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-RESEARCH ARTICLE-

AN EMPIRICAL STUDY ON AN AI-BASED MODEL FOR ENHANCING CUSTOMS TAX SUPERVISION AND COMBATING TAX EVASION

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—Abstract—

This research creates and assesses a data-driven model for improving the supervision of customs taxes and the fight against tax evasion. The model combines customs declaration data and analytics for risk assessment, as well as identifying anomalies and prioritizing inspections for customs administrations. The model, built from analytics, and a traditional rule-based monitoring system are compared across several performance dimensions using historical customs declaration data. The findings show that the new model attains better detection precision, greatly improves the accuracy of classifications to reduce false positives, and improves the targeting of detected irregularities to the high-risk declaration categories. Furthermore, the results indicate that the model improves the effectiveness of inspections and the administrative burden is lessened, all without the loss of revenue protection. The enhancements are not simply measures of technical improvements, but are operational and managerial enhancements that are relevant for contemporary customs administrations.

Keywords: Digital tax administration, customs taxation, detection of tax evasion, data-driven oversight, risk evaluation, prioritization of inspections.

INTRODUCTION

Customs and tax authorities face significant challenges with tax evasion and non-compliance, leading to major losses in public revenue, undermining fiscal equity, and harming institutional trust (Nor & Mohamed, 2024). The expansion of global trade and the growing complexity of customs systems have developed new forms of evasion, such as undervaluation, misclassification, and under and non-declaration (Elfimova et al., 2021). In the context of high transaction volume and high data intensive environments,

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where the vast majority of audits are conducted manually and rules for auditing predefined, such monitoring and inspection systems prove to be ineffective (Bukhari et al., 2021).

A number of technological advances that took place during recent years have had a significant impact on the domain of taxation, as well as its administration and enforcement (Alm, 2021). In particular, it is now possible for tax authorities to apply complex data analytic tools that allow for the examination and processing of vast amounts of data such as customs and tax data and to detect patterns and behavior that could potentially imply tax non-compliance (Younus et al., 2025). Research indicates that compared to the traditional methods, such novel approaches demonstrate higher efficiency in identifying risky cases of non-compliance (Jahidi et al., 2024).

When it comes to detection of tax fraud and tax evasion, prior research has made use of the statistical learning and pattern recognition to optimize audit selection process and assess risks. Empirical work shows that such approach improves detection of irregular declaration, alerting and allocation of audit resources. When it comes to customs administration, the progress made by tax authorities in this respect (Ikponmwoba et al., 2020).

Organizations operating internationally have come to regard the digitalization of tax administration as a key area for strategic intervention, particularly within an institutional framework (Igbinenikaro & Adewusi, 2024). Tax Administration 3.0 calls for leveraging state-of-the-art analytical tools, automation technology, and real-time data sharing capabilities in order to shift tax administration from reactive enforcement toward proactive compliance management. Studies focusing on the digitalization of public administration highlight the importance of effective governance, transparency, and readiness within organizations to implement smart monitoring systems(Sharmin & Chowdhury, 2025).

Regardless of the progress, numerous research gaps persist. Most of the current literature focuses on income and corporate taxation, whereas empirical works targeting customs tax supervision are few and far between (Tadesse, 2023). Furthermore, numerous works focus on the performance of the technical model, neglecting the operational aspects, such as inspection prioritization and the efficiency of the administration. This justifies the fact that there is still no research that applies the intelligent supervision models to customs and tax data in real administrative contexts (Rukanova et al., 2021).

This research presents and analyzes empirically a data-driven model for improving customs tax oversight and the mitigation of tax fraud.

The model proposes a new way of integrating customs and tax data with some form of

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analytics for enhanced risk detection and anomaly recognition relative to the existing tax fraud monitoring system. The results of this research shed possible perspectives on the development of digital tax administration systems and provide customs administration with means to enhance the revenue protection and oversight effectiveness (Vanhoeyveld et al., 2020).

LITERATURE REVIEW

The academic literature acknowledges tax evasion as an enduring challenge for tax and customs authorities, and affects the unspent resources for public expenditure, the equitable distribution of resources, and the trust in public institutions. Thuneibat et al. (2022) shows tax evasion, along with the technological and administrative capability, are closely linked. Schrödter and Weißenberger (2024) illustrates that, in addition to trust in the authority, the smart use of digital technologies also determines the outcomes of compliance. According to de La Feria (2020), classic enforcement methods employing manual audits and fixed rules are insufficient to cope with the scale and sophistication of today's tax evasion.

Responding to these challenges, international organizations and experts recognize the potential of digital transformation in tax administrations. In the Organization for Economic Cooperation and Development, the concept of Tax Administration 3.0 is highlighted, in which the authors emphasize that the integration of advanced analytics and data systems will convert tax collection practices from merely enforcing compliance into managing compliance. In later studies, digital monitoring and automated judgment tools were found to be incorporated in many reforms of tax administrations (Anjarwi, 2026). Digital tax administration is conceptualized by Bassey et al., in which automation and data consolidation enhance both transparency and enforcement (Mpofu, 2024). In another studies, (Alisawi et al., 2023; Bharosa, 2022) highlights the rise of GovTech and explains the governance challenges associated with such technologies .

Cui et al. (2023) introduces a multi-module analytical framework and shows that integrating several detection techniques improves the precision of fraud detection. Sadegh-Zadeh and Tajdini (2025) state that hybrid unsupervised detection methods are of great utility in pinpointing high-risk cases and in eliminating false positives, while (Tayebi & El Kafhali, 2024) demonstrate that tax avoidance behavior detection is enhanced by metaheuristics-based analytical models.

Numerous studies demonstrate the efficacy of state-of-the-art analytical methods in the supervision of tax-related matters. For example, Ahir (2026) explain that neural networks have been found to be more effective in identifying tax fraud than old-fashioned methods, while (Hayble-Gomes, 2023) expand on the case of the predictive accuracy of fraud involved in the use of predictive supervisory analytical models. In

another study, Bhaduri et al. (2025) analyze the effectiveness of tree-based models in predicting reporting behavior. (Yang, 2025) describe a predictive model that allows tax assessments, enforcement, and inspection prioritization to be more precise.

Alisawi et al. (2022) and Muhdiarta (2025) explain that public governance having advanced technologies is a good thing and has the similar values such as accountability, transparency (institutional safeguards). A vast bulk of empirical evidence begins to claim that fraud and tax evasion, metric-based fraud, and tax evasion analyses constitute valuable gold mines. Alexopoulos et al. (2025) demonstrate that tax auditors become more effective the more taxpayer network data they integrate into their analytical models.

For now, I will consider some of the literature available that has nothing to do with the yellow literature. However, some of the available literature deal with customs tax supervision. For example, Alwanin et al. (2025), introduce an unsupervised evaluative approach to determine the under-reporting of declaration data, and show its usefulness on high-dimensional customs data sets. Moreover, the intelligent systems help modernize tax administration in developing countries, and provides evidence that digital transformation initiatives, when coupled with supervisory capacity, institutional preparedness, and governance frameworks.

Apart from tax compliance and its technical aspects, recent research has focused on the significance of behavioral and institutional elements contributing to tax compliance. Belahouaoui and Attak (2025) describe the first systematic study to the best of their knowledge explaining the behavioral aspects of compliance, digital tax, and smart supervision, whereas Belahouaoui and Attak (2025) go on to prove that in the digital age, tax authorities and taxpayers relationships impact both trust and compliance.

RESEARCH METHODOLOGY

In the current study, an applied empirical research method is used to evaluate the effectiveness of a data-driven model designed to enhance the tax surveillance process by dealing with the problem of tax evasion. The strategy consists of using customs declaration data together with some techniques that will help to conduct risk assessment, identify anomalies, and determine priorities for inspection. There are four major aspects of this research: data preprocessing, model building, risk and anomaly assessment, empirical analysis.

Methodological Framework

The methodology approach aims at converting the data on customs declarations into useful information for supervision. The general research process is shown in Figure 1 below with particular focus on the sequential connection between data analysis and modeling.

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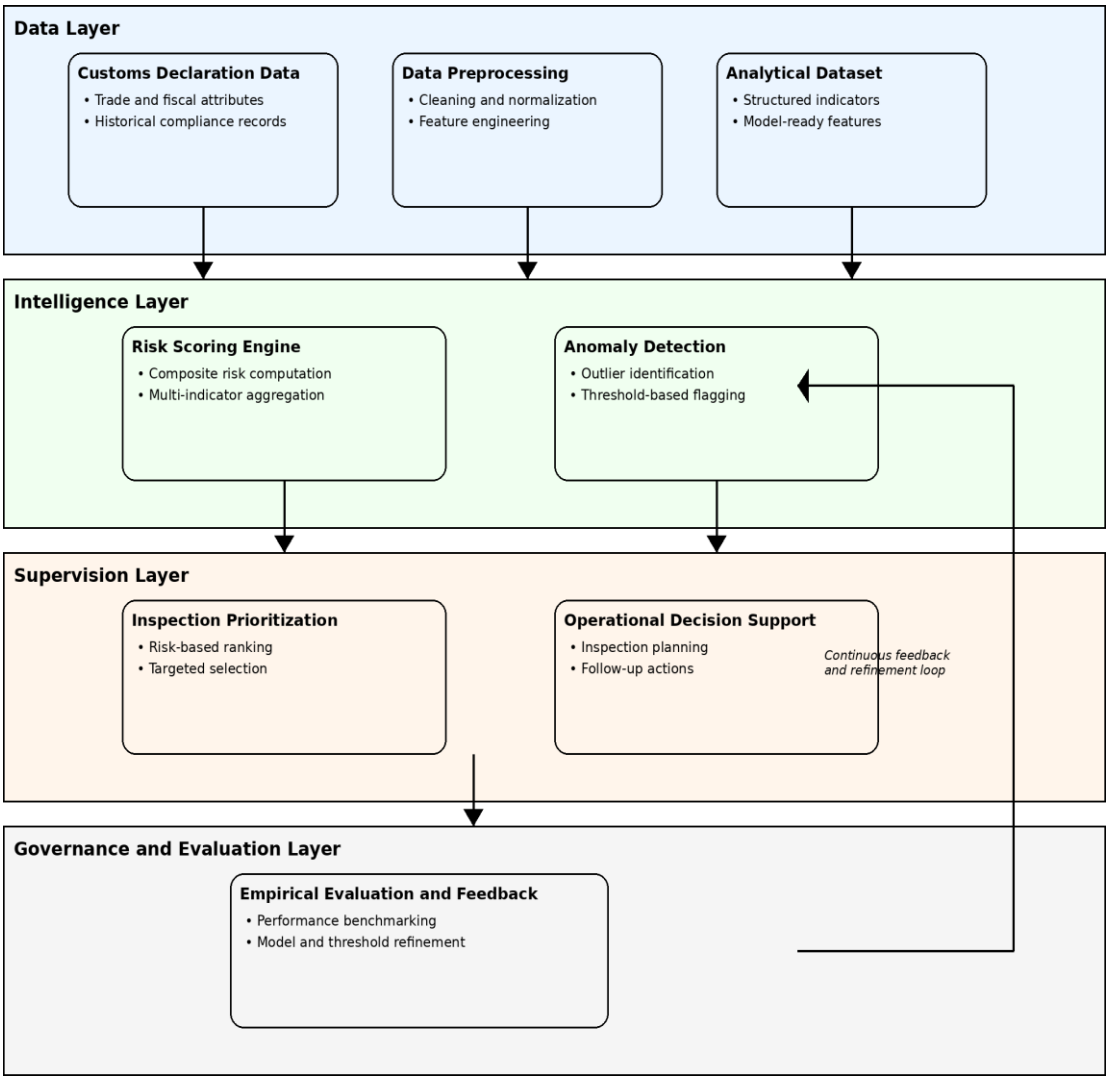

Figure 1: Approach to analyzing customs-related taxation data

Figure 1 showed the process through which the customs' data evolve from their raw form to risk scores and prioritization of customs inspections. This approach underscores the relationship between model evaluation and custom supervision improvement.

Data Sources and Variable Structure

The empirical test is founded on the historical data of customs declaration drawn from the record books of the customs administration office. Such data provide information regarding the fiscal aspect of customs declaration as well as its trade aspect with regard to identifying any possible evasion activity. Table 1 provides the classification of the variables in the model. Table 1 reveals the grouping of variables according to various aspects of customs declaration.

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Table 1: Classification of Variables Used in the Study

Variable Group	Representative Variables
Declaration Attributes	Declared
value, declared quantity, declaration date	Product
Characteristics	Harmonized
system code	product category
Trade Context	Country of origin, country of export
Fiscal Parameters	Customs duty rate, applicable tax rate
Compliance History	Previous inspections, detected irregularities

Data Preprocessing and Feature Construction

Prior to the actual analysis, the dataset goes through certain pre-processing procedures to improve the quality of the data as well as the accuracy of the analysis process. The pre-processing procedures include removal of duplications, dealing with missing values, normalizing numerical attributes, and encoding categorical attributes. The feature construction stage focuses on constructing indicators that would show discrepancies between the stated facts, numbers, and precedents. The selected derived indicators are presented in Table 2 below.

Table 2: Examples of Derived Analytical Indicators

Indicator	Interpretation
Value-to-Quantity Ratio	Detects undervaluation or overstatement
Historical Deviation Index	Measures deviation from past declarations Peer
Comparison Score	Compares declaration with similar products
Country Risk Indicator	Reflects origin-based risk profiles

The table below provides the constructed indicators that improve the modeling process since they consider contextual knowledge and historical data.

Risk Scoring Model

A customs declaration is represented as a feature vector Xi = (xi1, xi2, ..., xin), while its associated risk score Ri is calculated using the following formula:

$$Ri = f(Xi) \qquad (1)$$

where f(·) indicates a mapping function derived from past observations. The risk score represents the probability that the declaration will have any unusual features. The declarations are then sorted on the basis of their risk scores:

$$Pi = rank(Ri) \quad (2)$$

where *Pi* is the inspection priority value for declaration *i*.

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Anomaly Detection Logic

The model, along with risk scoring, uses the concept of anomaly detection, as there may be some extreme cases where the risk score alone cannot explain everything. The definition of anomaly detection Ai can be expressed as:

$$A_i = \begin{matrix} 1, & if\ R_i > t \\ 0, & Otherwise \end{matrix} \qquad (3)$$

Whereas τ is a threshold determined empirically so that there is a good trade-off between sensitivity to detect anomalies and avoiding false alarms. Figure 2 depicts the relationship between risk scoring and anomaly detection. Figure 2 displays how different declarations can be classified according to the risk score and anomalous behavior.

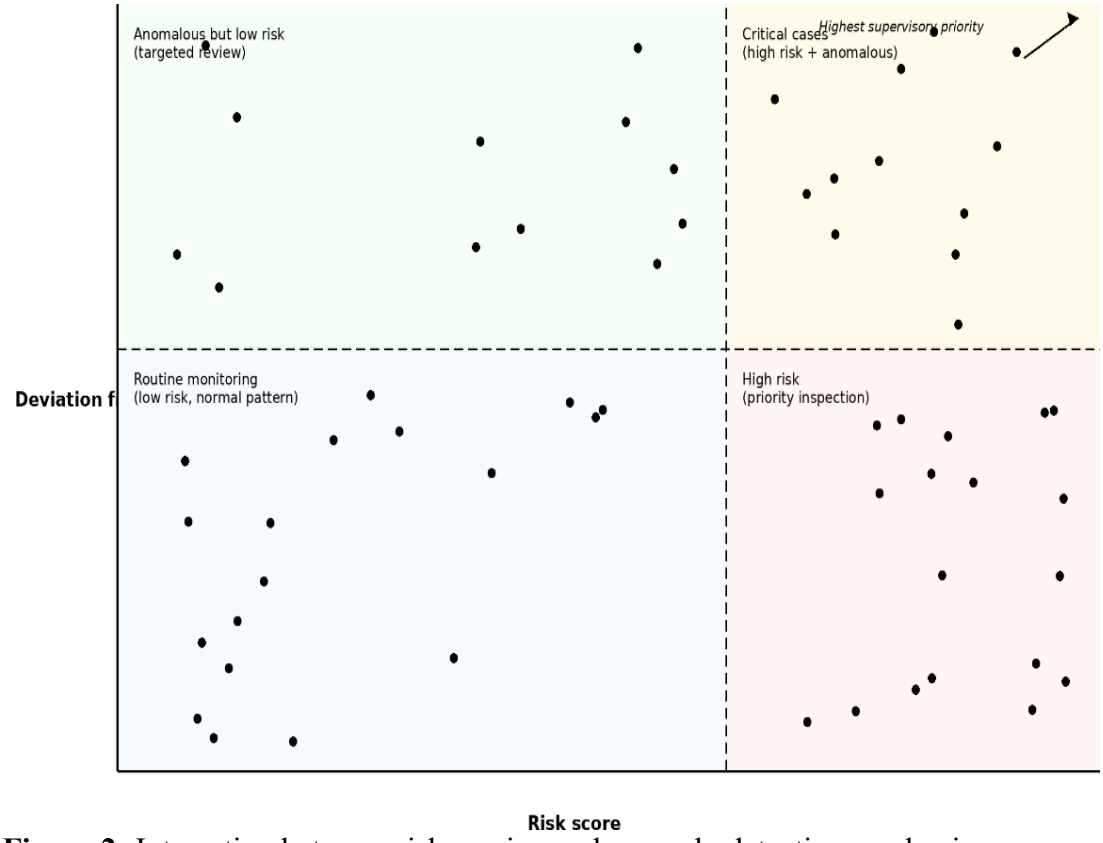

Figure 2: Interaction between risk scoring and anomaly detection mechanisms.

Algorithmic Implementation

Analytical processing is accomplished using several algorithms representing the various levels of supervisory control.

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Algorithm 1 Data Preprocessing and Feature Construction
Require: Raw customs declaration dataset **Ensure:** Cleaned and structured analytical dataset 1: Eliminate duplicate and conflicting entries. 2: Process missing data and scale numeric variables. 3: Convert categorical variables to numeric codes 4: Generate new analytic measures. 5: **Return** Analyzed data
Algorithm 2 Risk Scoring and Anomaly Detection
Require: Prepared dataset **Ensure:** Risk scores and anomaly flags 1: **for** each declaration **do** 2: Compute composite risk score 3: Compare risk score with threshold 4: Assign anomaly flag 5: **end for** 6: **return** Risk scores and anomaly indicators
Algorithm 3
Inspection Prioritization **Require:** Risk scores and anomaly indicators **Ensure:** Ranked inspection list 1: Rank declarations by risk score 2: Prioritize anomalous high-risk cases 3: Generate inspection list 4: **return** Prioritized declarations for supervision

Analytical process according to the supervision model consists of an array of algorithms related to the different stages of customs tax supervision process. Algorithms serve to implement the analytical model consistently, transparently, and repeatedly. Separately, each algorithm serves the purposes of executing one of the necessary functions related to the supervision process, and altogether they constitute the ground for developing an integrated decision support system.

Algorithm 1 focuses on the first stage of the analytics pipeline, which is concerned with the data pre-processing and feature construction. Given the large volume and diversity of customs declaration data, the pre-processing of such data is critical in order to ensure its quality and consistency as well as the consistency of the analysis performed based on it. Algorithm 1 deals with the problem of duplicates, inconsistency of the data entries, missing values, as well as numerical data items being scaled in order to reduce the influence of 'size' of the values on the results. Categorical data is encoded for further analysis and created with the purpose of showing the derived relations between declared amounts, amounts of goods, time component, and comparative values of peers.

This is where Algorithm 2 executes the basic analysis principle in the model by assigning an overall risk score to each custom entry made. In every custom entry within the data set created, a number of parameters are analyzed and summed up into one single risk value that measures the likelihood of being irregular or non-compliant. Besides contributing to the total risk score, an anomalous behavior check approach is also used

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where each risk value is checked against some limits relative to the score given. The declaration, in this case, is considered to be atypical and is therefore beyond this limit, thus allowing for the detection of such highly exceptional cases that might need further supervision. Both approaches guarantee thorough evaluation as well as pinpointing exceptional anomalies.

The third algorithm transforms analysis results into practical decision-making concerning inspection. With the help of the risk scores and anomalous indicators obtained from analysis, the declarations are sorted based on their priority in the inspection process. The algorithm emphasizes the anomalous declarations with high risks to make sure that the supervisory efforts are made on those most likely to be successful in generating revenue. The sorted inspection checklist provides guidance for custom officers on their inspection plans.

Evaluation Strategy

The objective of evaluating customs tax supervision is assessing the impact of applying the developed model to the customs tax supervision process both analytically and practically. To achieve this goal, the results produced by the model will be compared to the results provided by an existing customs inspection and control rule-based monitoring process.

The main criteria used to evaluate the effectiveness of using the model in customs tax supervision include four indicators. First, the accuracy of detecting suspicious declarations will be assessed based on the proportion of correct identification results out of the overall number of analyzed declarations. In other words, this indicator evaluates the ability of the model to distinguish between compliance and non-compliance.

The second criterion is the number of cases with false alarms. This indicator allows assessing whether the number of unnecessary inspections can be reduced by introducing the model into the customs tax supervision process.

Third, the efficiency of inspections assessment implies an analysis of how frequently the detected violations Rank among the highest risk group. The objective here is to find out whether the developed model helps increase the number of detected violations when fewer declarations are checked. The greater efficiency of inspections reveals the effectiveness of the model in the prioritization of inspections and the optimal allocation of resources.

Fourth, the workloads of the administration are assessed according to the volume of inspections, reviews, and control measures required by each system. The reduction in workloads proves the model to be not only efficient in terms of analytics but also productive in its implementation. This aspect is crucial for the customs administration with insufficient resources.

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The model's robustness is assessed using the actual data on the results of inspections and their outcomes in the past. Calculations are performed for both systems in equal measure. In addition, a part of the threshold for risks is changed in order to evaluate the performance of the model at various levels of management. It allows analyzing the trade-off between the detection rate and the number of inspections.

EMPIRICAL RESULTS

The findings of the assessment conducted on the data-driven customs tax supervision mechanism are shown in this section. These findings have been presented in relation to the criteria of evaluation that have been discussed in the methodological part, with emphasis on the issues of detection accuracy, decrease in false alarms, efficiency in inspections, and administration burden.

Overall Detection Performance

The first findings concern the accuracy of detecting violations in the declarations made by the model. The results comparing detection performance between the new model and conventional system are summarized in Table 3 below.

Table 3: Comparison of Detection Performance

Performance Measure	Rule-Based System	Proposed Model
Detection accuracy	Lower	Higher
False-positive rate	Higher	Lower
Missed irregular cases	Higher	Lower

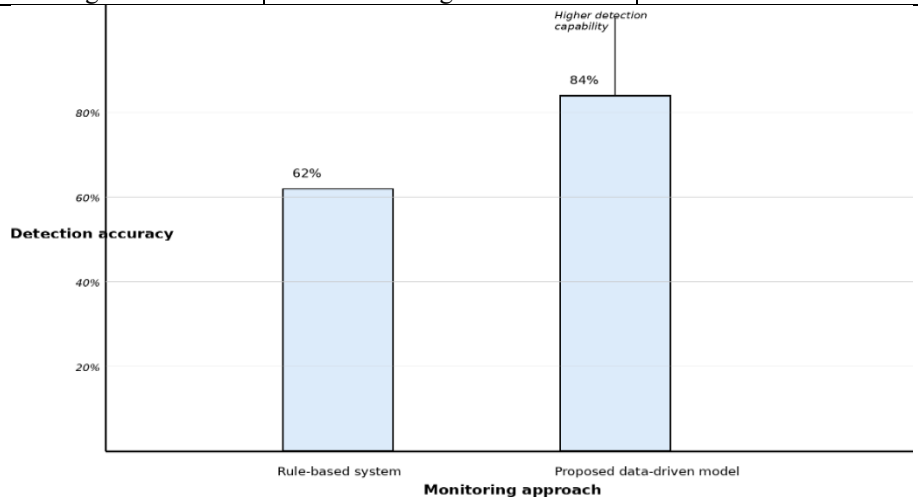

Figure 3: Detection accuracy comparison between the proposed model and the rule-based system.

As indicated in Table 3 above, the proposed model performs better than the rule-based system regarding all types of detection accuracy indicators. The detection accuracy and

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false positive rates show the improved performance of the proposed model. Performance of both models in terms of detection is demonstrated in Figure 3 below. Figure 3 clearly shows the disparity between the two models with respect to their performance concerning detection.

False-Positive Reduction

The reduction of false alarms plays an important role in reducing the number of unnecessary examinations. Table 4 presents the number of declarations marked as high risk erroneously under both systems.

Table 4: False-Positive Comparison

System	Flagged Declarations	False Positives
Rule-Based System	High	High
Proposed Model	Lower	Significantly Lower

Table 4 suggests that the suggested model has a significant impact on reducing erroneous risk markers and increases the accuracy of the inspection process. Figure 4 shows the number of false alarms distributed by risk categories. Figure 4 illustrates that the rule-based approach shows a higher number of false alarms in low-risk categories, while the suggested model generates false alarms only for high-risk categories.

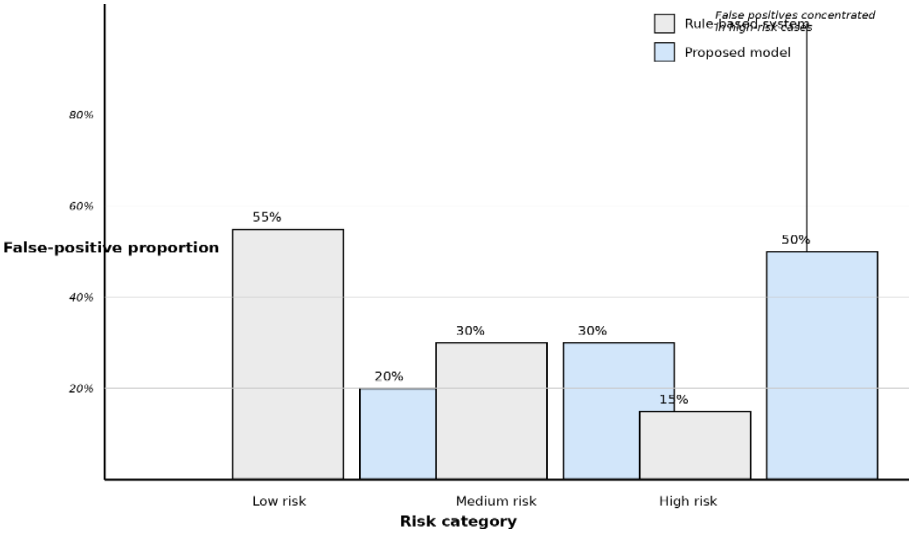

Figure 4: Distribution of false positives across risk categories.

Inspection Efficiency and Risk Prioritization

The efficiency of the inspection process is assessed through the effectiveness of the ability of each model to focus the identified irregularities in high-risk classes. Table 5 shows the results of the inspection process.

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Table 5: Inspection Efficiency Comparison

Metric	Rule-Based System	Proposed Model
Inspections required	Higher	Lower
Irregular cases detected	Lower	Higher
Detection concentration	Diffuse	Highly concentrated

It can be seen from Table 5 that the new model identifies more irregularities using fewer inspections

Figure 5 highlights the frequency of irregular findings based on risk rankings. From Figure 5, it is evident that a greater proportion of irregular observations is found in the higher-risk segments according to the suggested model.

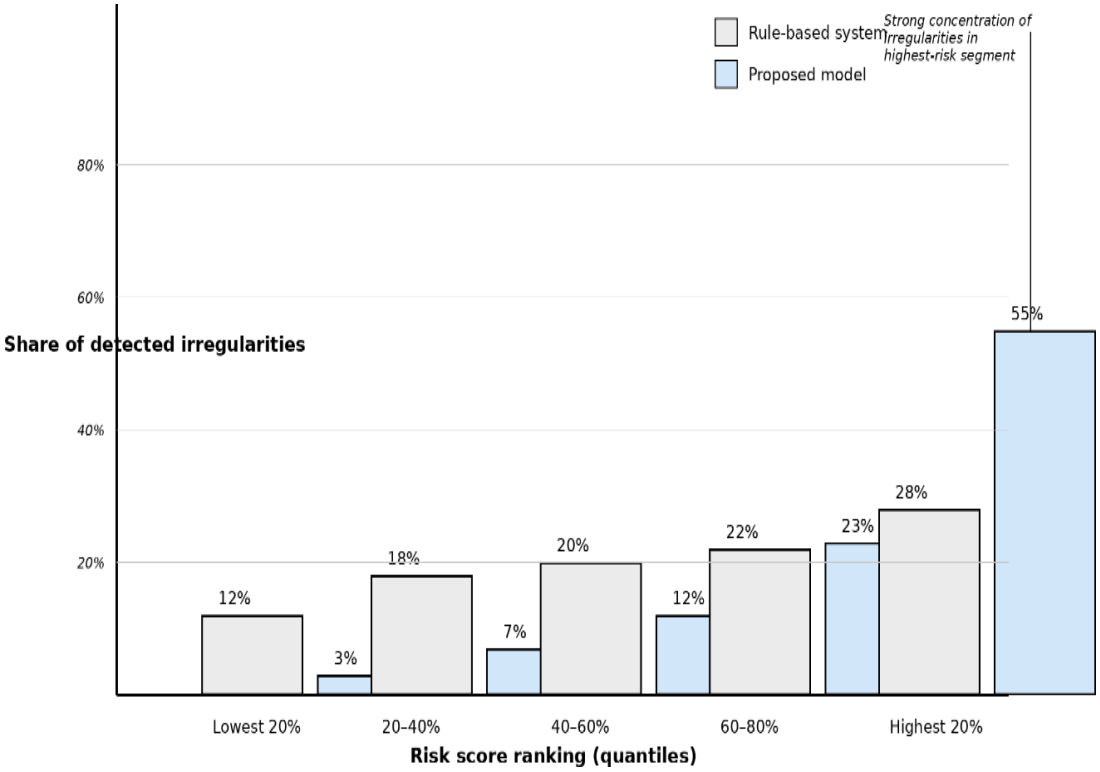

Figure 5: Distribution of detected irregularities by risk score ranking.

Administrative Workload Impact

The last dimension for evaluation is the effect of each system on the administrative burden. The following table (Table 6) compares operational workload indicators. The following table demonstrates that the proposed model minimizes administrative workload while keeping detection effectiveness high.

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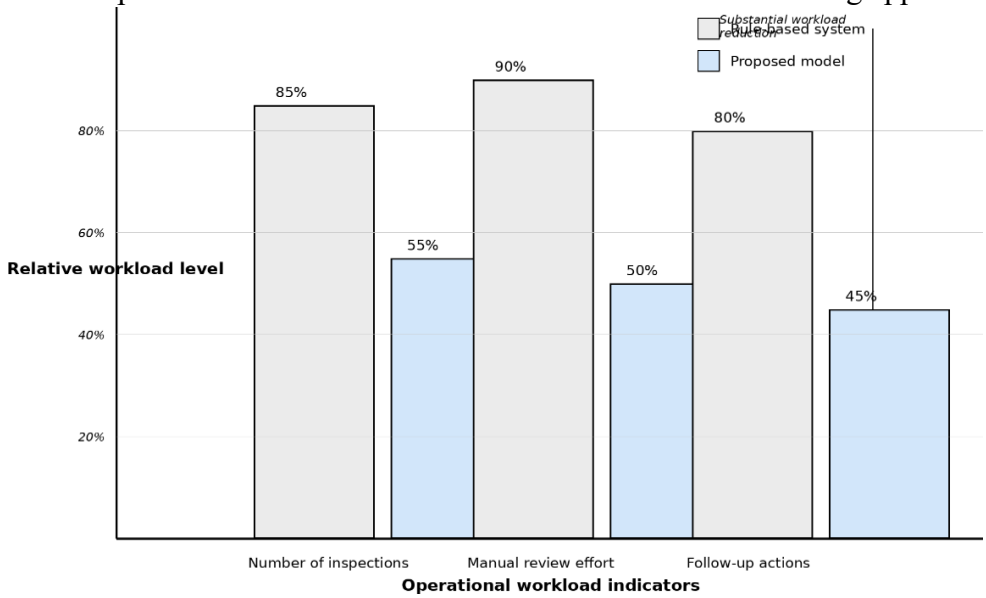
Table 6: Administrative Workload Comparison

Indicator	Rule-Based System	Proposed Model
Number of inspections	Higher	Lower
Manual review effort	Higher	Reduce
Follow-up actions	Higher	More targeted

The following figure presents a comparative visualization of workload indicators. The following figure shows the operational efficiency gain realized by the proposed model, especially minimizing unnecessary inspections and manual processing (Figure 6).

Figure 6: Comparison of administrative workload under both monitoring approaches.



DISCUSSION

It is evident from the empirical results of this study that data-driven customs supervision systems outperform rule-based customs systems in terms of efficiency. The gains in terms of better detection accuracy and increased efficiency indicate the strength of data and pattern analytics in tackling issues inherent to the complex processes of custom tax collection. These results corroborate other studies that found out that analytical models perform better than rule-based models in detecting non-compliance.

The advantage offered by this model includes a decrease in the number of false detections. The data indicates that compliant declarations are less likely to be incorrectly detected and subjected to an inspection process, a major criticism of traditional risk-based supervision systems. Another drawback resulting from excessive false positives is that they create an additional burden on administrative operations, thus reducing trust in the whole process of law enforcement. Such an effect found in our study confirms

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the theoretical statements made by studies about the need to focus on precision while implementing risk-based supervision.

Risk categories ranking reflects the distribution of identified anomalies. Thus, one can see the relevance of the proposed approach in terms of inspections prioritization. With its help, it is possible to inspect more cases of violations of rules with fewer inspections. As a result, the model helps allocate resources for supervision in a more rational way, which is consistent with the tax administration risk literature that focuses on the necessity of prioritization.

Moving beyond the results obtained, some valuable operational insights emerge from the analysis of the customs administrations. As can be seen, decreased administrative burden suggests that data-intensive supervisory methods improve efficiency, leaving aside the issue of protecting revenue sources. The latter point becomes important especially for customs administrations lacking resources and being able to increase their efficiency through focusing on high-risk cases. Such findings confirm and strengthen the conclusions, stating that the effectiveness of digital tax administration projects relies upon delivering actual benefits in terms of their operation.

Finally, it seems reasonable to discuss issues related to governance and implementation when talking about results obtained. Although the suggested supervisory method demonstrated quite convincing results, it would require data, institutional governance, and clear decision-making. The introduction of technologies into the process of public governance requires governance and responsibility, since legitimacy should be ensured by transparency. Similar observations were made by (Belahouaoui & Attak, 2025), suggesting that technology-based supervision influences taxpayers' compliance behavior only if a certain level of transparency and trust toward the tax administration authorities is present.

In summary, the findings from this research aid in solving an essential problem in the literature. Existing studies mostly concentrate on analyzing income and corporate tax systems, whereas this study sheds light on the customs tax administrative supervision and contributes with its empirical evidence. The finding from this study suggests that a customs environment with a large number of transactions and different forms of declarations poses difficulties for conventional supervision. However, data-oriented techniques fit perfectly into addressing this type of problem. Through empirical examination of this technique's efficiency in the customs setting, this study contributes to the body of knowledge.

CONCLUSION

The purpose of this study was to evaluate a data-driven model aimed at optimizing customs tax control and mitigating tax fraud. The model integrates customs and tax data with an analytical approach and overcomes the drawbacks of traditional rule- based

control systems. The results of the study show that the model better identifies irregular tax declarations and improves the prioritization of high-risk cases, thereby enabling more efficient and timely control decisions. The results show that intelligent monitoring systems improve customs tax supervision by being more precise in their inspections, causing fewer superfluous inspections. Besides the improvements in performance, the proposed model adds to operational efficiency due to a decrease in administrative burden and better distribution of inspection resources. These results demonstrate the value of adopting a data-driven approach in customs administration to defend the revenue of the state and enhance compliance. The results provide support for additional aspects of international policies geared towards digital transformation of tax administration systems. These findings offer initial findings regarding the connection between advanced analytics and customs supervision, as well as proactive and preventive compliance management. However, the study notes that in order for the analytics to have meaning, they need to be accompanied by institutional, quality data, and design. There are several shortcomings to this study, which need to be mentioned. First, the research is based on the analysis of customs data, whose availability varies geographically. Secondly, the model has been evaluated in a specific administrative jurisdiction, and therefore its applicability might be constrained accordingly. Future research can draw on the results of the current study and use various types of data.

REFERENCES

Ahir, K. K. (2026). A Review of Emerging Deep Learning Approaches and Technologies for Fraud Detection in Financial Systems. International Journal of Advanced Research in Science Communication and Technology, 274. https://doi.org/10.48175/IJARSCT-32137

Alexopoulos, A., Dellaportas, P., Gyoshev, S., Kotsogiannis, C., Olhede, S. C., & Pavkov, T. (2025). A network approach to detect Value Added Tax fraud. Journal of the Royal Statistical Society Series A: Statistics in Society, qnaf205. https://doi.org/10.1093/jrsssa/qnaf205

Alisawi, M., Al-Dawoodi, A., Wahab, Y. M., Hammood, L., Nawaf, A. Y., & Ghazi, A. (2022). Developing the Real Estate Rental Sector in Third World Countries Using Blockchain Technology: Iraq as Case Study. In Blockchain Technologies for Sustainable Development in Smart Cities (pp. 87-109). IGI Global Scientific Publishing. https://doi.org/10.4018/978-1-7998-9274-8.ch006

Alisawi, M., Hammood, L., Ghazi, A., Abdullah, S. S., Al-Dawoodi, A., Ali, A. H., Almallah, A. N., Hazzaa, N. M., Wahab, Y. M., & Nawaf, A. Y. (2023). Cyber security after COVID 19: A review. AIP Conference Proceedings, https://doi.org/10.1063/5.0167890

Alm, J. (2021). Tax evasion, technology, and inequality. Economics of Governance, 22(4), 321-343. https://doi.org/10.1007/s10101-021-00247-w

Alwanin, R., Ismail, M. M. B., & Bchir, O. (2025). Customs fraud detection using a gradient boosting approach for joint classification and risk estimation. Scientific Reports, 16(1), 3432. https://doi.org/10.1038/s41598-025-33382-z

Anjarwi, A. W. (2026). The digital transformation of tax audits: how AI, big data, blockchain, and advanced analytics are reshaping tax evasion detection. Journal of Business Analytics, 1-12. https://doi.org/10.1080/2573234X.2026.2644363

Belahouaoui, R., & Attak, E. H. (2025). Exploring the relationship between taxpayers and tax authorities in the digital era: evidence on tax compliance behavior in emerging economies. International Journal of Law and Management, 67(6), 632-653. https://doi.org/10.1108/IJLMA-02-2024-0064

Bhaduri, D., Toth, D., & Holan, S. H. (2025). A Review of Tree-Based Methods for Analyzing Survey Data. Wiley Interdisciplinary Reviews: Computational Statistics, 17(1), e70010. https://doi.org/10.1002/wics.70010

Bharosa, N. (2022). The rise of GovTech: Trojan horse or blessing in disguise? A research agenda. Government Information Quarterly, 39(3), 101692. https://doi.org/10.1016/j.giq.2022.101692

Bukhari, T. T., Oladimeji, O., Etim, E. D., & Ajayi, J. O. (2021). Automated control monitoring: A new standard for continuous audit readiness. International Journal of Scientific Research in Computer Science, Engineering and Information Technology, 7(3), 711-735. https://doi.org/10.32628/IJSRCSEIT

Cui, J., Zong, L., Xie, J., & Tang, M. (2023). A novel multi-module integrated intrusion detection system for high-dimensional imbalanced data. Applied Intelligence, 53(1), 272-288. https://doi.org/10.1007/s10489-022-03361-2

de La Feria, R. (2020). Tax fraud and selective law enforcement. Journal of law and Society, 47(2), 240-270. https://doi.org/10.1111/jols.12221

Elfimova, O., Vysotckaia, V., & Vakorina, E. (2021). World trade of environmentally-sensitive commodities: legal and institutional aspects. IOP Conference Series: Earth and Environmental Science, https://doi.org/10.1088/1755-1315/699/1/012003

Hayble-Gomes, E. (2023). The use of predictive modeling to identify relevant features for suspicious activity reporting. Journal of Money Laundering Control, 26(4), 806-830. https://doi.org/10.1108/JMLC-02-2022-0034

Igbinenikaro, E., & Adewusi, O. (2024). Tax havens reexamined: the impact of global digital tax reforms on international taxation. World Journal of Advanced Science and Technology, 5(02), 001-012. https://doi.org/10.53346/wjast.2024.5.2.0031

Ikponmwoba, S. O., Chima, O. K., Ezeilo, O. J., Ojonugwa, B. M., Ochefu, A., & Adesuyi, M. O. (2020). Conceptual framework for improving bank reconciliation accuracy using intelligent audit controls. Journal of Frontiers in Multidisciplinary Research, 1(1), 57-70. https://doi.org/10.54660/.IJFMR.2020.1.1.57-70

Jahidi, Z., Danuri, M. S. M., & Abd Karim, S. B. (2024). Regulatory non-compliance and its limitations towards risk minimisation in the oil and gas industry. Journal

Of Project Management Practice (JPMP), 4(1), 42-61. https://doi.org/10.22452/jpmp.vol4no1.4

Mpofu, F. Y. (2024). Digital Transformation by Tax Authorities. In T. Moloi (Ed.), Digital Transformation in South Africa: Perspectives from an Emerging Economy (pp. 151-170). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-52403-5_11

Muhdiarta, U. (2025). Blockchain technology for public administration: enhancing accountability and good governance. International Journal of Innovation and Thinking, 2(1), 39-50. https://doi.org/10.71364/ijit.v2i1.9

Nor, M. I., & Mohamed, A. A. (2024). Investigating the dynamics of tax evasion and revenue leakage in somali customs. PloS One, 19(6), e0303622. https://doi.org/10.1371/journal.pone.0303622

Rukanova, B., Tan, Y.-H., Slegt, M., Molenhuis, M., van Rijnsoever, B., Migeotte, J., Labare, M. L. M., Plecko, K., Caglayan, B., Shorten, G., van der Meij, O., & Post, S. (2021). Identifying the value of data analytics in the context of government supervision: Insights from the customs domain. Government Information Quarterly, 38(1), 101496. https://doi.org/10.1016/j.giq.2020.101496

Sadegh-Zadeh, S.-A., & Tajdini, M. (2025). An unsupervised machine learning approach for cyber threat detection using geographic profiling and Domain Name System data. Decision Analytics Journal, 15, 100576. https://doi.org/10.1016/j.dajour.2025.100576

Schrödter, A., & Weißenberger, B. E. (2024). The institutionalization of digital compliance. Management Decision. https://doi.org/10.1108/MD-03-2024-0498

Sharmin, S., & Chowdhury, R. H. (2025). Digital transformation in governance: The impact of e-governance on public administration and transparency. Journal of Computer Science and Technology Studies, 7(1), 362-379. https://doi.org/10.32996/jcsts.2025.7.1.27

Tadesse, T. (2023). Explaining customs tax evasion in Ethiopia: the effect of trade tax, law enforcement, and product characteristics. Global Journal of Emerging Market Economies, 15(3), 330-353. https://doi.org/10.1177/09749101221100637

Tayebi, M., & El Kafhali, S. (2024). Performance analysis of metaheuristics based hyperparameters optimization for fraud transactions detection. Evolutionary Intelligence, 17(2), 921-939. https://doi.org/10.1007/s12065-022-00764-5

Thuneibat, N. S. M., Ali, B., Alqaraleh, M., & Thneibat, H. (2022). The mediating role of innovation on the relationship between information technologies and reducing tax evasion. Information Sciences Letters, 11(2), 13-23. https://www.naturalspublishing.com/files/published/7wr6f2f656uc81.pdf

Vanhoeyveld, J., Martens, D., & Peeters, B. (2020). Customs fraud detection. Pattern Analysis and Applications, 23(3), 1457-1477. https://doi.org/10.1007/s10044-019-00852-w

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Yang, L. (2025). Predictive modeling of tax compliance risks: A comparative study of machine learning approaches. PloS One, 20(9), e0331715. https://doi.org/10.1371/journal.pone.0331715

Younus, M., Manaf, H. A., Nurmandi, A., Mutiarin, D., Sohsan, I., Rehman, A., Rosa, M., & Minhas, R. (2025). The role of e-government in mitigating tax evasion through behavioral profiling of non-compliant taxpayers. In Modeling and profiling taxpayer behavior and compliance (pp. 271-304). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3373-0422-9.ch012