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Leveraging AI, Machine Learning, And Big Data For Enhancing Tax Compliance, Fraud Detection, And Predictive Analytics In Government Financial Management

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Abstract

A review is given on the increasingly large investments made by public authorities in Fintech providing a number of technologies associating public finances to improve tax compliance, fight fraud in public procurement, and increase the yield of public funds, etc. A detailed list of these technologies include fiscal cash registers, e-Procurement, e-Invoicing, big data analytics, Artificial Intelligence (AI), Machine Learning (ML), distributed ledger technology, Blockchain, etc. The investments reviewed support a number of strategies such as increasing automation of tax collection tasks, performing of large-scale descriptive and predictive data analysis to guide individual decisions of tax auditors and policy planners, the countrywide constant top-down screening of VAT transactions to detect salient patterns of VAT fraud, and the development of natural language processing tools to process audit reports.

Digital technologies have the potential to radically increase the efficiency and effectiveness with which Government activities are performed. This potential has been lying latent for a long time, outside, perhaps, the Defense field, because public agencies traditionally procured technologies by "big vendors". This habit is deeply consolidated, so that also in these years of extreme innovation few Government CIO's consider to use commercial AI and Big Data software to automate the routine tasks that require the processing of large corpora of public text.

Keywords: *Leveraging AI, Machine Learning, and Big Data for Enhancing Tax Compliance, Fraud Detection, and Predictive Analytics in Government Financial Management.*

1. Introduction

New options for government financial managers are described by the authors with those options associated with machine learning, artificial intelligence, and big data. Emerging initiatives in this field are presented by the authors. Because public financial management has become complex, policymakers, auditors, and program managers need to comprehend these emerging technologies. More governments execute multi-dimensional decisions to fulfill mandates and

roles. To efficiently realize public goals in a manner that is effective and accountable, an understanding of how decisions might be improved by new analytical and financial management gadgets is needed. In the financial sector, new tools allow the administration of financial resources adequately through a cycle that encompasses procurement, payment transactions, the collection of revenue in amounts that are due, the deposit of money according to policy, and the investment of deposits. Traditional and emerging options in this field are depicted by the authors, such as purchasing cards and blockchain. Governments obtain or dispense money on an increasing scale because of the diverse and complex nature of financial management in response to demands for a more extensive variety of public services and social commitments. Local or national governments, international organizations, or corporations provide government money. Governments are the largest single pesticide consumer buying vehicle in the world. Aside from the administration of income enforcement, governments establish social market economic policies on wages, standard work hours, branded educational- and health-spending, clean environment policies, and other incentives.

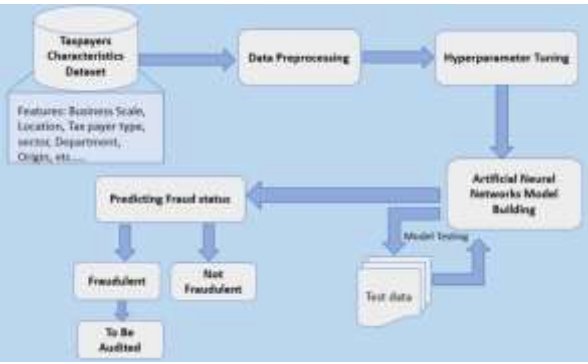

Fig 1: Fraud Detection

1.1. Background and Significance Article argues implementation of AI, Machine Learning and Big Data for better compliance, fraud detection, predictive analytics in government financial management. Thus, it reviews most Big-Data-driven research first, and then draws on concepts and applies them to revenue operations. There are nationalistic notions and laws which bar sharing of taxpayer information, quite often, across and within departmental silos. Several government initiatives to be in place, especially at the revenue administrations, when shifting its focus to improve VAT compliance.

Equ 1: Housing Finance Equation: Optimizing Loan Approvals

$$P_L = \frac{A_i \cdot (1 - C_r) \cdot D_s}{(M_r \cdot H_v) \cdot T_s}$$

Let:

- P_L = Probability of loan approval
- C_r = Credit risk factor (a value between 0 and 1,
- A_i = Applicant's income level
- D_s = Down payment amount
- M_r = Market rate (interest rate)
- H_v = Housing value
- T_s = Time to approval (in months)

2. Research design

This research proposes a new approach for leveraging AI, machine learning, and big data to enhance tax compliance, fraud detection, and predictive analytics, in the field of government financial management. The research design will take the format of research questions, study hypothesis, research objectives, research methodology consisting of data sources, case studies, model development, and model validation, and research questions.

By integrating artificial intelligence (AI) capabilities, machine learning (ML) algorithms, big data, and blockchain technology, government financial management can significantly enhance tax compliance, fraud detection, and predictive analytics. Rich information in unstructured and structured data can be exploited for improving the efficiency, effectiveness, and resilience of compliance operations and the accuracy of risk management. The eruption of the digital economy in the blockchain era accelerates the importance of these topics in enhancing the quality of technologies and skills in government financial management.

Four research questions are addressed in this study: how to develop the compliance risk management system to enhance the compliance risk management capacity and level of government bureaucrats; how to leverage AI, ML, big data, and blockchain for fraud detection and risk management in government financial management; how to design the predictive analytics system to analyze historical data and predict the future trend of government finance; and how to conduct case studies and conduct empirical research to validate the feasibility, effectiveness, and accuracy of the proposed methodologies and hypotheses.

Seven hypotheses are proposed based on the four research questions. Three main objectives are developed: compliance risk management, tax fraud detection, and fiscal predictive analytics. Data sources, case studies, model development, and model validation are designed and conducted. The research questions and hypotheses based on case studies and empirical research are discussed in the concluding remarks.

2.1. Overview of Tax Compliance Traditionally, tax administrations carry out compliance through audits, however tax administrations recently started using new technologies, such as artificial intelligence, machine learning, and big data tools, for improving risk management, predictive analytics, and fraud detection in revenue and customs. In the area of fraud detection, a hybrid unsupervised outlier detection method, composed of distance-based approach and Minimum Covariance Determinant method, is proposed and evaluated. The hybrid method achieved the best overall performance with highest F1 measure, highest area under the receiver operating characteristic curve, and lowest false discovery rate. In addition, the unsupervised methods were compared with supervised logistic regression and support vector machine classification approaches. The performance of the MCD method was found similar to the logistic regression and support vector machine classification methods involving feature augmentation. Finally, a software application which implements the proposed methods is provided, along with illustrative results of the unsupervised hybrid method in detecting fraud in customs data.

Tax evasion and tax avoidance represent a big challenge for authorities in all countries. Tax evasion reduces tax base and related public resources for the provision of public goods and erodes fiscal equity. Recent studies estimate that every year between EUR 100 – 150 billion are lost by the European Member States due to fraud with VAT. Moreover, the level of tax evasion is higher in countries where the tax system relies more on personal income tax rather than on consumption tax. In the last several decades, tax administrations are facing increased

pressure in social and political debates to fight against tax evasion and to improve tax compliance and payment discipline. However, the traditional method for improving tax compliance by tax audits is costly and limited in reaching the huge population of taxpayers. On the other hand, procedures of tax avoidance differ from tax evasion, and are more difficult to recognize, however tax avoidance is not legally prohibited and the computation of taxes through legal knowledge and behavior does not cross the legal framework. Digitalization of government services is also essential in decreasing the possibility of tax avoidance.

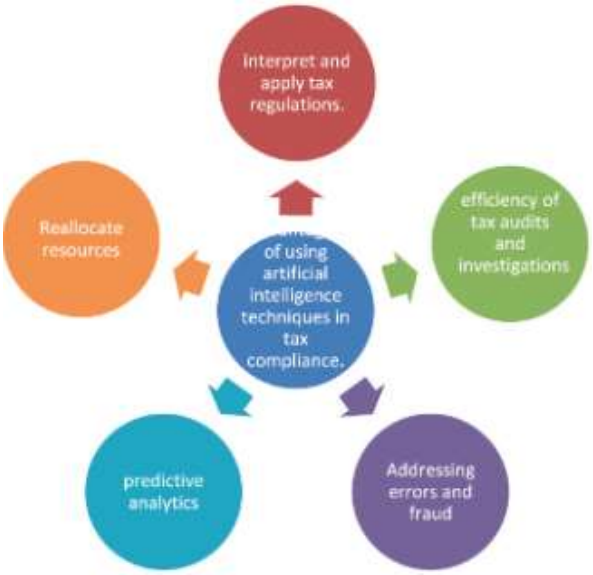

Fig 2: Tax Compliance

3. AI and Machine Learning in Government Finance

The old cliché that the only things that are certain in life are death and taxes holds true, at least as far as most people are concerned. For governments, the only things that are certain are spending and having mechanisms in place to extract taxes. Extracting tax resources to redistribute wealth and deliver public policy as public benefit is one of the long-standing and arguably most essential functions of any government. Tax enforcement, however, is not necessarily as simple as deducting a percent from a salary, as the economy has tremendously evolved over the past few hundred years. Today the economies are not only based on goods and services (tradable), but to a large extent on intangible value such as intellectual and financial capital. Artificial Intelligence (AI), in the form of Machine Learning, and Big Data platforms have been combined into instruments that have the ability to understand complex patterns, better than the human brain, using statistical procedures on available data. Governments' finances have long had a major role to play in the advancement and development of Machine Learning (ML) methods, as with applications on fraud detection, tax compliance and more recently on predictive analytics. From this perspective, the use, and potential miss-use, of such methods represented in two well-known governmental financial tools are examined.

3.1. Defining AI and Machine Learning Artificial Intelligence (AI) is the capacity of a machine or computer program to accomplish tasks commonly associated with intelligent beings. Initially, the intention is to carry out a balanced presentation of the technology,

particularly focusing on the analytical dimensions, with a dominant view on its positive prospects. This is to provide the context for the implementation of AI in the two functions of government financial management to be discussed formally, tax compliance and fraud detection. Moreover, increasingly from predictive analytics, emphasizing the significance of big data, to consider some of the broader implications of these new technologies. AI as a field consists of the intuitive AI and the rational branch and, tied in with this, what is called dumb AI. Together, pertaining to AI as a technical platform, what more specifically is meant in the general sense by AI. The discussion then moves on to examine some of the key transformations presently underway in AI and ML, as well as some potential future developments in this area. Similarly with the application of big data in government financial management, an initial focus in the implementation of AI in the more developed countries, shifting later to more technological discussion on how this is occurring. Two main sources are exploited in this task—original data analysis and a global review of more theoretical and often critical studies. Because of the novelty and fast pace of development of AI, the latter is weighted more heavily.

Fig 3: AI and ML in Financial

3.2. Applications in Financial Management With substantial increases in the research surrounding the use of artificial intelligence (AI), machine learning, and big data over the last decade, the applicability of these technologies to government financial management is considered. Specifically, the focus is on how these technologies can be used to enhance tax compliance, fraud detection, and in predictive analytics. Financial management in the public sector involves the proper collection and distribution of funds between different government activities, such as education, public safety and national defense. The goal of the government is to provide the public with services and performance superior to that of any other entity. To achieve that goal, government financial management must be transparent, accurate, complete, insightful, and timely. With recent progress in AI and big data technologies, governments worldwide have been presented with new tools to improve financial management. This paper examines the concept of fiscal transparency, outlines what is considered good practice, identifies which countries are the most transparent, determines what drives fiscal transparency, and tests the relationship between alternative measures of fiscal transparency. By employing advances in AI, machine learning and big data technologies, it is possible to manage large volumes of data for predictive analysis. An extensive outline of how AI and machine learning technologies can be put to use for the benefit of public service, research, and policy making is provided.

Equ 2: Insurance Solutions Equation: Risk Evaluation

$$P_R = \frac{A \cdot L_i \cdot H_c \cdot T_f}{C_p \cdot D_t}$$

Let:

- P_R = Risk premium for the policyholder
- A = Age of the policyholder
- L_i = Lifestyle risk factor (e.g., smoking, sedentary lifestyle)
- H_c = Health condition score (e.g., medical conditions, history)
- C_p = Coverage amount
- D_t = Duration of the insurance (in years)
- T_f = Fraud factor (risk of fraudulent claims, a value between 0 and 1)

4. Big Data in Tax Compliance

This section aims to give an overview of research and the latest findings on how to leverage AI, machine learning, and big data technologies to enhance tax compliance, fraud detection, and predictive analysis in government, with a special highlight on financial management. Among the various domains of public financial management, revenue collection is one of the most important functions. This function is usually associated with tax policies, tax enforcement, and tax administration.

With the support of the latest technologies and computational capabilities, nowadays government institutions have more choices and sources to act effectively and efficiently to comply with the regulations. In this context, leveraging artificial intelligence (AI), machine learning algorithms, and big data analytics has been an important topic in government to enhance tax compliance, fraud detection, and predictive analysis. Big data has emerged in recent years as a modern tool for coping with this ever-growing and heterogeneous set of data sources, outlining business rules which a company should follow to detect and prevent money laundering and to grant tax compliance. Nevertheless, financial data about economic activities can be difficult to analyze in this new perspective because they are represented by official tabular data. Current research efforts on the application of big data techniques to fiscal data are paid on text mining financial news, novel dataset generation, and web mining of e-commerce sites. By a joint application of graph based outlier detection, an anomalous subgraph mining approach on a complex Taxpayer Interest Interacted Network, and a graphlets based subgraph identification model by learning a classifier, a set of subgraphs is extracted from the network and each of them is classified as "normal" or "suspicious". Anomalous journal entries consist in those that generate a group of citations whose amounts are lower than expected, are managed to be issued within a predefined time, and flow only within the same group of companies. On the tested public financial datasets, gathered from the Revenue Agency and including all quarterly VAT declarations in the period 2014-2015, such methods exhibit a mean precision of 0.78 in identifying VAT fraud cases.

4.1. Understanding Big Data This section will present a thorough description and understanding of Big Data, AI, Machine Learning, and Advanced Analytics. It is designed to be as comprehensive and in-depth as possible so that the reader has a firm grasp of the issues and challenges posed by these technologies. This way, the text can serve as an illuminating prelude to the subsequent analytical and evaluative sections. At a preliminary level – and to set the scene for the more detailed discussion to follow – a brief definition and description of Big Data is offered.

Since its emergence as a buzzword around 2011, “Big Data” has been a major theme of public discussion about technology in general and in e-Government circles in particular. Governments

are increasing their attention to Big Data as they realise its potential for reforming public administration, public expenditure, public management, public services, and public governance. A range of new applications are emerging – particularly in areas like healthcare, education, and the environment – with promising results in terms of better and cheaper services and improved decision-making. Nonetheless, to date there have been only a few applications of AI, Machine Learning, and/or Big Data in the realm of government financial management. Government is also recognizing that where there are new benefits from the use of AI, Machine Learning, and Big Data in the public sector there are also challenges, some of which are considerable and serious. Governments are becoming more aware of various implications – including ethical, legal, privacy, and security issues – which AI and its underlying technologies raise and this is evolving into a new domain of AI governance. There are many questions surrounding policy execution, regulation, infrastructure distribution, and data practices.

Fig 4: Big Data Analytics in Government

4.2. Data Sources for Tax Compliance Tax evasion and tax avoidance represent a big challenge for authorities in all countries of the world. Tax evasion reduces tax base and related public resources for provision of public goods and erodes fiscal equity. It is empirically proven that grey economy including tax evasion is higher in countries with a lower level of per capita income. The same literature shows that the level of tax evasion is higher in countries where the tax system structure implies more reliance on personal income tax, which is easier to avoid. Given this, it is important for government authorities in countries like Serbia to understand and predict the dynamics of tax fraud to be able to design effective defensive strategies more effectively. The traditional way for improving tax compliance by tax audit is costly and limited in terms of outreach given the huge population of taxpayers. However, more modern techniques involving the digitization of financial data and the development of algorithmic tools for its analysis have been demonstrating some potential in recent years .

Public financial management involves all activities related to revenue and expenditure generation and oversight by the government sector. The former is closely related to tax policy decisions, administration and property right enforcement in general and often managed poorly by underdeveloped economies and in transition. Modern economies are witnessing a data driven revolution often referred to as the “big data era” which includes the extensive use of analytics, data mining, artificial intelligence and machine learning. The digitalization of government services is essential in tax avoidance. It is of utmost importance to understand and predict the dynamics of fraud schemes related to tax evasion.

5. Enhancing Tax Compliance

Worldwide, governments rely heavily on revenue collected through tax systems to finance their operations. Taxes are used to provide infrastructure, public goods, security, and services. As a result, it is imperative for tax revenues to be both collected and allocated efficiently and effectively. Because of the large amount of revenue processed by government entities, financial management and accountability are vital for tracking expenditures and revenue flows, reducing fraud, error, and leakage, and ensuring that policy objectives are followed.

Failure to ensure effective financial management and accountability can have serious consequences. For example, a lack of controls in the areas of revenues and expenditures could result in revenue wastage, diversion, or theft. Since fraud is often committed with falsified documents and there is deliberate concealment of the truth, effectively identifying and tracking fraud is a complex task. In government financial management, the abuse of resources involves the use or theft of resources for improper and illegal purposes, and is also known as fraud. Advanced technologies, such as big data analytics and machine learning, are being developed to monitor and identify potentially fraudulent financial transactions, supplementing traditional analysis. Such technology can identify fraudulent transactions and improve the effectiveness and efficiency of compliance monitoring and prosecution.

In recent years, predictive analytics has been applied worldwide for the analysis of data on both unlawful and ill-advised activities. It allows the identification of patterns, anomalies, and trends for early detection and response. In the context of financial management in government organizations, it has been used to enhance tax compliance, detect fraud and corruption, and estimate financial risk. Styled either as government analytics or public analytics, governments and other public organizations are leveraging the tools of machine learning and predictive analytics with the vast new datasets generated by advances in e-government and new technology not only to identify fraud, tax evasion or corruption, but also to predict it.

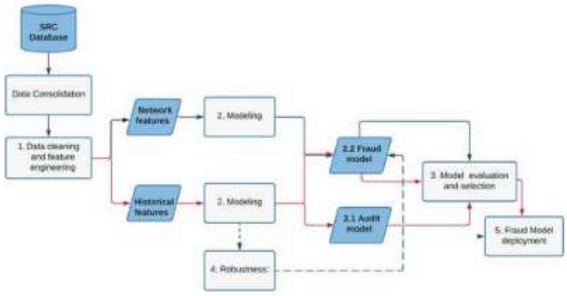

Fig 5: Enhancing Tax Compliance

5.1. AI-Driven Compliance Strategies Public sector organizations worldwide are experiencing a growing need for computational decision support, such as for resource allocation, risk assessment, performance evaluation, policy design, fraud detection, and compliance analysis. In government financial management, challenges surrounding AI, machine learning, and big data include leveraging technology to induce higher tax compliance and fraud prevention, and the fostering of predictive analytics for revenue and expenditure. This role for AI, machine learning, and big data in government financial management is seldom discussed from the perspective of top public officials, and would involve multiple domains of knowledge: public policy, accounting, economics, and statistics. Both government and academia might gain insights from the top public financial officials by these reflections on efficient tax enforcement, fraud detection, and predictive analytics.

The traditional view of tax compliance strategies focuses too much on coercive measures. To earn the taxpayers trust, the tax department has the responsibility, if bills are not contested by the taxpayer, to return the money as promptly as it was collected. Many AI technologies were associated with a do-more-with-less approach, leading to demoralization rather than empowerment. When one step after the other AI applications failed to deliver on their promises, the IT people lose faith in the ability of the government bureaucracy to handle computer-intensive new-gen big data and AI technologies. This narrow-minded perception of data intensiveness as a threat, rather than a resource, was further exacerbated by persistent layoffs and freezes on replacements in IT areas. The overloads on the few remaining IT employees made many of them unwilling to learn new wide-scope AI technologies and tools.

5.2. Case Studies of Successful Implementations Despite the success of around 200 tax authorities that monitor value added tax (VAT) transactions in real time or near time, it remains a significant challenge for tax authorities in many member states to monitor the ever-growing big data for various taxes, considering factors such as the agribusiness sector. While many of the same countries have been able to pass some or all of the transaction data for VAT billing and important taxpayers in real time or near real time, such information exchange usually marked a very weak monitoring or verification of individual transactions. The difference between the issues chosen for the exchange of transaction data and the wider obligations regarding individual reduction of VAT is total: the circumvention of fiscal obligations does not automatically entail manipulation of the affected transactions, the implemented methods do not entail that all relevant transactions are subject to one or both contractual obligations for their exchange and the two measures often apply to persons quite different. There is increasing interest in methods that would allow the use of new technology to monitor transactions in a given tax regime much better, as it is observed that close monitoring of VAT billing is found to be associated with a change in the behavior of traders, similarly engaged after monitoring individual transactions. In the overall tax compliance context, back box models, especially those based on deep learning, blur the distinction between understanding and prediction, which raises serious concerns. Increased promotion of the understanding of the power of these models has shown that they are more capable of memorizing than learning, which calls into question some of the critical findings with which they have been associated. However, what is perhaps most startling is the growing realization that their operation is a black box, even to those who build the models.

In recent years, the data science technologies of artificial intelligence, Internet of Things (IoT), big data, and blockchain have emerged as powerful tools with potential to revolutionize the provision and efficiency of the public sector. As a consequence potentially disruptive technologies have given birth to a new generation of startups embraced under the name GovTech. A wealth of GovTech systems is being developed, tested and employed, which expand and enhance the provision of public services and the procedural efficiency of public sector institutions and agencies: Chatbots, virtual assistants and intelligent systems for public engagement, interrogative or otherwise, bi- or multi-directional, automated and personalized, deployed via a variety of channels and offering guidance or services to citizens and business; Development of technology capable of monitoring and enabling the efficient and effective management of the national infrastructure, in functioning parameters and either during ongoing operations or future planning, supported by the eventuality of real-time regulation; Governance, compliance and regulation made fully automated and capable of ensuring that contractual obligations and legal requirements are met, with the due diligence and enforcement mechanism run by data analytics and artificial intelligence; Management, routing and authentication of public records using blockchain technology, having documents in perpetuity,

securely and verifiability stored on distributed ledgers, both paper and digital originals, authenticated by smart contracts and self-executing upon satisfying pre-set conditions.

Equ 3: Retail Supply Networks Equation: Optimizing Supply Chain

$$E_f = \frac{D \cdot (I_s + R_s) - T_c \cdot L_d}{D \cdot P_t}$$

Let:

- D = Demand for the product (units per period)
- I_s = Inventory stock level (units)
- T_c = Transportation cost per unit
- L_d = Lead time for delivery (days)
- R_s = Retailer supply capacity (units per period)
- P_t = Product price per unit

6. Fraud Detection Mechanisms

A high number of fraudulent activities in the public financial management environment can lead to undesirable consequences for the sustainability of public finances. Systematically conducted, financial fraud detection mechanisms facilitate almost immediate detection without the necessity to collect evidence post-factum during external or internal audits. Public sector financial data are a basis for the development and use of a number of mechanisms which can be used for fraud detection: tax levels and dynamics, government budget or its amendments, total expenses of government sector entities, and public debt. The effectiveness of these mechanisms individually depends also on the sector of public finance they are applied to. By using additional mechanisms, like the average size of government sector entities, the compiler-payer ratio, or the taxation rate, their efficiency in the department can be raised on the basis of which they are applied.

6.1. Machine Learning Algorithms for Fraud Detection Machine learning has transformed fraud detection into an integral science in a broad array of industries and is an increasingly crucial technique when a large number of transactions and operations flow through financial systems daily. The government market boasts a series of challenges and intricacies foreign to customary for-profit businesses; e.g. transparency, accountability, efficiency and effectiveness of spending are vital, thereby fostering a business environment demanding refined solutions. Structuring these challenges underrated prevailing machine learning models on usual big data opens a route to advancements in government financial management.

Government financial management comprises tax compliance among the most important issues. Once citizens, firms, and institutions pay income and VAT taxes dependably, governments can ensure and enhance public services and amenities. However, non-compliance results from either intentional activities such as fiscal fraud and tax evasion, or unintentional ones, such as mistakes in filling forms. Leveraging AI on big data negotiations through the implementation of various machine learning algorithms can help authorities in tax audits, taking tax administration actions on potential defrauders.

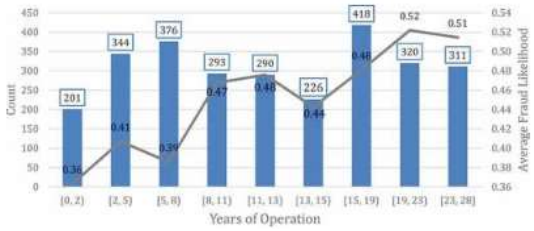

Fig : Improving Tax Audit Efficiency Using Machine Learning

6.2. Real-Time Monitoring Systems The leveraging of artificial intelligence, machine learning, big data, and behavioral/predictive analytics is reviewed. It presents a simple taxonomy of public governance and services to introduce data science automation in the public sector. The convergence of technological trends of algorithmic automation, chatbots, and machine learning within a few application layers is discussed around the financial management aspects aiding compliance, fraud detection, and predictive analytics. Six pillars for GovTech development are proposed and a call to action is made to the computer science community.

7. Conclusion

The use of AI, machine learning, and big data could play a key role in enhancing tax compliance, and make a substantial contribution to governments' revenues. There has been increased interest in using data to improve government financial management more widely, including in fraud detection and predictive analytics of tax and expenditure, which can also help to reduce the tax gap.

On the other side, government spending is significant and increasing in many areas so there is demand for AI applications in budgeting, expenditure control, and strategic financial planning. There are open questions about the extent of automation and any possible negative effects on civil servants, and the challenges in using AI in low- and middle-income countries.

Benefits of using AI in government financial management include cost savings and improved productivity for public sector accountants and financial management staff; new data-driven tools for financial reporting and control; and potential for improved fiscal outcomes. Many governments have already taken steps along this path, and financial management is one of the most data-intensive administrative domains, so stands to benefit from AI advances. However, there are concerns too. There is little causal evidence on how use of these AI tools affects the design of administrative procedures, and outcomes like fraud detection & missed taxes by civil servants. The literature on automation and its effects on workers is also largely silent on effects in government. Further research is needed on these different interactions too, and on the adoption of these technologies in low- to middle-income countries.

7.1. Future Trends Introduction to artificial intelligence, machine learning and big data; THE BLOCKCHAIN SOLUTION In recent years, governments worldwide are increasingly embracing the potential of artificial intelligence, machine learning and big data to transform how public services are delivered to their citizens and businesses. This is largely arising from the successes of the private sector with a plethora of applications from recommendation systems and chatbots through to autonomous vehicles and drones. The clear benefits of such technologies include increased efficiency, improved quality and at minimum sustained cost. Recent survey data found the use of these technologies in operational delivery, compliance and regulation and resource allocation to be the top three finance and treasury priorities worldwide

among the national finance ministries and treasuries of countries. However, governments also face a number of challenges resulting from these same technologies. These include a falling number of professional tax collectors, an increasing budget deficit and rising level of public debt. The governments therefore view technological progress as a key driver to support revenue collection and fiscal sustainability. Indeed, promises are extremely high showcasing capabilities such as predictive resource prospectivity, near real-time environmental risk assessment, crime detection and security alerts. This is in addition to revenue insights such as hidden incomes and citizen behavior analysis lending to paradigm changes in how hidden economy projects are applied. Therefore, the government councils are becoming increasingly interested in how to leverage this tech and in particular are seeking guidance to navigate the emerging landscape of potential applications. This timely research is the first comprehensive review on this topic and brings together, for the community's attention, the broad field through a remit of tools, a focus on lessons learned, and an outlook on future techniques and challenges.

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