the way Nigerian industrial firms handle taxes. A structured questionnaire and a multistage sampling method were used to get information from 800 companies in three industry clusters. The poll answers were analyzed using descriptive statistics and logistic regression. Regular tax audits, firm size, making tax-related communications easier to understand, delivering deterrent messages, entrepreneurs' education, and the legitimacy of the current government all affect enterprises' tax compliance. Financial incentives such as tax credits, tax reductions, capital allowances, and investment incentives also play a significant role. These findings directly motivate the inclusion of firm size as an internal determinant and audit probability and government-related factors as external determinants in the ranking framework.

De Neve et al. (2021) analyzed data from large-scale studies conducted in Belgium to determine the effects of tax simplification, nonpayment prevention, and tax morale on taxpayer compliance. The researchers altered the tax office's communication with Belgian income taxpayers by conducting four field experiments. The results demonstrated that compliance rates were substantially higher when communications were made more understandable, and the effect was even more pronounced when the messages were intended to discourage people. However, bringing up tax attitudes seldom helped and often made matters worse. The study also showed that steps to simplify processes are much more cost-effective, which means significant savings in administrative costs.

Slemrod (2019) provided a comprehensive review of the literature on tax compliance and related enforcement policies. The study surveyed hundreds of empirical and theoretical works, which proposed an analytical framework to understand the interactions among enforcement policies (audits, penalties, and incentives), taxpayer characteristics (firm size, liquidity, and ownership structure), and the institutional context. Based on the assessment findings, it is clear that a mix of "hard" enforcement instruments and "soft" techniques, such as trust-building and procedural simplicity, is necessary for an effective strategy to increase compliance. The paper also highlighted disparities between rich and poor nations, demonstrating how local institutional factors determine the success of tax policies (Slemrod, 2019).

2.7.1.4. Corporate Governance & Firm-Level Determinants

Desai and Dharmapala (2006) show that corporate governance also has an indirect effect on tax avoidance through the integrity of financial reporting, which serves as a mediating factor. Furthermore, higher audit quality was found to reduce tax avoidance, both directly and indirectly, via its positive influence on financial reporting quality.

Other studies have shown that board independence, executive incentives, tax penalties, tax position, tax expertise of managers, managerial risk aversion, firm performance, firm size, and the difference between reported taxable income and accounting income all affect taxpayer compliance or avoidance. These studies include Armstrong et al. (2015) and Alasfour et al. (2016).

frameworks, including behavioral models such as the Theory of Planned Behavior, which

emphasizes attitudes, norms, and perceived behavioral control; the psychological tax contract, which highlights trust and reciprocity between taxpayers and tax authorities; and the slippery slope framework, which integrates trust with enforcement power. A comparative reading of this literature reveals consistent patterns across studies: trust, fairness, and transparency are central drivers of voluntary tax compliance. At the same time, governance-related mechanisms—such as board characteristics and ownership structure constrain opportunistic behavior and aggressive tax practices. At the same time, enforcement-related factors, including tax burden and audit probability, exhibit context-dependent and sometimes nonlinear effects, as stronger enforcement may enhance compliance in some settings but weaken voluntary compliance under excessive tax pressure. Despite these insights, prior studies have largely examined compliance determinants in isolation and outside the operational framework of Iran's Comprehensive Tax Plan and digital tax system, without systematically comparing internal firm-level factors with external institutional determinants or ranking their relative importance. Addressing these gaps, the present study adopts a firm-level and institutional perspective by embedding tax compliance analysis within the framework of the Comprehensive Tax Plan and its digital infrastructure, and by applying a decision tree–based approach to jointly evaluate and rank observable internal and external determinants such as governance, transparency, liquidity, ownership structure, tax burden, and audit probability thereby capturing nonlinear interactions and offering a structured prioritization of compliance drivers not provided by earlier Iranian studies.

While the literature on tax compliance extensively emphasizes behavioral constructs such as trust in government, perceived fairness, and corruption, these variables are inherently latent and not directly observable in firm-level archival data. Accordingly, this study adopts a proxy-based empirical strategy, whereby observable firm-level and institutional variables are used to capture the economic and informational manifestations of these underlying behavioral mechanisms. Variables such as disclosure quality, corporate governance attributes, and government ownership reflect transparency, monitoring, and institutional credibility, while the ICTPlan index captures the evolution of enforcement capacity and system digitalization. This approach enables the integration of behavioral theory within a data-driven empirical framework.

2.8. Critique of previous studies and research innovation

Many prior studies (e.g., Mebratu, 2024; Bani-Khalid et al., 2022; Nwokoye et al., 2023; Bartha and Boda, 2024) have focused either on a limited set of economic or accounting variables or on behavioral and psychological factors, without integrating these dimensions with contextual environmental and institutional variables related to the Comprehensive Tax Plan. In Iran, researchers have similarly relied on a narrow set of economic or accounting indicators, often using financial ratios and corporate governance measures comparable to those employed in global studies of fraudulent financial reporting (e.g., Armstrong et al., 2015; Alasfour et al., 2016). As a result, two important gaps remain in the literature. First, prior studies have not sufficiently incorporated economic, environmental, and institutional factors, particularly those associated with the ongoing implementation of the Comprehensive Tax Plan, alongside internal accounting variables in tax compliance prediction models. Second, existing research has largely relied on traditional statistical approaches and has not employed data-driven ranking methods to assess the relative importance of internal and external determinants. Addressing tax compliance in Iran, therefore, requires a comprehensive framework that jointly considers internal firm-level characteristics and external environmental factors and systematically ranks their contributions.

3. Research methodology

The goal of this study is to find and rank the factors that affect tax compliance for businesses listed on the Tehran Stock Exchange under the comprehensive tax plan. The study uses both accounting and non-accounting data and will consider internal and external factors. The study population consists of all companies listed on the Tehran Stock Exchange. This study employs a longitudinal firm–year dataset (panel data) and analyzes it using machine-learning techniques rather than panel econometric models. The final dataset comprises 1,337 firm–year observations. The sample of listed firms was selected using a systematic elimination approach. Firms were included if they had a fiscal year ending in March, did not change their fiscal year during the study period, had the required financial information available, and were listed on the Tehran Stock Exchange no later than the end of fiscal year 2009. Financial institutions, including banks, insurance companies, investment firms, financial intermediaries, holding companies, and leasing firms, were excluded due to differences in corporate governance structures and financial disclosure requirements. Data were collected from the CODAL system, audited financial statements, and official records of the Securities and Exchange Organization. To extract information from the data, examine what drives corporations to comply with tax rules and pay taxes, and develop ways to make this happen nationwide, the study used a three-step data mining process. The first step was to understand and prepare the data. At this step, we examined values outside the normal range, codes that did not make sense for qualitative variables, outliers, missing data, data integration, and descriptive statistics. During the modeling stage, decision tree algorithms were used to examine and rank the factors that affect tax compliance levels. A hold-out validation approach was used to test the model, with 70% of the data being used for training and 30% for testing. The dependent variable (tax compliance) exhibits an imbalanced class distribution, with the compliant class occurring approximately 3 times as often as the noncompliant class. To address this issue, multiple strategies were employed. First, model performance was evaluated using metrics robust to class imbalance, including recall, precision, F1-score, AUC, and lift, rather than relying solely on accuracy. Second, cost-sensitive learning was applied in decision tree–based models by assigning a higher misclassification cost to the minority class, proportional to the observed class imbalance.

In this study, the factors influencing tax compliance, comprising both accounting and non-accounting data, were analyzed by considering internal and external variables. These variables are tax compliance, implementation of performance evaluation of the comprehensive tax plan, proportion of non-directional board member, amount paid to the board members as salary and wage, separation of CEO and chairman positions, public percentage ownership (free float), institutional accommodation ratio, government's presence on company and effects it has on companies decision making investment size firm size we consider Cash holding level in such a way that is more than 0.36, tax surcharge again from 05-02-2006 after passing law against this constitution type disclosure quality smoothing earnings Smoothed corporate income audit report form me suitable Operating Cash Flow difference result estimated operating cash flows discretionary accruals Total Accruals evaluation performance Evaluation Total Accruals from Differences ImplementationA comprehensive plan to meet the Islamic Republic for Iran. In conclusion, IBM SPSS Modeler Software was used to rank decision tree models on data from firms listed on the Tehran Stock Exchange. To construct the dependent variable, we first compute tax evasion for firm i in year t as the difference between the final tax assessed by the tax authority and the tax declared by the firm. To account for systematic differences across firms due to accounting standards and tax regulations, the sample mean of tax evasion is subtracted from each observation. Negative values, which indicate full compliance or overpayment, are set to zero, while positive values are retained. The resulting values

are then normalized to the [0,1] interval to obtain a continuous non-compliance index (TA_{it}). Finally, tax compliance is defined as the inverse of this index:

$$Tax\ Compliance_{it} = 1 - TA_{it}$$

For classification in the decision tree model, a binary variable is constructed such that firms with $TA_{it} = 0$ are classified as compliant (1), and firms with $TA_{it} > 0$ are classified as non-compliant (0) (Dyreng et al., 2008).

The ICTPlan variable is constructed as a composite index based on expert assessments of the Comprehensive Tax Plan's implementation. The index was developed through a structured multi-step process. First, data were collected from a questionnaire covering 32 core projects across five main dimensions of the plan. For each project, experts evaluated (i) the year of effective implementation and (ii) the intensity of its impact on improving the tax system using a five-point Likert scale. The questionnaire was completed by 35 tax experts, including senior administrators and specialists in tax policy.

A panel of experts confirmed the instrument's content validity, and its reliability was assessed using Cronbach's alpha (α = 0.958). Next, responses were numerically coded, and average impact scores were computed for each project. These scores were then aggregated at the dimension level to capture differences in implementation across the plan's five core areas. Finally, dimension-level scores were combined to construct an annual composite index, which was normalized to a 0–100 scale. This index provides a time-varying measure of the degree of implementation of the Comprehensive Tax Plan and is used in this study as an external institutional variable. A full methodological description of the index construction is provided in a companion paper by the same authors, currently under review.

Although the dataset has a panel (firm–year) structure, the objective of this study is not to estimate causal relationships using panel econometric techniques, but to identify and rank determinants of tax compliance using data-driven classification algorithms. Therefore, decision tree methods are employed, which do not require the assumptions or diagnostic tests associated with panel regression models.

The classification algorithm was trained and verified using a confusion matrix in this work. To assess the model, performance metrics were calculated from the confusion matrix, including accuracy (Acc), error rate (1-Acc), true positive rate (Recall^{+}), positive predictive value (Precision^{+}), negative predictive value (Precision^{-}), and negative predictive value (Precision^{-}). Furthermore, the F1 score and the Lift Index were used to evaluate the models' overall performance (Sokolova and Lapalme, 2009).

4. Research findings

4.1. Descriptive statistics

Table 1 displays the descriptive statistics of the research variables. These statistics include the mean, standard deviation, skewness coefficient, median, mode, number of observations, the lowest and highest values, and the research variables. Given that most variables in the study are continuous and multidimensional, outlier treatment was applied prior to discretization using a multivariate anomaly-detection approach. Specifically, a clustering-based technique was employed to partition the data into homogeneous peer groups, maximizing within-cluster similarity and between-cluster dissimilarity. For each observation, the distance from the center of its assigned cluster (anomaly index) was computed and evaluated relative to its peer group. Observations exhibiting unusually large distances from their cluster centers were identified as outliers and removed from the dataset. Regarding missing data, only one missing value was detected in the CashHold variable, which was replaced using the median value to preserve sample size and robustness.

Table 1. Descriptive statistics of the study variables

Symbol	Variable	Min	Max	Mean	SD	Skewness	Median	Mode	Uniqueness	Observations
OMBS	Non-executive board members	0.000	1.000	0.568	0.283	-0.804	0.600	0.600	--	1337
BOBO	Board remuneration	0.000	0.079	0.001	0.003	18.287	0.000	0.000	--	1337
INDCH	CEO–board separation	0	1	--	--	--	--	0	2	1337
FRFL	Free float share percentage	0.910	97.820	25.492	18.245	1.343	21.600	1.000	--	1337
POIN	Institutional ownership percentage	0.000	99.090	74.219	18.365	-1.351	78.190	99.000	--	1337
SOIC	Government ownership and influence	0.000	98.040	6.522	14.833	2.987	0.000	0.000	--	1337
Size	Firm size	9.069	20.467	14.253	1.616	0.595	14.076	12.212	--	1337
CashHold	Cash holding level	0.000	2.669	0.085	0.141	6.829	0.042	0.003	--	1337
Disclos	Disclosure quality	0.837	99.859	69.530	19.160	-0.676	73.471	50.000	--	1337
SMO	Earnings smoothing	0.027	34.721	1.659	2.875	5.411	0.919	0.040[1]	--	1337
Audit	Audit report type	0	1	--	--	--	--	0	2	1337
Profit	Profitability	0	1	--	--	--	--	1	2	1337
CashFlow	Operating cash flow	0	1	--	--	--	--	1	2	1337
TaxCom	Tax compliance	0	1	--	--	--	--	1	2	1337
TaxBurd	Tax burden	0	9	--	--	--	--	9	7	1337
ICTPlan-cof	Comprehensive Tax Plan coefficient	0.013	0.921	0.425	0.342	0.73	0.492	-	--	1337

Table 1 shows that several variables exhibit extreme skewness (e.g., BOBO with a skewness of 18.287, CashHold with 6.829, SMO with 5.411, SOIC with 2.987). Some of the quantitative variables are skewed. Although skewness alone does not necessarily require discretization, this study adopts a tiles-based discretization approach for most quantitative variables for methodological and interpretive reasons. First, the study's primary objective is not parameter estimation but the identification and ranking of tax compliance determinants using decision-tree–based models. Discretization facilitates the extraction of interpretable decision rules and reduces sensitivity to extreme values in highly skewed firm-level variables. Second, tile discretization preserves the relative ordering of observations while creating balanced intervals that are robust to skewness and outliers. To fix this, the Tiles discretization technique was used to turn the Earnings Smoothing (SMO), Disclosure Quality (Disclos), Cash Holding Level (CashHold), Firm Size (Size), State Ownership and Influence in Companies (SOIC), Institutional Ownership Percentage (POIN), Free Float Shares (FRFL), Board Bonus (BOBO), Non-Executive Board Members (OMBS), and the comprehensive tax plan (ICTPlan-cof) variables into ordinal qualitative variables. The fitted models derived from the data are delineated as follows:

4.2. CART Decision Tree

CART is a binary decision tree technique that sequentially partitions the feature space by selecting splits that maximize node purity (homogeneity). The splitting process continues until a stopping rule is satisfied (e.g., minimum node size or insufficient impurity reduction). The algorithm can be applied

in two modes: classification and regression. Given that the dependent variable in this study is categorical (TaxCom), the classification mode of CART was employed. The confusion matrix for the test data is presented in Table 2. To assess whether the observed accuracy is meaningful, we report a simple baseline that always predicts the majority class in the test set. Based on Table 2, the test set contains 293 "compliant" observations (Class 1) and 114 "non-compliant" observations (Class 0), i.e., 72.0% and 28.0%, respectively. Therefore, a majority-class baseline would achieve an accuracy of 0.720 by predicting Class 1 for all cases. In contrast, CART attains an accuracy of 0.54 on the test set. This indicates that overall accuracy alone is not an informative metric in the presence of class imbalance, and the added value of CART should be evaluated using class-specific measures and lift rather than raw accuracy. In particular, while the baseline has zero ability to identify the minority class (Class 0) (Recall_0 = 0.00), CART provides non-trivial identification of the minority class (Recall_0 = 0.52; Table 2), which is critical for detecting non-compliance.

Table 2. Confusion matrix of the CART Algorithm

Actual Values	**CART Algorithm Predictions Negative (N)**	**Positive (P)**	
True (T)	59	159	*Correct predictions*
False (F)	134	55	*Incorrect predictions*

Equations were used to construct the model evaluation metrics from the confusion matrix results, as shown in Table 2.

$$Acc = \frac{(TP + TN)}{(TP + TN + FP + FN)} = \frac{(159 + 59)}{(159 + 59 + 55 + 134)} = 0.54$$

$$Recall^{+} = \frac{TP}{(TP + 0 + 0 + FN)} = \frac{159}{(159 + 0 + 0 + 134)} = 0.54$$

$$Recall^{-} = \frac{TN}{(0 + TN + FP + 0)} = \frac{59}{(0 + 59 + 55 + 0)} = 0.52$$

$$Precision^{+} = \frac{TP}{(TP + 0 + FP + 0)} = \frac{159}{(159 + 0 + 55 + 0)} = 0.74$$

$$Precision^{-} = \frac{TN}{(0 + TN + 0 + FN)} = \frac{59}{(0 + 59 + 0 + 134)} = 0.31$$

$$F - Measure^{-} = \frac{2 * Recall^{-} * Precision^{-}}{Recall^{-} + Precision^{-}} = \frac{2 * 0.52 * 0.31}{0.52 + 0.31} = 0.388$$

$$F - Measure^{+} = \frac{2 * Recall^{+} * Precision^{+}}{Recall^{+} + Precision^{+}} = \frac{2 * 0.54 * 0.74}{0.54 + 0.74} = 0.624$$

$$Lift = 1.22$$

As shown in Table 3, the importance of the identified variables and their respective predictive significance levels in the CART decision tree algorithm are presented. Lift measures how much more effectively the decision tree identifies the target (minority) class compared to a random classifier, making it particularly informative in imbalanced classification settings where accuracy alone may be misleading.

Table 3. Predictive importance of variables in CART

No.	Variable	Symbol	predictor importance
1	Non-executive board members	OMBS	0.110
2	Level of cash retention	CashHold	0.110
3	Percentage of institutional shareholder ownership	POIN	0.090
4	Company size	Size	0.080
5	Government ownership and influence in companies	SOIC	0.080
6	Operating cash flow	CashFlow	0.060
7	Disclosure quality	Disclos	0.060
8	Board remuneration	BOBO	0.060
9	Tax burden	taxburd	0.060

The predictor importance values in Table 3 are derived from IBM SPSS Modeler and represent normalized importance scores relative to the most influential predictor, which is scaled to 1. Accordingly, the reported values do not sum to 1 but indicate each variable's relative contribution to impurity reduction in the CART tree relative to the strongest predictor. Table 3 reports the predictor importance values obtained from the CART model. The prominence of non-executive board members is consistent with agency theory, which highlights the monitoring role of independent directors in limiting opportunistic managerial behavior, including aggressive tax practices. The importance of cash holdings reflects liquidity-based explanations of tax compliance, as firms with stronger liquidity positions face fewer constraints in meeting tax obligations. Institutional ownership aligns with corporate governance theory, emphasizing the disciplining role of professional and sophisticated shareholders. The role of firm size captures both higher audit probability and stronger legitimacy pressures faced by larger firms. Finally, the significance of government ownership and influence is consistent with institutional theory, particularly in contexts where state involvement intensifies formal and informal compliance expectations.

The ICTPlan coefficient (ICTPlan-cof), along with variables such as earnings smoothing, audit type, and profitability, was included in the CART estimation. Their absence among the highest-ranked predictors reflects the structure of the CART algorithm, in which the frequency and strength of node splits drive variable importance. These variables primarily affect tax compliance through interaction and contextual mechanisms rather than as primary splitting variables. In particular, ICTPlan-cof represents a macro-level institutional factor whose impact on tax compliance is largely indirect and materializes through firm-level governance, transparency, and incentive structures, explaining its lower standalone importance in the CART ranking.

4.3. C5.0 Decision Tree

The C5.0 decision tree algorithm is similar to the CART algorithm; however, it differs in its pruning strategy. For classification, this approach partitions the dataset into subsets, with records more similar to one another than to the parent node. In the C5.0 decision tree algorithm, samples are split on the field that yields the highest information gain. The first branching determines each subgroup, and then division based on new fields continues until further splitting is impossible. Afterwards, the branches are retested starting at the lowest level, and any that do not make a meaningful contribution to the model are deleted. In Table 4, the confusion matrix for the test data is shown.

Table 4. Confusion matrix of the C5.0 Algorithm

Actual Values	*C5.0 Algorithm Predictions Negative (N)*	*Positive (P)*	
True (T)	*49*	*202*	*Correct predictions*
False (F)	*91*	*65*	*Incorrect predictions*

Table 4 presents the confusion matrix findings used to calculate the following model evaluation criteria .The C5.0 results show asymmetric performance, with higher Precision^{+} and Recall^{+} than Precision^{-} and Recall^{-}, indicating that the model identifies compliant firms more accurately than noncompliant firms. This asymmetry reflects the imbalanced nature of tax compliance data and implies that misclassifying noncompliant firms as compliant may be more costly from a policy perspective. Therefore, the model is best interpreted as a screening tool for risk-based audit prioritization rather than a definitive compliance classifier:

$$Acc = \frac{(TP + TN)}{(TP + TN + FP + FN)} = \frac{(202 + 49)}{(202 + 49 + 65 + 91)} = 0.62$$

$$Recall^{+} = \frac{TP}{(TP + 0 + 0 + FN)} = \frac{202}{(202 + 0 + 0 + 91)} = 0069$$

$$Recall^{-} = \frac{TN}{(0 + TN + FP + 0)} = \frac{49}{(0 + 49 + 65 + 0)} = 0.43$$

$$Precision^{+} = \frac{TP}{(TP + 0 + FP + 0)} = \frac{202}{(202 + 0 + 65 + 0)} = 0.76$$

$$Precision^{-} = \frac{TN}{(0 + TN + 0 + FN)} = \frac{49}{(0 + 499 + 0 + 91)} = 0.35$$

$$F - Measure^{-} = \frac{2 * Recall^{-} * Precision^{-}}{Recall^{-} + Precision^{-}} = \frac{2 * 0.43 * 0.35}{0.43 + 0.35} = 0.385$$

$$F - Measure^{+} = \frac{2 * Recall^{+} * Precision^{+}}{Recall^{+} + Precision^{+}} = \frac{2 * 0.69 * 0.76}{0.69 + 0.76} = 0.723$$

$$Lift = 1.40$$

As shown in Table 5, the importance of the variables specified in the table and the degree of importance of predicting the variables in the C5.0 decision tree algorithm are as follows. All conceptually relevant variables were included in the C5.0 model. Variables not reported in Table 5 show negligible normalized importance after tree construction and, therefore, are not retained among the most influential predictors; their absence reflects data-driven selection rather than exclusion from the analysis.

Table 5. Predictive importance of variables in C5.0

No.	Variable	Symbol	predictor importance
1	Disclosure quality	Disclos	0.520
2	Board remuneration	BOBO	0.210
3	Free float percentage	FRFL	0.170
4	Government ownership and influence in companies	SOIC	0.060
5	Cash holding level	CashHold	0.030
6	Profit smoothing	SMO	0.020
7	Company size	Size	0.010

Consequently, in this model, the order of ranking variables is: quality of disclosure, compensation for the board of directors, percentage of free-float ownership, government interest and influence on companies they invest in, cash retention level, profit management smoothing, and company size.

The tree structure of the C5. 0 model is also displayed in Figure 2:

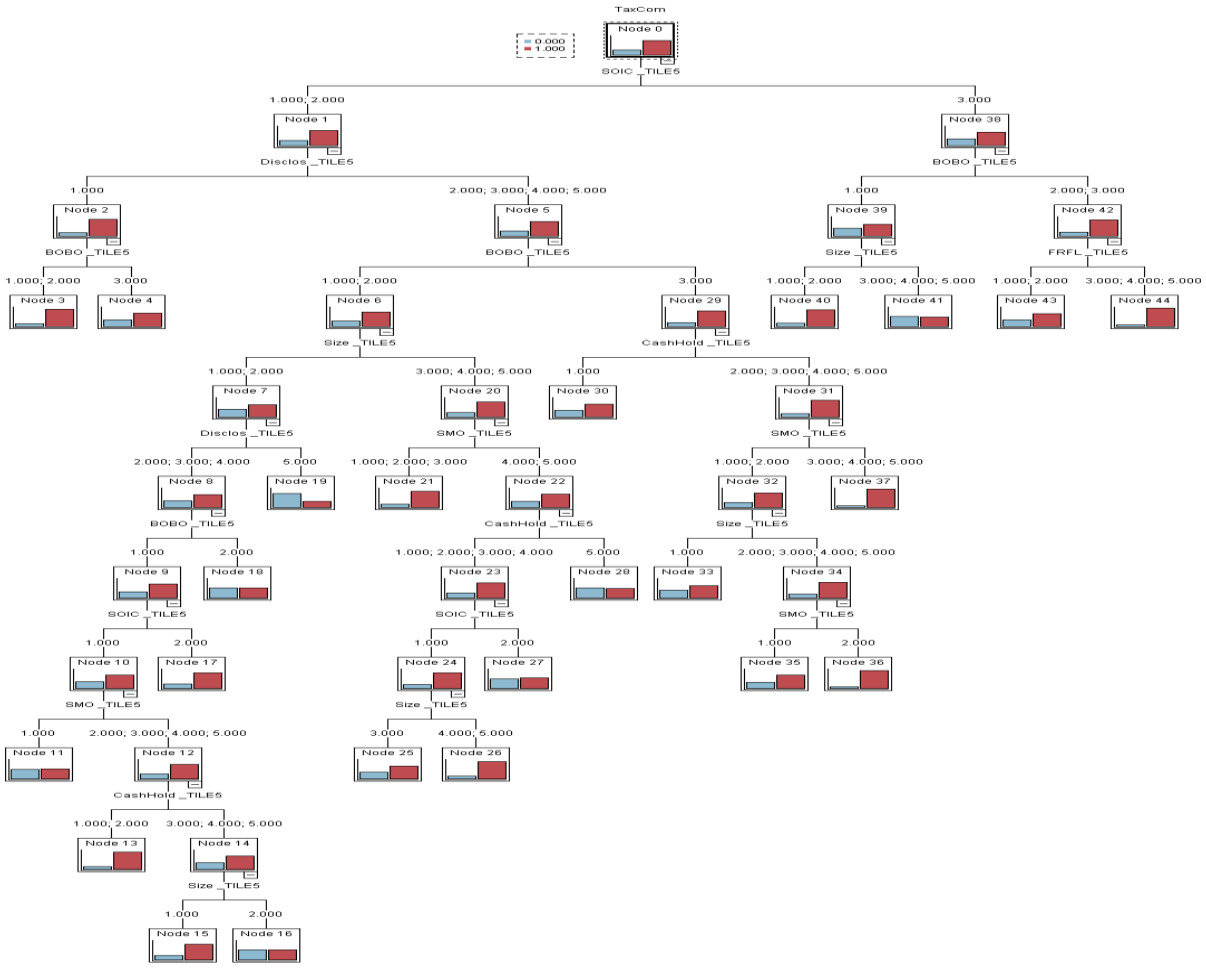

Figure 2. Tree structure of the C5.0 model

4.4. CHAID Decision Tree

The CHAID (Chi-squared Automatic Interaction Detection) algorithm finds the most important relationships between independent and dependent variables using the p-value from the chi-square statistic in the test of independence for contingency tables. In this approach, the variable with the minimum p-value is chosen first from among those available for splitting at a given node. CHAID differs from other decision tree methods in that it can have more than two branches at any level of the tree. Thus, it is not a binary decision tree like CART and C5.0. The tree structure that CHAID produces is usually wider and more complex than those produced by other methods. Table 6 shows the confusion matrix for the test data used by this program.

Table 6. Confusion matrix of the CHAID Algorithm

Actual Values	CHAID Algorithm Predictions Negative (N)	Positive (P)	
True (T)	78	139	Correct predictions
False (F)	154	36	Incorrect predictions

Using the results of the confusion matrix, as shown in Table 6, the model evaluation criteria have been calculated as follows:

$$Acc = \frac{(TP + TN)}{(TP + TN + FP + FN)} = \frac{(139 + 78)}{(139 + 78 + 36 + 154)} = 0.53$$

$$Recall^{+} = \frac{TP}{(TP + 0 + 0 + FN)} = \frac{139}{(139 + 0 + 0 + 154)} = 0.48$$

$$Recall^{-} = \frac{TN}{(0 + TN + FP + 0)} = \frac{78}{(0 + 78 + 36 + 0)} = 0.68$$

$$Precision^{+} = \frac{TP}{(TP + 0 + FP + 0)} = \frac{139}{(139 + 0 + 36 + 0)} = 0.79$$

$$Precision^{-} = \frac{TN}{(0 + TN + 0 + FN)} = \frac{78}{(0 + 78 + 0 + 154)} = 0.36$$

$$F - Measure^{-} = \frac{2 * Recall^{-} * Precision^{-}}{Recall^{-} + Precision^{-}} = \frac{2 * .68 * .36}{.68 + .36} = 0.47$$

$$F - Measure^{+} = \frac{2 * Recall^{+} * Precision^{+}}{Recall^{+} + Precision^{+}} = \frac{2 * 0.48 * 0.79}{.48 + 0.79} = 0.579$$

$$Lift = 1.34$$

As shown in Table 7, the importance of the identified variables and their corresponding predictive significance levels in the CHAID decision tree algorithm are presented. The dominance of government ownership (SOIC), institutional ownership (POIN), and the comprehensive tax plan (ICTPlan) in the CHAID model underscores the central role of institutional and ownership structures in shaping tax compliance in Iran. Given the strong presence of the state and concentrated ownership, compliance is more closely linked to regulatory oversight and enforcement capacity than to purely firm-level financial characteristics, consistent with institutional approaches to tax compliance.

Table 7. Predictive importance of variables in CHAID

No.	Variable	Symbol	Predictor importance
1	Government ownership and influence in companies	SOIC	0.190
2	Percentage of institutional shareholder ownership	POIN	0.170
3	Iran's comprehensive tax plan	ICTPlan	0.150
4	Profit smoothing	SMO	0.140
5	Disclosure quality	Disclos	0.100
6	Percentage of free float shares	FRFL	0.100
7	Company size	Size	0.080
8	Level of cash retention	CashHold	0.050
9	Non-executive board members	OMBS	0.020
10	Board remuneration	BOBO	0.010

Therefore, in this model, the control variables have been ranked as follows: own state and influence on companies, the institutions' ownership percentage, the Century Iran Management Act, the earnings management smoothing rate, the quality of disclosure, traded shares proportion remaining in free market shares, company size, access to cash, companies level of non-captive board members, as well as executive pay rate.

4.5. QUEST Decision Tree

The QUEST (Quick, Unbiased, Efficient Statistical Tree) algorithm is a new method for expanding binary trees that uses only symbolic output fields and supports only two subgroups at each split in its recursive data partitioning method. The algorithm is efficient in terms of computing and uses backward pruning. Table 8 presents the confusion matrix for the test data collected using the QUEST algorithm.

Table 8. Confusion matrix of the QUEST Algorithm

Actual Values	QUEST Algorithm Predictions Negative (N)	Positive (P)	
True (T)	39	187	Correct predictions
False (F)	106	75	Incorrect predictions

Using the results of the confusion matrix, as shown in Table 8, the model evaluation criteria have been calculated as follows:

$$Acc = \frac{(TP + TN)}{(TP + TN + FP + FN)} = \frac{(187 + 39)}{(187 + 39 + 75 + 106)} = 0.56$$

$$Recall^{+} = \frac{TP}{(TP + 0 + 0 + FN)} = \frac{187}{(187 + 0 + 0 + 106)} = 0.64$$

$$Recall^{-} = \frac{TN}{(0 + TN + FP + 0)} = \frac{39}{(0 + 39 + 75 + 0)} = 0.34$$
$$Precision^{+} = \frac{TP}{(TP + 0 + FP + 0)} = \frac{187}{(187 + 0 + 75 + 0)} = 0.71$$
$$Precision^{-} = \frac{TN}{(0 + TN + 0 + FN)} = \frac{39}{(0 + 39 + 0 + 106)} = 0.27$$
$$F - Measure^{-} = \frac{2 * Recall^{-} * Precision^{-}}{Recall^{-} + Precision^{-}} = \frac{2 * ..34 * ..27}{..34 + ..27} = 0.30$$
$$F - Measure^{+} = \frac{2 * Recall^{+} * Precision^{+}}{Recall^{+} + Precision^{+}} = \frac{2 * 0.64 * 0.71}{..64 + 0.71} = 0.67$$
$$Lift = 1.08$$

As shown in Table 9, the variables' importance and predictive importance in the QUEST decision tree algorithm are as follows.

Table 9. Predictive importance of variables in QUEST

No.	Variable	Symbol	predictor importance
1	Non-executive board members	OMBS	0.110
2	Level of cash retention	CashHold	0.110
3	Percentage of institutional shareholder ownership	POIN	0.090
4	Company size	Size	0.080
5	Government ownership and influence in companies	SOIC	0.080
6	Profit smoothing	SMO	0.070
7	Operating cash flow	CashFlow	0.060
8	Disclosure quality	Disclos	0.060
9	Iran's comprehensive tax plan	ICTPlan	0.060
10	Tax burden	taxburd	0.060

As a result, in this algorithm, the variables are prioritized as follows: non-executive board members, cash-holding level, institutional ownership percentage, firm size, state ownership and influence in companies, earnings smoothing, operating cash flow, disclosure quality, Iran's comprehensive tax plan, and tax burden.

4.6. Model comparison

Comparing Models Table 10 presents the findings of the model evaluation comparison in a separate format for each decision tree model. This includes the confusion matrices and assessment metrics.

Table 10. Comparison of model evaluations

Model	TN	FP	FN	TP	Recall-	Recall+	Precision -	Precision +	Lift-	Accuracy
CART	59	55	134	159	0.520	0.540	0.310	0.740	1.220	0.540
CHAID	78	36	154	139	0.680	0.470	0.340	0.790	1.340	0.530
Quest	39	75	106	187	0.340	0.640	0.270	0.710	1.080	0.560
C5.0	49	65	91	202	0.430	0.690	0.350	0.760	1.400	0.620

From the results in Table 10 and the comparison of evaluation measures, especially overall accuracy and Lift Index, the C5.0 model is the best-performing. The C5.0 decision tree resulted in an accuracy rate (ratio of correctly classified observations to the total number of cases in the tax compliance classification) for tax-compliant firms (proportion would refer to the ratio of correctly classified observations over the total number of cases) of 62%, and the quantity predicted by class correctly predicted: 69%. The Precision (nc) of the Recall was 31%, and the Precision was 26%. For the other model class-compliant, non-compliant discretization: random assignment of firms to this class would have a 26% chance of being correct for the conforming class. At the same time, with perfect prediction accuracy (state-of-the-art), 25% was obtained. In contrast, the 36% of non-complying classes as correct by the model suggests that the probability of incorrect failure detection increased by a factor of 1.4 (Lift Index = 1.4).

5. Conclusion and recommendations

The results of the ranking of factors affecting tax compliance, obtained using various decision tree algorithms within the comprehensive tax plan framework, are summarized in Table 11.

According to Table 11, which presents the study's ranking of tax compliance elements, the C5.0 model outperforms the other algorithms examined in model evaluation measures such as overall accuracy and the Lift Index.

Disclosure quality, board remuneration, percentage of free-float shares, cash-holding level, earnings smoothing, firm size, and state ownership and influence in companies are the independent variables that rank most important in shaping the culture of tax compliance, according to the research findings.

This study examined the determinants of corporate tax compliance within the institutional framework of Iran’s Comprehensive Tax Plan, using multiple decision-tree–based machine-learning models. The comparison of model performance indicates that the C5.0 algorithm yields the best overall results, achieving the highest accuracy (62%) and lift (1.40), suggesting a meaningful improvement over random classification for identifying noncompliant firms. Beyond predictive performance, the findings offer important theoretical insights. The high importance of disclosure quality and board remuneration is consistent with agency theory, which emphasizes the role of transparency and incentive alignment in mitigating opportunistic behavior, including aggressive tax practices. Similarly, the prominence of free float and institutional ownership highlights the disciplining role of external monitoring mechanisms, aligning with prior corporate governance and tax avoidance literature. The significance of cash holding levels and earnings smoothing reflects firms’ liquidity management and reporting discretion as channels through which tax compliance behavior is shaped. Importantly, the relevance of government ownership and influence, as well as the Comprehensive Tax Plan (ICTPlan), underscores the institutional dimension of tax compliance in Iran. These results support frameworks emphasizing tax morale, trust, and enforcement capacity, suggesting that compliance is not driven solely by firm-level characteristics but also by the credibility and reach of tax system reforms.

Table 11. Ranking of factors affecting tax compliance

	Algorithm QUEST		**Algorithm CHAID**		**Algorithm C5.0**		**Algorithm CART**
predictor importance	**Variable**	**predictor importance**	**Variable**	**predictor importance**	**Variable**	**predictor importance**	**Variable**
0.110	Non-executive board members	0.190	Government ownership and influence in companies	0.520	Disclosure quality	0.110	Non-executive board members
0.110	Level of cash holdings	0.170	Percentage of institutional shareholder ownership	0.210	Board remuneration	0.110	Cash holding level
0.090	Percentage of institutional shareholder ownership	0.150	Iran's comprehensive tax plan	0.170	Free float percentage	0.090	Percentage of institutional shareholder ownership
0.080	Company size	0.140	Profit smoothing	0.060	Government ownership and influence in companies	0.080	Company size
0.080	Government ownership and influence in companies	0.100	Disclosure quality	0.030	Cash holding level	0.080	Government ownership and influence in companies
0.070	Profit Smoothing	0.100	Percentage of free float shares	0.020	Earnings smoothing	0.060	Operating cash flow
0.060	Operating Cash	0.080	Company size	0.010	Company size	0.060	Disclosure quality
0.060	Disclosure Quality	0.050	Level of cash retention			0.060	Board remuneration
0.060	Non-Executive Directors	0.020	Non-executive board members			0.060	Tax burden
0.060	Tax Burden	0.010	Board remuneration				

Overall, the findings demonstrated that tax compliance emerges from the interaction between corporate governance mechanisms and institutional enforcement structures, reinforcing the need for integrated policy approaches under Iran's digital tax transformation. The empirical findings can be interpreted in light of the slippery slope framework and the economic theory of crime. The prominence of disclosure quality and corporate governance variables reflects the role of transparency and accountability, which are associated with trust and perceived fairness. At the same time, the importance of the ICTPlan index and ownership-related variables highlights the role of enforcement

capacity, monitoring, and institutional power, which are central to the probability of detection and compliance decisions in the economic theory of crime.

This study is subject to several limitations that should be considered when interpreting the findings. First, the empirical analysis is based on firms listed on the Tehran Stock Exchange, which, while providing audited and standardized data and ensuring high internal validity, may limit the generalizability of the results. Although the Comprehensive Tax Plan represents a nationwide institutional reform affecting the entire tax system, including infrastructure, digital processes, and enforcement mechanisms, the behavior of small and informal taxpayers may differ due to lower transparency and different compliance incentives. Therefore, the findings should be interpreted in the context of formally listed firms, and caution is warranted when extending them to SMEs and other taxpayer groups.

Second, the study relies on historical data from a specific time period, which may not fully capture recent developments in tax administration and digitalization. Third, the analysis is based on proxy measures for tax compliance and the implementation of the Comprehensive Tax Plan, which, although grounded in theory and prior research, may not fully reflect underlying behavioral dimensions.

Based on these limitations, future research could extend the analysis to SMEs and unlisted entities using administrative or survey-based data, apply alternative machine-learning or econometric approaches, and incorporate direct behavioral measures to further enrich and validate the findings.

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