Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6, 5066-5074
2024
Publisher: Learning Gate
DOI: 10.55214/25768484.v8i6.3112

Application of AI to minimize information risk in tax control: Evidence from Bulgaria

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Abstract: The application of artificial intelligence (AI) in tax control is becoming more and more relevant in the conditions of globalization and digitalization of the economy, which creates a need for effective mechanisms for managing information risk. With the growing volume of data and the complexity of the tax processes, the risk of deviations, fraud and inconsistencies increases significantly. This article aims to examine applied AI tools and approaches that can minimize information risk in tax control, as well as to analyze their effectiveness through the prism of practice in Bulgaria. The methodology is based on correlation analysis, which measures the strength and direction of the linear relationship between pairs of variables. A Pearson correlation coefficient was used to evaluate the variable "Artificial Intelligence" and the different forms of tax control. Kendall's tau-b correlation coefficient was used to assess the linear relationship between the variables of collection, processing, verification, and management of tax information related to the application of AI. The main results show that AI has a positive and statistically significant effect on risk management and cybersecurity, suggesting the potential to improve data protection and reliability. However, the verification and revision of tax information needs to significantly impact AI, which points to the need for further development of these technologies for better integration. In conclusion, the application of AI offers significant opportunities to minimize information risk in tax control but requires targeted adaptation and refinement in specific aspects of control processes.

Keywords: *AI, Cyber security, Risk management algorithms, Tax control information.*

1. Introduction

The application of artificial intelligence (AI) in tax control creates conditions for transforming the applied aspects of control impact (Kostova, 2024). The development of technologies for automation and analysis of large volumes of data leads to the minimization of information risk and the increase of efficiency in the management of tax processes. The opportunities that AI offers are seen as an integral part of the future of financial control (Dwianika, Sofia, & Retnaningtyas, 2023). AI has the potential to improve data collection, analysis, and verification processes, allowing tax authorities to optimize resource use and be objective in decision-making.

The topicality stems from the need for modern tax authorities to respond to the challenges associated with processing and analyzing a large volume of information, especially in the context of globalization and the digitalization of the economy. Research indicates that technological solutions, such as AI, can significantly increase the reliability and accuracy of tax control, especially in data assessment and managing the risk of tax defaults (Kumar, Sridhar, Prasanna, & Priyanka, 2023). At the same time, AI challenges include ethical and legal issues that place new demands on data protection and risk management policies.

With the increase in the volume of data and the complexity of economic operations, information risk management is becoming an increasingly important factor in the implementation of tax control. Tax authorities are challenged not only to collect and process data but also to ensure a high degree of

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accuracy, speed and security. Artificial Intelligence (AI) has the potential to optimize information collection, processing and analysis processes, significantly minimizing information risk (Zhelev & Kostova, 2024).

Artificial intelligence in tax control is a modern technology developing as a result of globalization and digitalization. In conditions where information risk poses a significant threat to economic entities, AI offers tools and algorithms for automation and increasing precision in tax procedures (Aleksandrova, Ninova, & Zhelev, 2023). Machine learning, natural language processing and big data analytics technologies can not only process voluminous data but also identify anomalies, trends and potential risks that traditional methods cannot detect.

A key advantage of AI is its ability to minimize the risk associated with data processing. In tax control, attention is directed to the processing of a significant volume of financial documents, transactions and other reporting information. AI automates their collection and analyzes them in real-time, allowing tax authorities to focus their efforts on areas of increased risk and significantly optimize their resources. According to Ye et al., the implementation of AI in tax control improves the quality of data submitted by companies, providing greater transparency and reliability (Ye, Zeng, Tao, & Yun, 2023).

The automation of tax control contributes to the reduction of the information risk related to cyber security and the protection of personal data. As Olan et al. note, AI systems offer improved protection by analyzing behavioural patterns and identifying potential threats in real time, which reduces the risk of unauthorized access to confidential information (Olan, et al., 2022). Although artificial intelligence in tax control offers significant opportunities, its implementation faces regulatory challenges. AI technologies must comply with several data protection requirements, ensuring that their implementation complies with ethical standards of transparency and accountability (Manias, et al., 2023). It requires the creation of frameworks to ensure the safe use of AI in tax control.

This article aims to review and analyze various applied tools through which AI can identify approaches and methods to minimize potential information-related risks. Attention is focused on linking applied aspects with the technology of tax control. Based on the analysis, opportunities for optimizing the tools for minimizing information risk are derived by answering the **following research questions:**

1. *What are the specific approaches and tools in applying AI to minimize information risk in tax control?*
2. *To what extent can the use of AI increase accuracy and efficiency in data collection, analysis and verification processes in tax authorities?*

To answer the research questions posed, the present study covers the existing methods and tools used to minimize information risk through AI and how these methods can be adapted and applied in tax control. Based on international experience and modern technological achievements, effective mechanisms can be developed to strengthen the tax system and increase its resilience against risks related to data management. These mechanisms can be implemented through the strategic and phased application of AI technologies developed explicitly for tax control.

The present study examines the integration of innovative software solutions and monitoring systems based on advanced algorithms and artificial intelligence technologies to minimize information risk. By analyzing large volumes of data in real-time, these solutions allow monitoring of tax activity and identifying deviations that may be indicators of tax fraud or other violations. Thus, automated data analysis, including the detection of trends in tax transactions, can assist tax authorities in ensuring reliability and accuracy in applying tax controls.

AI-based systems can be adapted from international practices that have already proven effective in countries with well-developed tax systems. These systems typically include data analysis algorithms that detect atypical transactions and other potential information risks. In the context of Bulgaria, such systems can be integrated in order to increase the quality of the collected information while at the same time reducing the need for mechanical verification and optimizing the processes of collecting and analyzing tax information. Thus, by properly implementing AI, tax authorities can achieve significantly higher accuracy and efficiency in their processes.

The study also analyzes the country's current conditions and operating mechanisms, aiming to establish how international norms and standards can be effectively integrated into the Bulgarian tax

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 5066-5074, 2024
DOI: 10.55214/25768484.v8i6.3112

system. The main challenges are the need for more regulatory frameworks for using AI in the public sector, the limited resources to carry out technological updates, and the need to improve public understanding and support for implementing AI in tax administration. In this context, systematic actions to improve institutional infrastructure and coordination between regulatory institutions are essential to overcome these barriers and facilitate the deployment of AI technologies.

An essential aspect of the research is developing strategies to raise awareness among tax officials and the public about the benefits of using AI in tax control. Training employees and increasing their awareness can contribute to timely implementing innovative technological solutions in tax control. By improving the awareness of citizens and employees, tax authorities can achieve greater transparency and accountability, which will increase confidence in the National Revenue Agency in Bulgaria.

The main goal of this article is not only to expand knowledge in the field of using AI to minimize information risk in tax control but also to support the development of more effective policies and mechanisms for integrating these technologies in Bulgaria. By improving the national framework and adapting successful international practices, Bulgaria can strengthen its tax system and create a more secure data management environment. The present study offers practical solutions and recommendations that can be directly implemented by tax institutions and contribute to building a sustainable and effective tax control system based on artificial intelligence.

2. Literature Review

Existing research confirms that artificial intelligence (AI) is essential for modernizing and optimizing risk management in the public sector, including tax procedures.

2.1. Overview of Existing Research Related to The Use of AI for Risk Management in Tax Control

One of the main aspects of the application of AI is the increase in efficiency and accuracy in the recognition and minimization of risky tax practices, which helps to improve the control of tax liabilities. In Germany, for example, implementing automated tax systems based on AI allows the recognition of high-risk facts and circumstances subject to a more detailed examination by tax administration officials (Binder, 2020).

The use of AI in tax control impacts tax fraud prevention systems. Algorithms detect deviations and identify discrepancies in tax returns. In these cases, systems based on machine learning methods and statistical models can be applied (Kumar, Malholtra, & Grover, 2023). The application of AI to the analysis and management of tax risk significantly increases the accuracy of forecasts of the degree of impact and the probability of its manifestation, which ensures a reduction in the cost of tax checks and tax revisions (Huang, He, & Zhang, 2022).

The concept of Explainable AI finds application in credit and tax risk management. Integrating models such as SHAP and LIME supports transparency and accountability, increasing confidence in financial risk management systems (Misheva, Osterrieder, Hirsa, Kulkami, & Lin, 2021). Explainable AI can optimize controls to prevent tax fraud (Fritz-Morgenthal, Hein, & Papenbrock, 2022). AI is deployed in terms of integrated data to assess tax risk. This type of system enables automated classification of risky companies and improves the preliminary analysis for discrepancies in tax returns, which saves time and effort (Han, 2022).

The application of AI in tax control expands security capabilities by increasing protection against cyber threats and promoting the ethical use of data. The implementation of AI technology approaches in the banking sector has shown effectiveness in reducing fraud and operational risks through improved understanding and transparency of AI systems (Lee, Floridi, & Denev, 2021). AI supports the development of financial technology (Fintex) innovation by enriching risk management, fraud detection and credit risk assessment systems in tax control (Bogojevic Arsic, 2021). AI has the potential to significantly improve tax risk management, contributing to efficiency and transparency in the public sector.

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2.2. An overview of different approaches and tools used in other industries that can be adapted for tax control

Applying various artificial intelligence (AI) tools and approaches in industries such as manufacturing, financial services, and data management provides significant potential for their adaptation in tax control. Technologies such as machine learning and predictive maintenance in Industry 4.0 significantly reduce risks and minimize errors. Machine learning in predictive maintenance is an essential tool for maintaining the health of industrial assets and can be easily adapted to monitor tax data anomalies (Çınar, et al., 2020). Data management approaches in commerce and e-commerce that incorporate AI for fraud prevention can be used to identify suspicious tax transactions. Technologies implemented in e-commerce, such as predictive analytics to identify fraudulent payments, could be effectively adapted to risk assessment in taxation (Pallathadka, et al., 2023).

Integrating AI in the context of energy industries to optimize processes using big data can also serve as an example of tax control. In the energy sector, AI resource management solutions enable accurate tracking of operations and prevention of abuse. Such an approach could optimize the processing of tax data, thereby increasing transparency and control (Ahmad, et al., 2021). In cybersecurity, AI has been used to detect "industrial espionage." Similar techniques used to detect information security breaches can be applied to data protection in tax processes where data security and integrity are critical (Goyal, Rajawat, Solanki, Zaaba, & Long, 2023). With the help of explainable artificial intelligence (XAI) used in manufacturing processes to understand the results of complex models, tax authorities can gain greater transparency and confidence in their automated processes (Ahmed, Jeon, & Piccialli, 2022). Predictive maintenance and demand forecasting solutions in manufacturing industries provide examples of how tax authorities can predict potential reporting gaps and irregularities by using similar technologies (Carpanzano & Knüttel, 2022).

Robotic process automation (RPA) approaches are used in accounting and financial services to automate document verification and payment processing. These technologies can be easily adapted to improve accuracy and speed in tax control (Sharma, Kataria, & Sandhu, 2022). Machine learning algorithms that automate financial and accounting activities used by large companies are also proving effective in detecting fraud and increasing accountability. Similar algorithms can be applied in tax control to improve assessment systems and prevent tax fraud.

3. Methodology

The methodology applied in the article to analyze the correlation coefficients is based on the assessment of the relationship between the variable "Artificial Intelligence" and various aspects of tax control, such as collection, processing and verification of information, analysis and risk management, cyber security and protection of personal data as well as processing large databases. In this case, correlation analysis measures the strength and direction of the linear relationship between pairs of variables using the Pearson correlation coefficient (r). The value of the coefficients ranges from -1 to 1, with values close to 1 indicating a strong positive relationship, values around -1 indicating a strong negative relationship, and values close to 0 indicating no significant relationship. The p-value represents the level of statistical significance. Coefficients with a significance level (Sig.) below 0.05 are considered significant, with those below 0.01 indicating a higher confidence level.

To substantiate the research questions, the relationship between the variable "Artificial Intelligence" and the various aspects of tax control, including "Check" and "Revision", was analyzed and evaluated by applying Kendall's tau-b correlation coefficient. Kendall's tau-b is a non-parametric test that measures the strength and direction of the relationship between two variables, giving preference in cases where the data may not follow a normal distribution or be ordinal. This method was chosen because it is suitable for exploring relationships in sociological and economic data, as often found in research on tax control and artificial intelligence.

Kendall's tau-b coefficient can take values from -1 to 1. Positive values indicate a positive correlation between variables. Negative values indicate a negative correlation. Values close to 0 indicate no relationship between the variables.

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ISSN: 2576-8484
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4. Results and Discussion

In modern tax systems, information management is an important process that includes data collection, processing, analysis, and verification. As the volume of information and the complexity of tax procedures increase, the risk of errors, inconsistencies, and fraud also increases, leading to the need for effective mechanisms to minimize information risk.

Artificial intelligence offers new opportunities for automation and optimization of information management processes by providing tools to detect inconsistencies, assess risk and increase accuracy in data analysis. Through the application of AI, it is expected to improve the quality of information and reduce the likelihood of information gaps, which has a direct impact on the reliability of tax control. The analysis of the correlation dependence between information management and the application of AI presents essential aspects for the effectiveness of these technologies in reducing risk and supporting informed decision-making in tax processes (Table 1).

Regarding information gathering and processing, there is a very low or almost non-existent correlation between the use of artificial intelligence and information gathering (-0.019, p=0.813) and information processing (0.001, p=0.989). These values indicates that AI has not yet significantly impacted these primary stages of tax control. A possible reason could be the insufficient application of AI in routine data collection and processing tasks.

In risk analysis and management, the correlation coefficient between AI and risk analysis and management is 0.303** (p=0.000), indicating a significant positive relationship at the 0.01 significance level. It indicates that the use of AI in these activities is having a significant impact, possibly helping to automate the identification and assessment processes of risks in tax control. The positive correlation here can be attributed to AI's ability to process large volumes of data and identify patterns that point to potential risks, which is critical for preventing errors and fraud.

There is a significant positive coefficient (0.232**, p=0.004) in relation to cyber security and personal data protection. It suggests that AI plays a vital role in data protection by contributing to more effective detection and prevention of cyber threats. As tax systems evolve and online data processing increases, AI can offer improved methods for identifying anomalies and suspicious behavior that can prevent data loss and security breaches.

In the analysis of the correlation dependences of the processes of processing large databases and gathering evidence, low correlation coefficients were observed (-0.024 and -0.013, respectively). In both cases, the significance levels were above 0.05 (p=0.766 and p=0.870). This suggests that AI still needs to significantly impact these specific tax control aspects. A possible explanation is that AI technologies are often used in analytical processes and risk management rather than in the core processes of processing and gathering evidence.

About analysis and reporting, the correlation between AI and analysis and reporting was -0.007 (p=0.931), indicating no significant relationship. This indicates that the reporting and analysis process may still rely heavily on traditional methods or other non-AI analytical technologies.

The analysis reveals that artificial intelligence can improve certain aspects of tax control, such as risk management and cyber security. The correlation coefficients for these two domains are positive and statistically significant, suggesting that AI integration can minimize information risk in these contexts. However, AI's significant impact on data collection and processing, analysis preparation, and extensive database processing has yet to be established. It highlights the need for further development and implementation of AI at these stages to achieve overall optimization of tax control.

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ISSN: 2576-8484
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Table 1.
Correlation dependence of AI in information management in tax control.

Information management tax control									
		Collecting the information	**Information processing**	**Analysis of information**	**Risk analysis and management**	**Cyber security and protection**	**Large database processing**	**Preparation of analyses, reports**	**Gathering evidence**
Artificial intelligence	Corr. Coef.	-0.019	0.001	0.021	0.303**	0.232**	-0.024	-0.007	-0.013
	Sig. (2-tailed)	0.813	0.989	0.799	0.000	0.004	0.766	0.931	0.870
	N	151	151	151	151	151	151	151	151

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Edelweiss Applied Science and Technology
ISSN: 2576-8484
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Artificial intelligence can play a more vital role in risk management and data analysis than verification and control. For example, AI can help identify anomalies and patterns, but verifying information often requires confirmation and additional analysis that still needs to be automated.

Although AI can play a crucial role in automating many aspects of tax process, current data indicates that this potential is not yet realized in information verification and controlling. Tax institutions could invest in AI technologies that analyze and confirm the veracity of information to reduce information risk through more efficient verification processes. It may include developing specialized control tools that rely on AI to check facts and consistency in tax returns.

The analysis results show that, at the moment, AI does not significantly impact the verification and revision of tax information (Table 2). However, with further development and targeted integration, AI could support these processes and minimize information risk in tax control.

Table 2.
Correlation dependence of the use of AI and forms of tax control.

Tax control forms				
			Tax check	**Tax revision**
Kendall`s tau b	Artificial intelligence	Correlation coefficient	-0.057	-0.063
		Sig. (2-tailed)	0.488	0.438
		N	151	151
*. Correlation on is significant at the 0.05 level (2-tailed).				
**. Correlation on is significant at the 0.01 level (2-tailed).				

The research found that the correlation coefficient between "Artificial Intelligence" and "Tax Check" was -0.057, indicating a fragile, weak negative relationship between using artificial intelligence and tax control processes. The relationship is not statistically significant since the p-value is 0.488, well above the standard significance level of 0.05. It means that the use of artificial intelligence does not significantly impact conformation in tax control, or at least, no significant linear relationship between these two variables is found.

The study found that the correlation between "Artificial Intelligence" and "Tax Revision" also indicates a fragile negative relationship (-0.063) with a significance value of 0.438. This means that there is no significant statistical relationship here, too, which again suggests that the use of AI does not significantly impact tax processes.

The results show that the application of artificial intelligence in tax control does not significantly impact tax revision information. These processes require specific knowledge and skills that are currently difficult to automate through AI. It is also possible that AI will be applied more to automate and optimize processes related to data analysis and management but will yet to be widely used in tax control, which often involve detailed human review and confirmation of information.

The analysis's results show that artificial intelligence does not significantly impact the verification and revision processes in tax control. These activities require further development of AI technologies supporting specific tax data verification and validation functions.

A significant problem is emerging related to the need for sufficient integration of AI in the verification of tax data. The result may reflect the need for more developed applications of artificial intelligence in verifying and revising information in tax control. Verification processes often require specific expertise and contextual understanding that may still need to be fully automated or AI-assisted. Further development of AI revision technologies is needed. To use AI effectively in data verification and revision, algorithms and tools are needed to handle the complexity and specificity of tax procedures. These could include tools for processing text data, recognizing complex document relationships, and integrating explainable models (XAI) that allow reviewers to track and understand AI decisions.

5. Conclusion

The research indicates that the application of artificial intelligence (AI) in tax control has the potential to minimize information risk and improve the efficiency of the tax system. The main results

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ISSN: 2576-8484
Vol. 8, No. 6: 5066-5074, 2024
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indicate that AI is essential in managing information risk and enhancing cyber security by supporting the analysis and processing of large volumes of data. At the same time, however, it has been found that the impact of AI on the verification and revision of tax information remains limited. These findings highlight the need for further development of AI tax technologies to address the specifics and complexities of tax checks and tax revisions.

Machine learning algorithms and natural language processing are specific approaches and tools for applying AI to minimize information risk in tax control. They allow tax authorities to identify anomalies and potential risks in the data. The correlation analysis methodology indicates significant positive relationships between AI, risk management, and cybersecurity, substantiating these tools' effectiveness in information risk management. The positive correlation coefficient for the relationship between AI and risk management confirms that AI can identify risk patterns and prevent potential fraud.

The analysis results show that AI can increase accuracy and efficiency in data collection, analysis, and verification processes. AI influences the optimization of data collection and analysis processes but lacks a significant impact on verification and inspection. Although AI has successfully automated data processing and cybersecurity, results show little correlation with information verification, limiting its effectiveness. This finding highlights the need for further integration of AI into tax control to increase accuracy and reduce data processing time.

Based on the results, AI offers significant opportunities to minimize information risk in tax control, especially in the areas of risk analysis and management and cyber security. However, further development of specialized AI algorithms for verification and revision, which are more closely related to tax control features, is recommended. Their application will contribute to precision in the actions of tax authorities and the credibility of the final results of their work. Creating explainable AI models that provide traceable and reasoned solutions can improve the integration of AI into tax processes. These efforts will allow tax institutions to maximize the potential of AI, ensuring a more reliable and sustainable tax system.

Funding:

This research was funded by The Bulgarian National Science Fund at the Bulgarian Ministry of Education and Science, Funding Competition for financial support for projects of junior researchers and postdocs—2022, Funding number: KII-06-M65/2 from 12 December 2022, Project title: "Artificial intelligence in the economic perspective", Project coordinator: Aleksandrina Aleksandrova, PhD.

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Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 5066-5074, 2024
DOI: 10.55214/25768484.v8i6.3112