AI-Powered Decision Support Systems for Enhancing Tax Compliance and Public Revenue Management

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Abstract: *Tax compliance is crucial for all governments to collect taxes that support the provision of services to their people. With AE-related schemes increasing in scale and complexity, it is now more essential than ever to provide and maintain effective mechanisms to ensure tax compliance. This paper presents an overview of the 4AI-QDSS system architecture that can: (1) account for this growing need by demonstrating how modern AI technology can be harnessed in tax compliance systems and (2) present Eunomia, a prototype of the proposed system. The presentation mainly rests on the TA-8847 report and documentation, which describes a comprehensive decision support system for tax compliance and public revenue administration. Tax compliance is crucial for quickly collecting taxes that allow governments to provide services to their people. Tax compliance is the government's effort decision to ensure taxpayers' adherence to statutes, regulations, and penalties concerning technology assessments and proper licensing for monitoring compliance. In an increasingly globalized economy, different jurisdictions are facing pressures from sophisticated tax avoidance and evasion strategies. With the recent signing by more than 140 countries and jurisdictions of the OECD- and G20-accompanied Multilateral Convention on Mutual Administrative Assistance in Tax Matters, along with a broad consensus on the Common Reporting Standard for Automatic Exchange of Financial Account Information, it is more essential than ever for governments to provide and maintain effective mechanisms to ensure tax compliance [1]. Taiwan's authority decision in this matter is thus of both urgent and significant concern at this juncture. This past decade has witnessed intensified scrutiny of offshore tax avoidance. On July 1st, 2006, the first meeting of a new government initiative was held to discuss ways to abolish the International Banking Unit's Tax Exemption Act. The Act had allowed foreign banks to operate in Taiwan, and for any local tax-free deposits held in US dollar accounts. In February 2014, findings that estimates of the annual tax-exempt losses of a large domestic insurance company, current member of the Taiwan Financial Supervisory Commission with a 101% administrative abbreviation, furnished the intellectual basis and initial charge for timely and ethically sound reform. In late July of 2014, the Director of General Administration of Taxation, Ministry of Finance, held a public meeting asking for opinions on regulations to be promulgated. It was the last call for the proponents to argue to remove any loopholes before the issue was sent to Taiwan's Executive Yuans [2].*

Keywords: AI, Decision Support Systems, Tax Compliance, Public Revenue Management, Machine Learning, Predictive Analytics, Government Technology, Fiscal Policy, Risk Assessment, Automation, Data Analytics, Tax Administration, Revenue Forecasting, Digital Transformation, Compliance Monitoring

1. Introduction

The loss of tax revenues is a major cause for many economic and social problems in modern societies. As public revenue systems become more complex, the need for understanding taxpayer behavior becomes increasingly pressing if tax policy makers wish to maximize public welfare. Computational solutions are beginning to offer empirically grounded and theoretically-informed policy implications [1]. As tax evasion is complex and often relies on a multitude of institutional and economic parameters, control policies must be equally complex and consider the nuances of taxpayer behaviors. To that end, computational approaches opt for a more stylized representation of economic phenomena. Such systems, comprised of finite state automata or software agents, evolve over time according to a set of simple behavioral rules, modeling the world in which taxpayers are immersed within the limitations defined by the environment.

Regarding the taxation of firms, recent work addressed the strategic interaction between firms and the tax administration in settings where the latter's optimal audit policies are derived in reaction to the former's behavior. To that end, a computational model with internally heterogeneous firms was developed. The feasibility of knowledge-based firm behavior

was established, along with efficient detection policies for the tax administration. This work can be viewed as a precursor to applications in revenue management, which are in much greater demand now; however, the need for simulation-based extensive exploration of the state space limits its scalability. The aim is to employ the same tax model along with more accurate detector hiring decisions, based on dynamic programming. Rather than modeling firms' behavior via sophisticated heterogenous-response algorithms, a simpler state-space form is to be proposed, following computational models with more simplistic behavioral rules targeting firm dynamics.

Once firms' behaviors are generated via reinforcement learning or other behavioral algorithms, the results can be valid inputs to an approximator; a random ensemble would generate a continuous trading-time series and "typical" behavior, in a richer representation than firms conforming to a few parameterized stochastic processes. Disregarding the economic machinations shaping behavior, still leads to waves of optimism and pessimism noticeably correlated with stock returns. In the financial domain, the emergence of discrete event Monte Carlo simulation of order-book-based agent-based modeling is preferred to creative micro-or-agent level models. On the other hand, measuring hidden state-space

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algorithms for approximate dynamic programming could induce an accurate retrospective way of understanding public revenue systems.

2. Background and Literature Review

The effective detection of tax evasion in the real world is an important issue and a practical challenge that jurisdictions constantly struggle with. An approach employed much more recently to tackle this problem is through the use of machine learning algorithms. Instead of relying on rule-based techniques, a model can be trained to predict the likelihood of tax evasion on returns filed by taxpayers using historical data. Input features can include characteristics of taxpayer that are present on the filings as well as macroeconomic variables [2]. Conducted in a simulated environment, a framework is set out that evaluates the machine learning prediction models that have been applied in order to detect return fraud. The effort to detect fraudulent taxpayer returns in the business property taxes of a revenue authority jurisdiction in the United States entails a two-phase design. In the first phase, base machine learning solutions are built to preprocess the data in order to tackle missingness of attributes and to handle unbalanced class outcomes through the application of resampling methods. Then, data selection and feature engineering is discussed including the use of a business knowledge-driven subset of hand-crafted group-based features, obtained using tag trees, are introduced to enhance modeling performance. In the second phase, generated solutions are used to deliver a decision support apparatus to revenue authority officials. Taxpayers are becoming aware of the risk of a tax audit and are taking measures to safeguard themselves from it. Risk profiling of taxpayers has become a useful tool in identifying high-risk taxpayers for audit to enhance tax compliance. Risk profiling attempts to correlate taxpayers' observable characteristics with their compliance behavior so that low compliance perceived taxpayers can be examined further to verify their actual tax compliance behavior. The income probability model (IPM), a generic parametric approach to risk profiling taxpayer compliance based on the Burgess missed consideration class is proposed. Taxpayers are aware of the possibility of a tax audit and are taking measures to safeguard themselves against it. Risk profiling of taxpayers has become a useful tool in identifying potentially non compliant taxpayers for audit to enhance tax compliance. Risk profiling attempts to correlate taxpayers' observable characteristics with their compliance behaviour so that low compliance perceived taxpayers can be examined further to verify their actual tax compliance behaviour. The income probability model (IPM), a generic parametric approach to risk profiling taxpayer compliance based on the Burgess missed consideration class is proposed.

3. The Role of AI in Decision Support Systems

Tax authorities are under pressure to enhance their automated selections of tax audits and reviews. This poses considerable cognizance challenges and requires augmented decision support for reducing potential entry errors and creating public revenue benefits. Public management controlling (taxes, VAT, and customs duties) is liable for reaching the pre-existing amounts through secondary decision processes with observable performance. Nevertheless, this entails an extremely high amount of corresponding decisions and high cognizance demand for all involved taxation and customs workers.

The AI applications employ function centric digital approaches with AI-supported analysis algorithms exclusively [3]. The demand of input data and pre-existing knowledge is disregarded and considered as given. The taxation examiners as knowledge workers are responsible for all higher and remarkably cognizant steps. Nevertheless, an admonished combining of output data presentation and input systems can still have a positive contribution to a more effective decision process compared to non-AI solutions [4]. The objective is to show an AI-powered decision support system for augmenting knowledge work in the area of taxation inspections.

The term "decision support" is used as a probabilistic degree of automatic decision involvement made by the DSS equivalent to the degree of observability of the output decision. Decision support systems (DSS) are explicitly designed information processing and communication systems that aid decision-makers in the cognizance and/or act stage of a decision-making process. DSS support semi-structured and unstructured decisions by presenting computer-generated analysis results. The analysis suggestions are then elaborated further by a user, and a manually made final action is required. Decision support is a concept typically used for conventional statistical and simulation-based area.
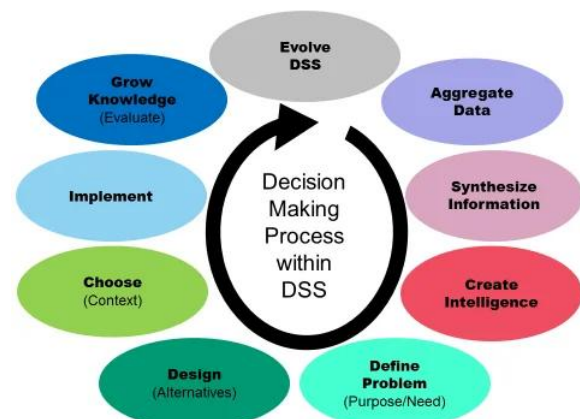

Figure 1: Decision Support Systems

3.1 Definition and Importance of AI

Artificial Intelligence refers to systems that simulate human intelligence and believed to change the way decisions are made. These systems use data from ever-increasing computational and information sources, extracting correlations across numerous dimensions and datasets, even ones previously regarded as uninformative. The AI approach is deemed appropriate for tasks suggested to have been too complex to program explicitly [5]: those where the causal relations among inputs and outputs are understood but too complex to express in code. Such tasks occur largely in domains characterized by uncertainty, where the objective is to find optimal policies in a stochastic, high-dimensional state space. AI methods are increasingly viewed as viable candidates for addressing issues in the realm of information economics. AI systems using Machine Learning (ML) enrich

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a long tradition of mathematical methods intended to detect patterns in datasets [3].

Public revenue management is complex due to the nature of the revenue, with multiple concurrent decisions made by different agents, both human and non-human. Non-compliance decisions are formulated by tax officers, and taxpayer decisions pertaining to compliance are handled externally by monitoring and enforcing authorities. In consequence, individual tax compliance can be modeled as the interaction of multiple decision systems. The tax system motivates revenue developers and enforcers. Taxpayers use tax advisors to manage compliance. Against each taxpayer behavior, decisions are made to handle detection, punishment, and subject fairness. AI and data have profoundly impacted all tax system elements, from initial development of the tax regime to subsequent public policy shaping. They remain vital for measurement and improvement of tax system considerations not directly related to public finances.

3.2 Types of AI Technologies Used

Tax administrations currently use AI technologies for many purposes. The three most commonly used technologies are machine learning (ML), natural language processing (NLP) and robotic process automation (RPA). ML is widely used to enhance audit processes, improve risk detection, detect fraud and money laundering, estimate revenue from newly developed economic activities, improve decision making and taxpayer profiling. NLP is used to interpret taxpayers' messages, monitor social media sentiment on topics of interest and read financial statements. RPA is used to automate the processing of documents and taxpayer information transfers. In using NLP technologies, the OECD also relies on sound methodologies, including clean datasets as well as additional information about the text's author [6]. Governments are currently preparing for how to regulate the use of AI technologies in the public sector. In the EU, legislative proposals are being prepared that may heavily influence AI use in government settings. The OECD has already set standards for the use of AI in the public sector, addressing aspects such as transparency, accountability and citizen engagement. Given the short time frame of this analysis, coverage will be limited to the aspect of automated data processing and recommendation, or "black box" legislation. Although this analysis focuses on the OECD in relation to general knowledge aspects of data processing at tax administrations, automated decision-making is expected to get comprehensive coverage in future AI legislation by OECD member states.

While the AI White Paper sets out the approach to classify systems by risk level and the associated legislation, finding examples of actual classification schemes that government departments can use in practice is difficult. In the context of knowledge antagonism, the current approach has significant implications. By implicating that citizens cannot or may not monitor the actions of administrative bodies, OECD member states may create an overly cumbersome legislative framework. On the other hand, through inaction, member states will have to continue to stand empty-handed against the growing social discontent regarding data processing practices in the public sector.

Tax Compliance Challenges

Noncompliance is a universal concern, with many developing nations affected. Cheating on taxes erodes trust and alters the role of government in society. Noncompliance is a severe problem for nearly all developing economies, leading to insufficient public revenues and poor provision of public goods and services. Concerns about lower tax compliance raise daunting questions about how to persuade people and firms to comply with requirements. Tax authorities must do more than write regulations; they must consider how noncompliance emerges and what solutions might make sense.

Eqn.1: Revenue Function with AI Decision Support Integration

$$R_t = \tau_t \cdot Y_t \cdot C_t$$

- τ_t: effective tax rate at time t
- Y_t: declared income (tax base) at time t
- C_t: compliance rate at time t, a function of AI support

Destructive patterns emerge that maximize the amount of tax evaded and undermine even the best decision rules. Nested security decisions deepen these evasion traps, as changes in tax agency behaviors lead to more sophisticated tactics by evaders. Trust in tax authorities diminishes, and an underground economy emerges. These ideas are formalized in a system dynamics model applied to the specific case of Zimbabwe. The model explores the dynamic behavioral patterns that arise from these decisions. Simulation results illustrate how well-intentioned but narrow-minded agency decisions can deepen the concerns of policymakers. Experimental simulations investigate the effects of new systemic drivers to address capital flight [7].

Modeling tax compliance levels is important as income tax varies across countries, enhancing comparability. Estimation of compliance levels can take the form of stated preferences using surveys and indirect measures. Data availability differs drastically across compliance levels. Audit data can be relevant for the highest compliance level, but not every country has them. Most estimates on international comparisons are indirect and done with stated preferences, leading to conflicting results. Several studies analyse taxpayers' decision-making in observance and evasion.

4. Current Issues in Tax Compliance

Tax revenue is the cornerstone of the government's income, which, if managed well, could benefit the citizenry in many aspects of life, including education, safety, infrastructure, and facilities. Hence, at the heart of public revenue management is effective tax compliance, which is all stakeholders' concerns, including the government, society, and individuals. In the majority of cases, the love-hate relationship between tax authorities and payers has been increasingly tense owing to expanding governments' needs beyond the capability of the current income. Nevertheless, given the many efforts exerted by the tax authorities across the world, such sentiment towards tax compliance has been challenging to eradicate in

order to achieve citizens' voluntary compliance and with that a high revenue management effort [8]. While there are many factors that may affect tax compliance and public revenue management that require understanding and attention, such factors can be broken down into three broad categories, each capturing a range of pertinent issues that are in turn vital for enhancing tax compliance and public revenue management effort. Such tax compliance factors and their corresponding issues could not be studied independently, differently, and arbitrarily, nor could each case be equated and evaluated numerically to facilitate benchmarking and comparisons. Rather, how they interrelate, impact, and draw inference require a more comprehensive and holistic approach to elucidate and some quantifying analytics to facilitate evaluation. On the other hand, it is noteworthy that both artificial intelligence (AI), as the frontier technology in the fourth industrial revolution, and recent data management advances have profound implications for closing compliance gaps and improving compliance management and enforcement capability. Such approaches if effectively harnessed, and coupled with improvements in regulations, institutions, and procedures, promise to improve the efficacy and efficiency of tax collection efforts, thus enhancing tax compliance and public revenue management.

4.1 Impact of Non-Compliance on Revenue

Tax compliance is a key issue to maximize revenue and ensure equity [7]. The effective operation of any government sector, including public services, infrastructure development and maintenance, law and order, and healthcare delivery, is possible only through the collection of public revenue. Tax non-compliance leads to significant losses in revenue, resulting in the inability of the government to meet its aims and objectives. This loss is not borne equally by all taxpayers; tax non-compliance reduces equity and undermines confidence in tax systems. Many tax authorities face issues with taxpayers failing to comply with tax laws.

Taxpayers exhibit differing levels of compliance tendency, and individuals with very low compliance tendencies are difficult to identify. Off-setting non-compliance through the identification of compliant taxpayers is challenging for direct assessments, where each taxpayer provides assessment information. Maintaining consistency in the treatment of compliance is not possible for self-assessments. Continued failure to comply with tax laws raises concerns about efficient use of auditor resources to maximize compliance. Substantive changes to compliance rates, files where compliance tendencies have not been previously influenced, and using fatigue in audit cycles to affect compliance requirements can affect the numbers in a manner that is difficult to measure or maintain.
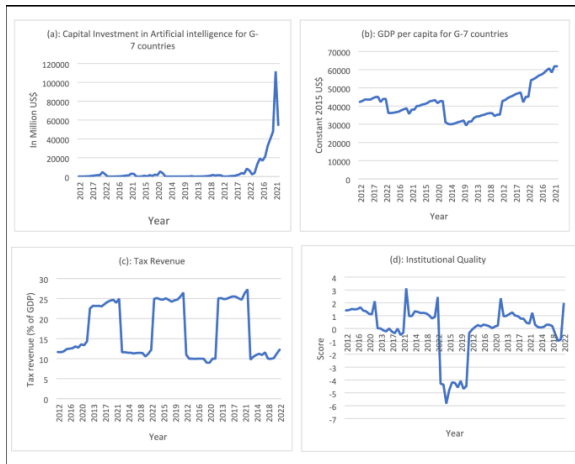
Public Revenue Management
In-depth examination of the methodologies, results, and contribution of the research could improve understanding of a framework of transparent and adaptive information, decision, and revenue simulation systems for taxation policy analysis and public revenue management in general using agent-based modelling and numerical simulations. Proactive policy assessment simulation systems could allow government authorities to test the implications of policy adjustments before they are publicly announced, to lower the risks of unintended outcomes. A framework for generalisation of public service and policy domain specific methodologies could make transparent and adaptive agent-based policy assessment possible in general, providing a first start catalogue of domain-general agents and policy component structures. With gradual improvements in transparency, a rich understanding of policies and their effects could emerge in the domains of taxation and public revenue management. This understanding would not only allow for transparent public policy management, evaluation, and assessment, but also generate new improvements related to the fairness, efficiency, and loyalty of tax collection. An entirely new topic could emerge by incorporating new innovations in artificial intelligence and machine learning, such as unsupervised and self-learning agents, adaptive choice rules, and deep reinforcement learning. Since the collection of indirect taxes is generally administered by the central government in most countries, the focus is only on estimation of direct tax revenue. The paper contributes to estimation of direct governmental tax revenues from firms. The analysis is medium-term, taking up to three years to be modelled adequately, again to make sure that a sufficient understanding of revenues over the entire dynamical support is obtained. Besides tax revenues, transformative taxation policies have far-reaching socio-economic consequences. A last reflection concerns the upscaling of the exploration of firm decision-making. Several different models could structurally and analytically examine sensitivity of switching incentives and fractions of firms switching to deductions to adjustments in input variables of firms decision-making. Considerable risks are involved when complex models undergo change without another thorough analysis, showing that pressure forcing governments to change decisions can very well backfire. Again, rigorous analysis of effects, including robustness analyses in the context of noise in the inputs and sufficient structures, should precede consideration of change in tax policy.

5. Overview of Public Revenue Management

Effective tax administration is characterized by the existence of a law-based taxation, efficient tax planning and policy, accurate structure of tax in public revenue, comprehensively efficient tax collection, supportive accruing, and recording system by the qualified available information technology, and appropriate, effective, efficient, and continuous law enforcement. Tax is a governmental levy imposed on resident or foreign taxpayers over the indirect or direct transaction, income, gain, dividend, salary, wealth, and asset, or over the other ability to pay with a certain amount, regulation, and requirements set forth in the prevailing taxation law, which will be utilized for the interest of the state and the prosperity of its people [9].

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Figure: Leveraging the potential of artificial intelligence

Tax compliance is a taxpayer's compliance to meet every tax obligation based on tax regulation, such as registering at the tax office and reporting as an online SPT to the Director General of Taxation with evidence of stamp duty. Tax compliance means a condition wherein a taxpayer pays his/her tax on time according to the provisions by not attempting to falsify or conceal true information. Compliance is regarded as the extent to which a tax obligor (a taxpayer) meets his/her obligations as stated in the Tax Law. Tax compliance is affected by tax-related aspects which can be categorized into legislation and regulations, tax knowledge and understanding, tax service and treatment, tax audit and investigation, perception on tax punishment and penalty, tax socialization and information dissemination, tax morale, tax amnesty, and tax obedience, as well as tax amnesty.

5.1 Importance of Effective Revenue Management

Growing revenue is a priority for governments in developing and emerging countries. Collecting taxes can deepen political legitimacy at no extra fiscal cost. It can increase demand for public goods, such as health and education, particularly in the absence of redistribution. This implies a focus on the wealthiest taxpayers and compliance of their taxes. Governments are looking for more effective revenue management in a later stage of development. They are considering increasing tax education, selective audits, and installing tax monitoring software that examine the specific structure of firms. Improving compliance to declared taxation revenues is a way to grow revenues without requesting governments to do farther than they consider is an "acceptable" compliance and lose "good" taxpayers. Failure to prepare and manage firms with software may have a smaller impact than other changes. Consultancy firms offered their services to tailor proposals, notes, and parameters that governments should include in tax software implemented at firms.

Most research on tax compliance has adopted some version of the Becker model which assumes that taxes are perceived as a one-sided lottery. Detection probability, statutory rates, and penalties are the core parameters that cause simulated tax compliance. Faster detection may lead to higher compliance, as is clear from random audit programs in Italy and Mexico. Better legal systems are expected to be associated with lower tax evasion. Encouragement if frequent audits are not possible is to conduct fewer but larger audits. In the sought after solution, consent is to be obtained from firms to allow the law to gather and process data, and governments anticipate a deterrent on their side [10]. Understanding how agreements to share firm data appear is a conundrum.

Return on capital diminishes as capital outflows and cost of taxation rise and falls with a corresponding gain on domestic distribution and investment. Capital flight and tax avoidance vary positively with the statutory rate of tax. Growing tax enforcement undermines both effects. Better education decreases income inequality and political participation rises with inequality. Provision of public goods is key but takes time and agreement, and by aggregation is thus impractical. Suggestions for tax policy involve lobbying, information, and delay [9].

### 5.2 AI Applications in Tax Compliance

The interplay of income taxes and corporate accounting is examined in a stylized model in which firms act as risk-averse agents. Furthermore, a thorough assessment of conditioning attributes and effects that can help to curtail tax evasion appears to be lacking in the literature on tax compliance and public revenue management [11]. By bringing these contributions together, it is anticipated to increase the research agenda regarding the interactive AI applications dedicated to TRM challenges, in particular, tax compliance. Compliant taxpayers are generated by tax administrations. A public organization using scenario-based deep Q-learning as the basis of a multi-agent simulation model mimicking firms, auditors, and controllers has been designed together with a citizen science campaign. All agents target their rewards while long-term strategies only for the tax administration are discussed.

Q-learning is employed to confer the procedure to adjust auditable transactions, to become records with penalties, and to revenue losses, besides in-house compliance investments. After hundreds of simulation runs, some unexpected but reasonable behaviors and strategies, e.g., random opportunities, would emerge. Maximal evasions foreseen lead to an adjustment of personality constants attendant to learning capabilities. Ultimately, the controller's satisfaction gains importance, achieving a trade-off between long-term benefits and the kind of day-to-day operations. A parsimonious representation of a firm's strategy abstracted with the help of the agent-based simulation model and learned with a hybrid concatenation of deep policy, Q-learning, and model-based values has been endowed to reinforce the compliance, public revenue management, and decision support systems through audit trail evaluations, predefined traps, and dynamic career paths.

The value-added research agenda in multi-agent adaptability in a second-best framework would bear personalisation and scenarios to fine-tune parameters and strengthen the citizen science initiative profitability. It would also target the renewal and transferability of the simulations, the usefulness of seekers, and the public interest.

6. Predictive Analytics for Compliance

This section describes how AI-powered predictive analytics can enhance compliance by empowering enhanced decision support systems for the anticipation of taxpayer behavior. Until recently, the compliance prediction domain has primarily centered around evasion (risk) prediction, mainly using classification-based approaches [2]. However, the ensuing development and proliferation of enhanced taxpayer delights have made compliance anticipation necessary. Beyond that, massive, and increasingly pushing amounts of additional data are made available across all tax areas and domains. Rendering a reconsideration of the base problem explicit, an entirely new, pioneering approach to compliance anticipation based on forecasting and regression analysis is described. It develops on classical forecasting methodology, ML regression algorithms, and new data infrastructures and rooted analytics for enhanced pre-compliance anticipation. Compliant- or delighted-enhancing measures can be guided by this anticipation in a proactive manner. A proof-of-concept of the system is presented, which includes the underpinning architecture, the reasoning and methodology, the implementation of a regression-based pipeline system, as well as an analysis of its applied gain through a short usability study at a DTA.
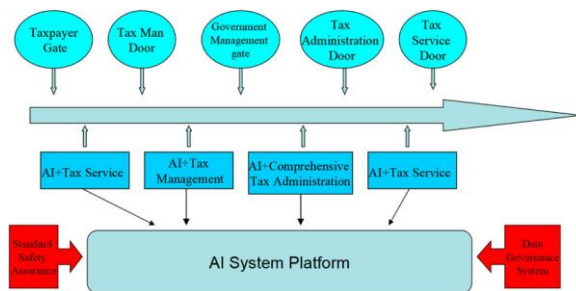
Figure 2: Optimization of the environmental protection tax system

Predictive analytics is a data analysis technique that utilizes statistical algorithms to predict future behaviors, while building predictive analytics algorithms involves selecting the opportunity dimension; selecting the mission outcome measure; identifying, preparing, and cleansing data; selecting and applying appropriate modeling technology; and ultimately assessing and applying the models. Data exploration involves detail-level profiling as the means of understanding observed data behavior by examining transactions, variables, and model performance. The data for tax compliance were obtained from a survey conducted to measure taxpayers' attitudes and behaviors: the Taxpayer Transparency and Trust (3T) Survey (TTT). The final dataset consisted of 84 compliance risk indicators, representing the level of compliance with tax obligations and values from longitude (D) and attitude orientation (A), measured on scales from 0 to 3. Of these 84 indicators, 36 were selected for detailed modeling, while the supporting enforcement measures and factors were composed of seven deterrence variables, 57 factors beyond tax policy measures, and 16 characteristics of investigation methods (D) and monitoring mechanisms (M). The final dataset consisted of 26 deterrence indicators indicating a country's citizens' perception of enforcement measures and values from continuity (D) and approach (A), and of 47 contextual and institutional indicators. The idea of added value remains the key metric for accurately measuring the output of each model to be used and evaluated.

6.1. Fraud Detection Mechanisms

Various international organizations have conducted studies affirming that public revenues in developing countries are lost mainly due to tax evasion by mega taxpayers and digital economy companies. On the other hand, tax administration in developing countries lacks the necessary knowledge, technologies, and resources to search for and collect information on suspicious transactions of mega taxpayers [12]. Also, there is a lack of experience among government analysts in detecting and filing criminal charges against these business entities. To address these tax compliance vulnerability, known as "tax evasion risk management" in this article, public revenue authorities in developing countries should implement an AI-powered decision support system. This proposal focuses on AI-powered risk management which continuously predicts and measures the tax evasion risk of mega taxpayers and alerts tax administrations proactively, rather than once a year audits based on the available files [13]. Proposed is a state-of-the-art AI-powered fraud detection mechanism which uses explainable machine learning algorithm called "XGBoost" and MLMTD theory. This innovative mechanism identifies at least twenty suspicious transaction types and risky behavior which are employed by the mega taxpayer to evade public revenue. Through detailed workflow, it generates parameters that transform transaction primitives to calculated transaction outputs and parameters which populate suspicious transaction types are fed to the ML algorithms. Based on the legacy transaction dataset and output labels generated by the AI-powered prediction algorithm, the "XGBoost" model is trained and validated respectively. They investigate the knowledge distribution of model prediction. If any suspicious behavior is found, it will be marked as generated alerts for further assessment by the tax investigators.

6.2 Automated Reporting Systems

Encouraging greater compliance by means of automated reporting systems falls within the purview of tax administrations (TAs) using engineering instead of legislation. It implies that taxpayers will be made to submit to TAs all relevant financial and economic data gathered from various financial institutions. A proper exploitation of such data could make it possible for TAs to bring tax compliance rates close to 100% in many countries. Greek tax administrators could attain the same outcomes if all accolades given to the excellent performance of TAs in some fields were rigorously examined. Such task implies taking a great deal of education, premeditated slow and gradual implementation, and a scrupulous work by all Greek TAs. The task is achievable with certainty but moving a mountain is never an easy task and requires strenuous effort [14].

The main political parties in Greece should cooperate in tackling the problem of noncompliance. It is advisable that beforehand the positions of all stakeholders including TAs, taxpayers, judicial and law enforcement authorities were synthesized into an all-inclusive national tax compliance

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strategy. Within such a framework, possible approaches to enhance tax compliance should be identified together with analytics employing the social choice optimization paradigm. Alternative scenarios pointing out quantitative compliance enhancement and revenue collection forecasts could be produced, and the most favorable one be chosen and implemented.

Modern e-policies regarding major components of taxes functioning with the market economy like the monetary system, the stock market operations, etc. could be formulated and discussed. TAs could be strictly trained to graduate from the estimation of tax base and tax credits to a routine operation with mandatory precise computerized reporting. At the last stage, a modernization of publicly owned enterprises could be initiated. Ownership should be vested in private bodies since ownership inalienability by TAs could be misused triggering oppressive reconstruction.

7. Case Studies

In Kenya, tax revenue contributes a broader percent of the government revenue compared to any other source of revenue. Corporate tax audits are the process through which the government verifies the accuracy of taxpayer returns. Audit case selection process is an important step in corporate tax audit where some tax payers are selected for scrutiny assessment. Assessment process not only takes away scarce resources from KRA but also voluntary compliance could erode should taxpayers feel that tax audit is inefficient. Therefore, it is important that the authority deploy its resources on audit cases worth while so as to give tax audit meaning. The authority assesses tax compliance risk on the basis of numeric indicators derived from ongoing audits. However, these indices have inherent bias against tax payers that have been audited accrued from experience gained through continued scrutiny. Therefore, a case-selection model akin to a generalized linear prediction/model to assess taxpayer corporate tax compliance risk is needed. This model ought to retrieve only significant compliance indicators from any available electronic corporate data and quantitative indicator. Further, an ongoing evaluation model is desirable to determine compliance status of tax payers that cannot be assigned to either compliance or non-compliance based on numeric data. Compliance is the task of carefully matching the needs of the domestic economy and the global economy so as to raise the necessary funds for the Government. Whether and how proposed policies are implemented can pose a significant risk to compliance. Companies would keep a careful watch on measures to eliminate restructuring models. MNEs would watch the horizon to design agreements in line with alternative national guidelines.

Eqn.2: Behavioral Compliance Model

$$U = (1 - p_t) \cdot U(Y - \tau \cdot Y) + p_t \cdot$$

- p_t: AI-enhanced probability of audit
- θ: penalty rate for evasion
- Y: true income
- τ: tax rate

Tax administrations around the world are facing a growing need to develop innovative strategies to more effectively address the tax gap, revenue loss that occurs when businesses and individuals do not pay all the taxes they owe. This study presents a pioneering research effort that attempts to classify tax non-compliance behavior, explore potential compliance techniques, and develop a classification model to predict tax non-compliance in the corporate income tax context. The increased use of computerized, internally developed tax preparation software being used in tax audits, and the automated deployment of business intelligence tools has seen new opportunities for compliance analysis become possible. The revenue/profit determined by each MNE depends on the location of its manufacturing facility or the geographic area where demand originates from. The final/book profit with which the company pays taxes is just a matter of accounting. Tax avoidance as the practice of not paying taxes by finding clever ways of avoiding the legal definition of tax.

In Canada, a preliminary analysis conducted on Saskatchewan's property tax system showed that the current method for appraising and adjusting assessments was inefficient. In this study, it was suggested implementing a Machine Learning model based on Random Forest regression and a geographical database to convert property information into features. Such predictive capabilities are expected to help develop an Intelligent Decision Support System for the province's property tax system. It is hypothesized that the adoption of such technology would save managers' time, help keep assessments up-to-date for public revenue purposes, and make property taxpayers accountable for their liabilities when required. Deliverable 3 includes a feature set that requires further development of the Decision Support System. Features extracted from the aforementioned features are summarized to document the forecasting process. Based on the Random Forest regression analysis conducted, it is checked which of the 92 input features significantly influence the assessment. This model was selected as the best by evaluating its goodness of fit on the training data and the goodness of predictions on the validation sets. Numerical values representing the relative influence of features predicted by the Random Forest model are documented to determine which features are to be included in the reporting tools. The decision maker can examine those important features to determine adjustments in property tax appraisal and classification. In many countries, it is the local governments that administer the property tax system. Decisions regarding the modelling will be made, as the structure of tax administration varies widely around the world. Nevertheless, results are expected to positively influence the local government's capability for taxation system upgrades in regard to transparent and legitimate removal of subjectivity from tax appraisal. In South Korea, tax managers recently adopted Optical Character Recognition technology as the new Office Automation system for incoming fax work. This new OCR-based OA system is capable of collecting, extracting, and processing tax relevant information from incoming fax documents automatically. Normally, tax compliance involves various documents that should be submitted by taxpayers periodically. Although the law mandates submission of these documents within a certain period, many taxpayers are either late in submission or aware of the prescribed action. In line with increased document

requirements due to tax evasion attempts, the number of submitted documents also has drastically risen. To handle this big data in an appropriate way, a plan using OCR application was developed to implement a new OA system. Normally, tax managers manually check incoming documents on fax machines at fixed times in a day. This checking produces tax cheaters' reports that are submitted to tax audits when substantial tax evasion is identified. However, such reports cannot cover all suspicious cases, producing a kind of lottery based manual screening. In addition, excessive effort is spent in collecting evidence to prove wrongdoings after tax evasion. AI technologies have been rapidly evolving and can be used to transform PA so that it becomes more effective. Such a transformation will involve the implementation of a variety of tools enabling countries to implement AI-PDSS, allowing tax authorities to implement big data analytics based on AI algorithm models. Such models will evolve over time, as countries and tax authorities build more and more information and data sources and tax compliance ways. A comparative analysis of different parameters across countries' performance can provide significant insights into the initial performance of AI-PDSS implemented in different countries for different areas of tax compliance. At least four areas of comparative analysis can be considered: the emergence date of major AI-PDSS tools, the share of voluntary disclosure compliance, the share of trends monitored in participation of audits planned, and the share of upward compliance trends observed from similar behavioral models.

AI-PDSS tools are capable to rapidly analyse huge amount of pre-selected data from different sources. Countries have classified those sources into six main types of comprehensively analysed information and data sources. It is the amount of heterogeneous sources that provide more or less comprehensive and consistent results across countries. Countries with high numbers of sources tend to register higher shares of voluntary disclosure compliance. Routine tax declaration data sources provide great opportunities for incorporating and providing significant hints for further analysis, allowing risks and probabilities of observing different behaviours by taxpaying agents to evaluate and calibrate. Various behavioural-models based tools have been rapidly implemented by tax authorities of three Eastern European countries in addition to standard data scraping models that can generally be used by any country regardless of its development level. Those AI-PDSS tools capable of monitoring different trends of PA made on the same day across countries have showed that participation in audits planed typically grows day-by-day, although the monitored growth rates could vary significantly across tools and countries [15]. More advanced AI-PDSS models, capable of exploring soft estimates for building different behavioural models that outline expected means and bounds of compliance, are still under development. Despite such initial comparative metrics across countries' performance, future upgrades are expected to help countries and tax authorities significantly improve their capacities in identifying the most noncomplying taxpaying agents from many similar tax-payers. Hopefully, this will help more developed countries to succeed in supporting development of lower-capacity countries for narrowing the global NA gap and contributing to more just and equitable tax systems.
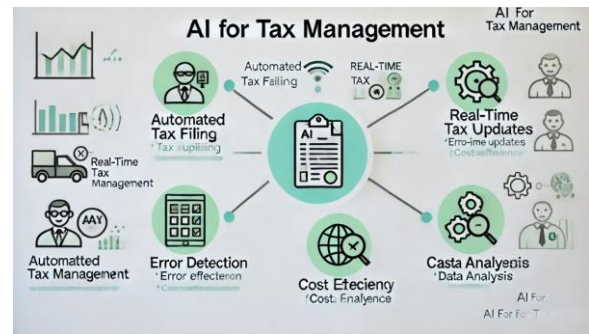

Figure 3: AI in Finance Transforming the Industry

8. Challenges and Limitations of AI in Tax Systems

In the recent years AI, particularly ML-based AI systems, has gained the lime light to benefit range of sectors like healthcare, finance, security, transportation and social policy. These systems hold the transformative potential to improve ordinary citizen's life and boost revenues for governments. Still there are challenges that need to be solved to meet AI's full potential. Many countries, especially LMICs, are applying AI to taxation and boosting tax revenues. AI can enhance administrative efficiency for tough-to-tax sectors like Crypto-assets and digital services and boost compliance through decision-support systems (DSS) for better targeting, less noisy audits and timely assessments. AI insights in tax systems raise new challenges. Moreover tax footprint data and product markets hold unique challenges in different jurisdictions, beyond national boundaries [5]. Bias and interpretability of systems have been raised as key challenges. However the same have not been able to tackle consistency and robustness in the context of complex tax systems and tax DSSs. Robustness indicates that an AI system can work safely also under harsh conditions, such as errors, unforeseen use cases or blatant abuses. From a legal perspective, this becomes especially relevant in order to determine the level of responsibility and accountability of the AI manufacturer. Consistency deals with long-term predictions by models. AI with self-learning capabilities learns during the deployment and delivery phase without human intervention. The primary challenge of long-term prediction is that the data used for the training and predictions go on changing over time [16]. Each of these data's is treated as independently identically distributed sample, which may or may not be the case independent and identically samples ensure stability of the model. The behavior of the model is random and changes over time. Non-stationarity of models includes gradual, abrupt, recurrent or seasonal changes. Robust systems are able to learn and adapt in an ever-changing environment with durability over an extended period time. Robustness is usually done by testing the model in harsh conditions on a newly acquired data set, differently from the training set. Robustness can be categorized as uncertainty robust, adversarial robust and distribution shift robust depending on type of lack of stability of model. Robustness of prediction w.r.t variability of input data is studied. More focus is on distribution-free approaches testing performance on a newly acquired distribution instead of training distribution. Specific focus on instability may help design measures to improve robustness consistency studies provide insight on how stable predictions are against perturbations in the explanatory data. This

involves randomness in the model or the input and randomness w.r.t time periods under analysis (domino effect). As with all technologies, data protection is a fundamental requirement for any AI-powered decision support system (DSS). The solution presented within this project relies heavily on analysis and processing of sensitive data in order to deliver accurate risk scoring for cross-border transactions and other tax compliance insights. The development of this DSS must comply with the GDPR and other applicable legislation around data protection, data sharing, data accessibility and usage for AI processing outside the public administration domain. DSS needs to be designed, developed and deployed either as on-premise or hybrid installation. Depending on the capabilities and willingness of the PAs to share analytics workloads in the cloud, the solution can still comply with stringent data protection measures. The availability of privacy-preserving federated learning and collaborative machine learning-to-learn across data silos allows countries to share their AI models while keeping their data private and secure [17]. This complies with the need to keep sensitive data under exclusive control and non-disclosed, while still providing an assessment of the risk scoring for taxpayers across borders. The fundamental advantage of this novel approach is that it copes with a lack of a central governance authority requiring data centralization. The DSS cooperates heavily with Knowledge Base implementations (KB) that would ensure an efficient and private data access pathway. As the biggest knowledge providers or data owners are the public administrations, third-party knowledge providers must negotiate the usage and sharing of data to generate AI models, statistics and other valuable insights. With strict governance policies in place, and commercial agreements enabling data sharing, third-party knowledge providers can aggregate data from various agents and deliver scores and insights to PAs [18].

Algorithmic decision systems have the potential to reduce recklessness, without which tax compliance systems can never work. On the contrary, algorithmic decision systems can take on intrinsic restrictions that distort their neutrality, fairness, and accuracy. Recent advances in machine learning have spurred previously inconceivable traffic monitoring/management systems. However, collecting big-data takes precedent over its processing in many developing countries. In this regard, many tax regimes fall behind. This situation is improving as governments invest more in cloud computing and data processing toolings, like business intelligence (or reporting) systems, which could be the first aspects in tax governance to take advantage of greater processing capabilities. Abstractive auto-review AI/DSS; on the other hand, second generation decision support systems, which highlight anomalies rather than trying to reconcile the whole dataset, are increasingly applying broader contexts to effective filtering. These approaches could be figments of imagination for many developing regions since access to descriptive modeling tools, budgets, and expertise is unequal; cheaper black-box algorithms are less likely to be adopted and trust has to grow over time [19].

The advent of black-box decisions systems raise nondiscretionary fairness concerns. There is a tension between accurate representation in the data or models and fairness in decision-making. The correct framing of fairness is fundamental but often contentious, and fair representations do not guarantee fair outcomes. Learning fair representations is a form of data augmentation although black-box systems barely disclose their features out of concern for robustness and privacy issues. Post-generation decisions may help in some cases if models or their selected risk scores can be audited and retrained. Filtered analogs of discretion restrict proper representation of facts while some forms of active discrimination would be socially unacceptable. On the other hand, relevance filtering based on voting power may either discriminate structural inequity or favor fairness-aware preferences entrenched against freedom of speech.
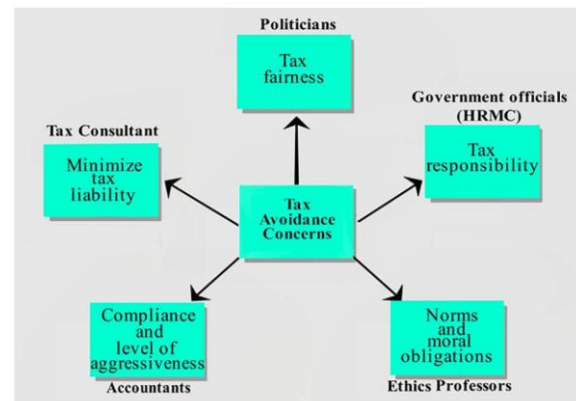

Figure 4: Taxation Perspectives

B7.1. Successful Implementations of AI in Tax Systems
7.2. Comparative Analysis of Different Countries

8.1. Data Privacy Concerns

8.2. Algorithmic Bias and Fairness

8.3. Implementation
Iersarr The concept of a global tax on the profits of large technology firms is not new. It was fashionable before the coronavirus crisis. The pandemic intensified a debate on how to mitigate the effects of public spending necessary to counter it. More recently, the pace of the debate has accelerated dramatically. OECD countries agreed on 1 June to a two-pillar system. The first pillar proposes a concept of significant digital presence, with new taxing rights allocated to countries with a relevant market share. The second pillar intends to enact a global minimum effective tax rate. More than 135 countries supported these proposals. The concept of a global digital tax (and hence the notion of a public global tax system) has resurfaced, at the top of the agenda of most nations. A debate has been opened to re-consider how to shift to a sustainable balance public debt/public revenue, through global regulations, maybe influenced by the devasting effects of money laundering and tax evasion via offshore finance. This is particularly timely for tax authorities. They are facing a multifaceted 'perfect storm'. Existing legislation is not enough. Massive information about the global economy is being disclosed. Comprehensive databases are built with AI. Some are public. Others are accessible for a fee. Disruption by tech is here. It has led to new undisclosed value creation. The part of governments on the astronomical global value creation is miniscule. Countries want a slice of the cake. Resource-rich countries should grab the opportunity or risk being exploited. Software to analyse the extensive

information is available and there is a race to implement it on time. Massive profits cannot last for long if the huge public revenues are missing. The financial secrecy legislation is changing. Multi-jurisdictional offshore flows will become more costly and scrutinised. The new regime will be adaptable to some countries and not to others. The latter should evolve faster into a jurisdiction geared to maintain such capacity [20]. A DSI for all stakeholders potentially exists and can be assembled. The turning point may be when opaque multinational enterprises become the target of the new scrutiny [9]. An alternative future seems frightening.

9. Future Trends in AI and Tax Compliance

AI has been viewed as a domain that sees its scientific, technical, and economic development by contributing to the monetary value generated by a number of sectors. Moreover, it is viewed as a powerful tool that needs to guide the appropriate actions and behaviors towards respect to privacy, etc. AI is also perceived as a not-so-complex domain that simply deals with a number of algorithms that are mapped to risk management frameworks [16]. The above mentioned views on AI are definitely true. In addition, however, it is also important to realize that AI is a complex and heterogeneous technology area whose ultimate aim is modeling and engineering conscious and intelligent systems. AI can be supported in terms of its methods currently offered by the so-called AI Computing (AIC) community, which combines hardware, memory technology, system, architecture, algorithm and methodologies together to perform AI tasks effectively and efficiently. Here, the emphasis is on those key AIC aspects that are important for future Tax AI and thus on those key enablers that needed to be developed or adapted to empower the coming tax AI in terms of spatio-temporal probabilistic ontology representations and COT tax forecasting, explainable and trustworthy tax models, hybrid computational tax analytics, efficient deep tax learning approaches compatible with edge computing, etc.

While existing explainable AI approaches shed a light on the upstream tax reporting side, there is little understanding on how AI deep models are captured and communicated to downstream identification, investigation, and prosecution decisions that also involve human workflows or routine operations [21]. To make things worse, the black-box nature of deep learning itself fundamentally complicates its explanation or interpretation. It is indeed a great challenge to extract useful knowledge explicitly comprehensible or interpretable by a human or unclearly mapping to taxonomy under which high value-added analytical activities can be performed. To bridge the above-mentioned knowledge gap and roadmap, a meta-learning bring-your-own-partial-expertise architecture that requires minimal human guidance will be proposed. It can cope with any types of knowledge extracted from different AI systems and moreover learn to transfer and reassemble them for new scenarios or tasks different from the original. Along with the tax data auto-domain-reduction and hybrid method innovation for fast and accurate tax emulations, this will computationally support the dynamic and democratic tax model regulation.

10. Emerging Technologies

Public authorities around the world are updating their tax compliance measures using the contemporary digital technologies that have transformed today's world. Likewise, public revenue management is gaining priority for ensuring the proper spending of public resources. Current trends reflect the powerful implementation of new technologies such as big data, AI, machine learning, and data analytics for tax compliance and public revenue management. Benefits from adopting these technologies will improve tax compliance which ultimately leads to increasing public revenue transparency and responsibility. These technologies can automatically receive useful information from various sources, analyze massive datasets quickly, evaluate tax compliance risks in a fine-grained manner, and make intelligent decisions automatically with indicated errors [20]. What is more, stakeholders can gain all-round insights to develop data-driven policies for tax compliance enhancement and public revenue management.

With many fields getting intelligent with the advance of AI, machine learning, and data analytics applications, taxation remains largely unchanged. Various stakeholders, including policymakers, tax authorities, tax payers, and governments, will benefit if intelligent decision support systems (IDSSs) are developed to help finalize and substantiate their decisions on tax compliance and public revenue issues. The goal of this research is to close the data-driven decision-making gap by integrating big data and domain knowledge, developing an integrated and systematic design methodology of IDSSs for tax compliance and public revenue management, and designing new types and styles of IDSSs [22].

AI-based tools for enhancing tax honesty were developed and introduced to the Australian Tax Office in the past years. These tools leverage big data and AI technologies to identify taxers' behaviors and refine their tax assessments. They have improved the efficiency and precision of tax audits, increased the coverage rates of audits, and also expedited the response of the system. Tax authorities in other countries have been identified many times as taking similar actions, including the implementation of predictive systems in the UK and the establishment of Intelligent Operations Teams in the Netherlands. However, such applications of technologies are still very simple and conducted in silos, such as developing different models for the same purpose. This situation will lead to either considerable redundancy in handiwork and resources or a lack of systematical analysis for comprehensive evaluations of tax and revenue policies.

Potential for Enhanced Compliance
The use of Artificial Intelligence-Powered Decision Support Systems (AI DSS) and their underlying algorithms offers the potential to enhance tax compliance monitoring and public revenue management in developing countries. The following factors should be taken into consideration to further explain the underlying tax compliance and revenue management scenarios.

There is a huge tax compliance gap in Kenya. In the fiscal year 2012, it was estimated that at least 600 billion Kenyan shillings, or approximately six billion U.S. dollars were not

collected. This equates to roughly 7 percent of the gross domestic product, making it more than double the total restorative funds for the subsequent fiscal year. In any given year, the Kenya Revenue Authority selects tax declarations of selected taxpayers for detailed scrutiny assessment. In contrast, it ignores others, leading to audit biases. In practice this would include over twenty two thresholds for total tax audit liabilities in excess of US$40 million per year. On the basis of the previous year's tax declared assessment alone, it would likely suppress other over thirty five thresholds; keeping in mind the taxpayer's industry sector, size, tax compliance history and declared taxes. The same biased thresholds and case characteristics are used repeatedly, hence the need for an objective optimal case-selection model [2].

Currently, there is biasness on the part of case selectors on selecting the same cases for audit year in year out based on their knowledge and inherent subjectivity. The Kenya Revenue Authority (KRA) also faces the challenge of selecting cases for audit assessments from thousands of tax declarations, given its limited human and time resources. These assessments are completely dependent on the case selector, and on their understanding of the tax system and auditors. Therefore, KRA needs a solution that would not only automate its human resource-intensive risk-based case selection but also apply predictions of non-compliance in the case selection process to prioritize good audits. This solution would leverage on already available vast amounts of data and data mining algorithms, specifically decision trees to evaluate taxpayer compliance and identify good cases for scrutiny assessment. If successful, this research would directly impact the authority in terms of objective (automated) case selection, increased revenue from tax audits, improved voluntary compliance, and efficient deployment of audit resources. The taxpayer would also benefit from accountability because of a fair case selection system and non-biasness.

11. Policy Recommendations

The proposed approach for developing a decision support system using AI algorithms for measuring tax compliance, tax-risk modeling and profiling, detecting suspicious behaviors and activities significant to tax evasion, estimating government officials and assessing risks detected. In parallel, there have been initiatives in major tax authorities and organizations to develop AI-based modules of systems constituted of machine learning algorithms for detecting tax noncompliance and profiling tax payers. Ongoing research efforts are in view to introduce analytical tools in the area of generic applications currently addressing taxation, focusing on estimation of time series risk levels. Similar efforts will soon start in an attempt to computerize analytical systems using simulation-based optimization for real-time modeling long term decisions. This research aims to proceed with the development of AI-based decision support systems that address such issues on a practical as opposed to a merely theoretical, level [23]. This research effort is expected to enhance the governments' capabilities in combating tax evasion and increasing compliance. By monitoring time periods of differing risk, tax authorities can harmonize their audits better since they can focus on time periods of higher risk, and thus better utilize their resources. They can monitor the tax system more thoroughly since firms that are about to

significantly increase their compliance risks can be tipped off early on and countermeasures can be taken before significant losses occur. The government/society as a whole can gain since cigarette smuggling and informal business activities will be partially eradicated and tax revenues will grow. Moreover, such platforms are expected to have positive side effects and applications to other domains currently modeled by simulation [1].

12. Guidelines for Implementation

The tax compliance and public revenue management environment will heartily present the possibilities for improvement. At least one AI decision-support tool will be implemented cross-functionally to detect abusive practices in taxpayers and tax advisers, as well as to forecast and proactively manage tax functions. Plans for the design and implementation of such AI decision-support tools will follow a phased approach that will be refined with employees and stakeholders involved [23].

It is expected that the development of valuable and feasible AI decision-support tools takes time, effort, and both financial and personnel investments. Employee involvement and training are crucial variables for the effective implementation and support of such innovations. By gradually building tool capability, more meaningful AI input can be extracted while simultaneously improving understanding and knowledge of data processing. At the outset, it will be part of a company strategy to replace or improve existing procedures instead of implementing revolutionary tools across the board.

Figure 5: AI Improve Performance in Tax Administration

Therefore, the first phase presents a sandbox environment to work and experiment in. Initial tool(s) will function on the existing systems with minor organizational adjustments, training, and tuning. Lessons, outcomes, and understanding of these more straightforward tool(s) will be used to guide phase II (armoring). The second phase will still consist of sandbox-like developments but is intended to more exclusively facilitate standardized organizational policies on the basis of improved understanding.

Eqn.3: Public Revenue Forecasting Model

$$\hat{R}_{t+1} = R_t + \delta \cdot (AI_t \cdot \Delta I_t + \Delta C_t)$$

- $\hat{R}_{t+1}$: forecasted revenue
- ΔI_t: change in income base
- ΔC_t: change in compliance
- δ: sensitivity of the forecast to AI-driven insights

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12.1 Best Practices for Stakeholders

Tax identification of taxpayers and public sector tax organizations: Taxpayers should be identified based on their conformity to the requirements set in the tax legislation and requirements provided in the tax administration law. The public sector revenue authorities should identify institutions, public enterprises, and non-profit organizations that must be registered, assessed, and tax billed. The level of institution and public sector organization identification should be pursued at every level such as federal, state, and local government, public service commissions, councils, and other parastatals if any. Tax agencies should assess, bill, and estimate the expected payment of any public sector organization for the first time provision of tax identification [24]. The authorities should digitize and document tax identification of newly identified institutions once they are established and formally trained. Taxpayer's information must be updated whenever there are significant changes in tax organizations. tax training on public revenue management and public entities tax laws, legislation, and guidelines: The tax administration office should formally provide intensive training on public revenue management and public enterprises tax laws and legislation. Intensive tax training on information methods of the law, using the tax system, and writing tax identification letters. Other ethical considerations that any resource must be taken into account to facilitate effective training such as availability and placement. Establishment of effective grievance handling mechanism recommends enabling feedback processes and provision; enabling whistleblowing and etc. Local and community awareness to change perceptions and have a value for tax: Awareness of the local and eligible experience of a public sector organization should be created to provide expert opinions. Information should be published through regular informational pamphlets, posters, brochures, discussions, and public events.

13. Conclusion

Despite the numerous benefits of AI-based DDS for tax authorities, the predictability of taxpayer behavior also raises concerns about the fairness of tax parameters. Tax policies are often not independent of tax authorities that apply them. Rules for audits put on schedule E, for instance, are stricter than for taxpayers receiving dividends from entities at a lower rate. Unfairly taxing inescapable wages at a greater rate than business revenues would protect taxpayers from evading behavior, while potentially imposing a greater burden on taxpayers with no chance of complying. The generalizability of the methodology used in this work can be extended to accommodate these concerns by implementing other policy parameters and tax authorities that seek to change tax parameters. These criteria can ensure that the environment set and policies implemented protect taxpayer interests and welfare. Nevertheless, the extent and type of tax cheating modeled may influence the applicability of findings in some cases [1]. This added scope is a deeply complex dynamic game because the interdependent formulation of parameters between tax authorities further increases the complexity of the state-action space. Therefore, taking advantage of advances in Multi-Agent Reinforcement Learning to independently optimize tax distortion, a multi-agent system can be created where each tax authority, as an agent, optimizes only tax parameters that influence the taxpayer in that country.

Furthermore, this work sought to optimize strategies to improve government revenue generated by tax authorities with respect to irreversible cheating. As a consequence, optimization was limited to tax parameters directly influencing growth, implementation costs, and kind. Numerous tax parameters influencing taxpayer behavior are not independent of the action space considered but still ensure taxpayer welfare. These tax parameters can involve means to address deliberate, transient cheating. Payments based on other taxpayer behavior keep a cumulative or comparative measure of taxpayer behavior for audit selection at a greater rate. However, the general complexity and difficulty in explaining standard behavior reduce the scope of these metrics. The need for interpretability in machine learning is a growing field that may shed light on some of these non-standard models. In this case, the robustness of prediction models, for example, is paramount when implemented in high-stake settings. This robustness does not involve whether or not the predictions are computed using models that "learn" the data, with many orthogonal approaches being equally effective. The broad applicability of the models found does not preclude the use of other methodologies for prediction, yet require a better understanding of and means to address unfairness concerns or sensitivity to manipulations.

As a result of regularly producing better taxpayer identification, predicting taxpayer behavior may aid in disincentivizing the widespread development of portable tax evasion methods. Future work can also advance in determining the private sector methods with respect to taxpayer visibility and audit strategy that result in maximizing the welfare of taxpayers on average instead of at the end of the time horizon. Understanding these concerns as a means of extending scope can protect taxpayer rights and welfare while upholding complex, otherwise opaque audit sifting.

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