Chapter 1

Artificial Intelligence in Tax Fraud Detection and Prevention

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1.1. Introduction

Tax fraud remains a significant challenge for governments worldwide, contributing to an estimated 4% to 15% of the tax gap in various OECD countries (Gaie, 2023). These losses place additional pressure on public finances, especially in times of economic uncertainty and high government deficits. Addressing this issue requires effective detection mechanisms that can identify fraudulent activities while minimising disruptions to legitimate taxpayers.

Traditional tax fraud detection methods rely on audits, risk assessment models, and rule-based systems. While these approaches have proven useful, they often struggle with scalability, adaptability, and the ability to detect complex fraudulent schemes. Fraudsters continuously evolve their tactics, exploiting regulatory loopholes and technological vulnerabilities, which makes manual and rule-based detection increasingly inadequate.

Recent artificial intelligence (AI) advancements offer new possibilities for enhancing tax fraud detection. Machine learning algorithms, predictive analytics, and anomaly detection techniques allow tax authorities to analyse vast datasets more efficiently, identify hidden patterns, and improve fraud prediction accuracy. Despite these promising developments, AI-driven solutions also face challenges related to data privacy, transparency, and the risk of bias, necessitating a balanced approach to their implementation.

1.2. Techniques of Tax Avoidance and Evasion

Tax avoidance and tax evasion are common problems worldwide. Their scale largely depends on the level of economic development, legislation, and corporate culture. Various theories explain this phenomenon from different perspectives, but the key interest lies not in the causes themselves, but in the implications and consequences.

AI as a set of appropriate tools cannot affect unfair taxpayer attitudes towards taxation, but it can highlight and predict such violations among other taxpayers' data. To highlight possible AI tools for tax fraud detection, it is necessary to investigate the main tax avoidance and tax evasion techniques.

Tax avoidance and tax evasion techniques are mostly common worldwide, but some countries have their own approaches. The most used tax fraud techniques are:

■ Manipulating income recognition. Companies adjust the timing of income recognition to shift taxable income across different periods, lowering their tax liabilities. This is done by either delaying income recognition or accelerating expenses.

■ Using tax havens and offshore subsidiaries. Companies expand their operations into low--tax jurisdictions (such as Singapore and Mauritius, as observed in the case of PT Adaro Energy) to report income in countries with lower tax rates, thereby reducing tax obligations in their home country.

■ Leveraging capital intensity. Firms with high capital intensity (large investments in fixed assets) benefit from higher depreciation deductions, reducing taxable income. Since depreciation is a non-cash expense, it allows businesses to minimise tax payments while maintaining financial flexibility.

■ Profit shifting through transfer pricing. Multinational firms use transfer pricing strategies to allocate profits to divisions located in low-tax countries, thus minimising taxable income in high-tax jurisdictions.

■ Debt financing (thin capitalisation). Companies with high leverage can deduct interest expenses from taxable income, lowering their effective tax rates. This strategy aligns with the trade-off theory, where firms optimise debt levels to maximise tax benefits while balancing financial risks.

■ Institutional ownership influence. Although institutional ownership could theoretically reduce opportunistic tax behaviour, the study found no significant correlation between institutional ownership and tax avoidance, suggesting that even well-monitored firms engage in tax planning (Cahyaningrum & Wulandari, 2024).

When addressing Ukrainian realities, there are several common tax avoidance techniques, but some of them are less common in other countries. The most common for Ukraine are the following (Institute of Social and Economic Transformation, 2024).

■ Customs violations and smuggling
  – underreporting the customs value of goods to reduce import duties,
  – interrupted transit schemes, where goods are declared as transit but end up in the domestic market tax free,
  – use of intermediaries, individuals who import small quantities to avoid taxation.

■ VAT fraud and manipulation
  – illegal VAT refunds through fake exports,

- 'mMissing trader' and carousel schemes, where companies claim VAT refunds without real transactions,
- product substitution, where expensive taxed products are swapped for lower-taxed ones.

■ Profit shifting and offshore tax havens
- using low-tax jurisdictions to shift profits and reduce tax obligations,
- round-tripping, where Ukrainian-owned capital is routed abroad and reinvested as foreign investment to gain tax benefits,
- misusing tax treaties ('treaty shopping') to take advantage of preferential tax rates.

■ Shadow economy and unregistered business activities
- unreported cash transactions in retail and services to avoid corporate and income taxes,
- unregistered agricultural businesses which operate outside the tax system.

■ Abuse of tax preferences and special regimes
- misuse of tax exemptions meant for specific industries,
- artificial restructuring of businesses to benefit from preferential tax regimes.

■ Tax base manipulation and underreporting
- falsifying financial reports to minimise taxable income,
- using shell companies to create artificial expenses and lower profits.

■ Payroll tax evasion
- paying employees off the books ('envelope salaries'), reducing payroll taxes.

Comparing these two approaches can provide some insights concerning the similarities and differences related to the context of Ukraine (Table 1.1).

Table 1.1. Tax avoidance schemes comparison

Tax avoidance techniques	Common tax avoidance	Tax avoidance in Ukraine
Income recognition manipulation	Adjusting timing of income recognition to shift taxable income across periods.	Less emphasised. Instead, businesses underreport income through unregistered activities.
Offshore tax havens & profit shifting	Companies establish subsidiaries in tax havens (e.g. Singapore, Mauritius) to shift profits and reduce tax liability.	Strong emphasis on offshore structures, treaty shopping, and round-tripping (repatriating funds disguised as foreign investments).
Transfer pricing abuse	Multinational corporations shift profits by manipulating inter-company pricing.	Similar, but with a focus on transfer pricing audits and BEPS countermeasures.
Debt financing (thin capitalisation)	Companies use excessive debt to deduct interest payments and lower taxable profits.	Not a major concern for Ukraine.
Capital intensity for tax benefits	Businesses with large fixed assets leverage depreciation deductions to reduce taxable income.	Less relevant in the Ukrainian context.
VAT fraud & manipulation	Rarely used in other countries due to legislative differences.	A critical issue, with schemes like carousel fraud, missing trader fraud, and fake VAT refunds costing billions in lost revenue.
Payroll tax evasion ('envelope salaries')	Less common issue due to non-standard employment utilisation.	A major issue, with companies underreporting wages to reduce payroll taxes.

Smuggling & customs evasion	Less common due to legislative and digitalisation aspects.	Highly prevalent – includes undervaluing imports, fake transit schemes, and direct smuggling.
Abuse of tax incentives & special regimes	Some companies manipulate tax incentives, but no major emphasis.	Strong emphasis on misuse of tax exemptions, preferential tax regimes, and restructuring to avoid taxation.
Unregistered business activities (shadow economy)	Institutional ownership and governance factors are more common, but informal businesses are less.	A huge problem in Ukraine – cash transactions, unregistered businesses, and fraudulent financial reporting are common.

Source: compiled by the authors based on (Cahyaningrum & Wulandari, 2024; Institute of Social and Economic Transformation, 2024).

1.3. AI and Tax Fraud Possible Solutions: A Case Study of European Countries

Across Europe, tax authorities are leveraging artificial intelligence to improve fraud detection, enhance compliance, and optimise tax collection. AI-powered systems enable real-time risk assessments, automate audits, and analyse vast datasets to identify suspicious transactions, leading to significant financial recoveries. To date, tax agencies have prioritised three key objectives: identifying tax fraud and errors, enhancing the taxpayer experience, and increasing internal operational efficiency (Fig. 1.1).
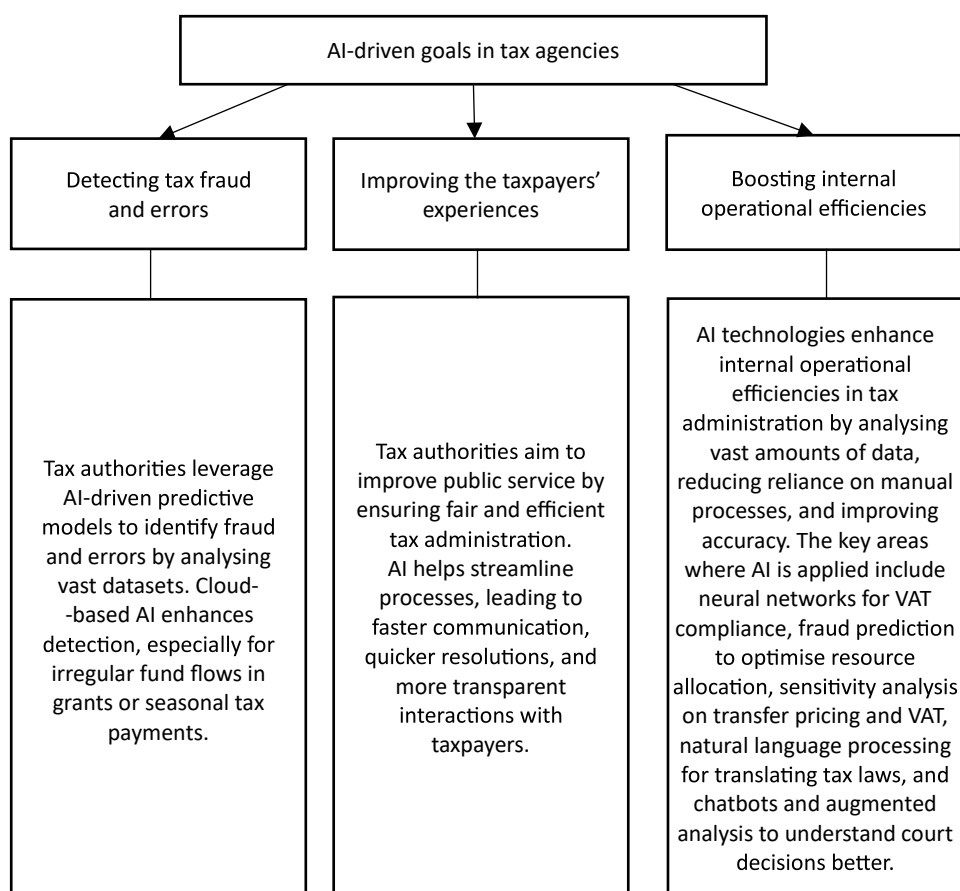


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                    │   AI-driven goals in tax agencies │
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│ Detecting tax  │  │ Improving the  │  │ Boosting       │
│ fraud and      │  │ taxpayers'     │  │ internal       │
│ errors         │  │ experiences    │  │ operational    │
│                │  │                │  │ efficiencies   │
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Tax authorities leverage AI-driven predictive models to identify fraud and errors by analysing vast datasets. Cloud-based AI enhances detection, especially for irregular fund flows in grants or seasonal tax payments.

Tax authorities aim to improve public service by ensuring fair and efficient tax administration. AI helps streamline processes, leading to faster communication, quicker resolutions, and more transparent interactions with taxpayers.

AI technologies enhance internal operational efficiencies in tax administration by analysing vast amounts of data, reducing reliance on manual processes, and improving accuracy. The key areas where AI is applied include neural networks for VAT compliance, fraud prediction to optimise resource allocation, sensitivity analysis on transfer pricing and VAT, natural language processing for translating tax laws, and chatbots and augmented analysis to understand court decisions better.

Fig. 1.1. AI-driven goals in tax agencies

Source: compiled by the authors based on (Asquith, 2024b).

One of the primary applications of AI in tax enforcement is identifying discrepancies in financial transactions and tax filings. Italy leads in this area with its VeRa algorithm, which cross-checks tax returns with bank account data to detect inconsistencies. In 2022, this system identified over a million high-risk cases and prevented €6.8 million in tax fraud (PwC, n.d.). Poland employs a similar AI-based approach through its STIR system which analyses daily banking data to detect VAT carousel fraud in near real-time – an improvement over the previous two--month delay. This innovation has contributed to a sharp reduction in Poland's VAT gap, from EUR 6.6 billion in 2017 to EUR 1.7 billion in 2021 (PwC, n.d.). In response to its VAT gap of 17.8% (one of the highest in Europe), Greece followed Austria's example by establishing an AI-driven monitoring centre for real-time VAT fraud detection (Asquith, 2024a).

AI is not only helping tax agencies combat fraud but also improving interactions between tax authorities and taxpayers. Slovakia introduced TAXANA, an AI-powered chatbot, in 2018 to assist taxpayers with queries related to tax returns, electronic filing, and VAT (Financial Administration Slovak Republic, n.d.). Similarly, Latvia's State Revenue Service (SRS) launched the chatbot Toms, which provides automated assistance on general tax matters. These AI tools streamline taxpayer interactions, reducing administrative burdens and making tax compliance more accessible (PwC, n.d.). Additionally, Hungary has experimented with nudging tools, adapting tax communication based on behavioural insights to encourage voluntary compliance (Tamás Czinege, 2019). Other European countries, including Spain, the UK, Ireland, Finland, and Estonia, have also deployed AI-powered virtual assistants to improve tax-related services (SERES, n.d.).

Beyond fraud detection and taxpayer support, AI is enhancing tax agencies' internal processes, making audits more effective and operations more efficient. Austria's Predictive Analytics Competence Centre (PACC) exemplifies this approach, with dedicated AI-driven units focusing on VAT fraud detection, tax audit automation, and customs risk assessment (The Austrian Federal Ministry of Finance, n.d.). In 2023 alone, PACC helped reclaim nearly EUR 185 million in tax revenue and investigated 27.5 million compliance cases (The Austrian Federal Ministry of Finance, 2023). Slovakia and Hungary have also deployed risk-scoring models, which segment taxpayers by risk level, enabling automated selection for audits (Financial Administration Slovak Republic, n.d.; Imrecze, 2016; Tamás Czinege, 2019). These predictive models allow authorities to prioritise high-risk cases while reducing unnecessary investigations.

Looking ahead, Romania is investing EUR 100 million in AI-driven tax solutions as part of its e-Invoice project, aiming to integrate machine learning and robotic process automation to boost VAT revenues by up to 1.0% (Vasilache, 2023). Latvia, meanwhile, has developed an AI--powered taxpayer rating system, using SAP HANA Rule Framework and machine-learning algorithms to assess compliance risk and identify undeclared wages with the accuracy of nearly 90% (PwC, n.d.).

Among the numerous advantages of using AI in tax authorities, it is important to recognise that AI systems are not infallible. Despite their efficiency, errors can occur, and relying entirely on automated processes without proper oversight can lead to significant mistakes. A notable example of this occurred in the Netherlands. In 2013, it was revealed that Bulgarian migrants were exploiting the Dutch social welfare system by registering briefly at an address and retroactively claiming healthcare and housing allowances. The system at the time allowed tax authorities to pay allowances upfront, with eligibility checks conducted afterward, often when the individuals had already left the country (Amaro, 2021). To address such fraud, the Dutch Tax and Customs Administration implemented an AI-powered system to scrutinise family

benefit claims for potential fraud. However, the system began incorrectly flagging legitimate claims as fraudulent. Civil servants in tax authorities, relying heavily on these AI flags, approved the erroneous decisions, leading to thousands of families being wrongly ordered to repay their benefits. This resulted in significant financial hardship for many, with the so-called Dutch childcare benefits scandal (*kinderopvangtoeslagaffaire*) affecting tens of thousands of parents from mostly low-income families (European Parliament, 2022). This case is a stark reminder that AI requires careful supervision to prevent serious consequences.

1.4.　AI and Tax Fraud Possible Solutions: The Case of Ukraine

Due to Russian invasion of Ukraine, tax fraud became more dangerous and destructive, as well as a common phenomenon. Revenues from tax and payments are used to finance many governmental spheres of the economy, especially military and social expenditure. Any tax violation reduces the country's ability to maintain its highest priority obligations and can affect the overall economy and market situation.

Different schemes of tax violations led to total budget losses of approximately UAH 354-568 billion (USD 7-11 billion) (Institute of Social and Economic Transformation, 2024). If one compares these losses with overall revenues of the Ukrainian budget in 2023, UAH 3104.8 billion, 11-18% of yearly incomes are missing. These losses are then transformed into an additional burden in terms of expenditures, namely UAH 4441 billion in total and UAH 2098 billion spent on defence. Thus, up to 27% of defence budget was lost due to tax violations (Ministry of Finance of Ukraine, 2024).

AI is not a magic wand and is still limited to keep in line with legislative and compliance requirements, but its efficiency and immunity to human factors are undoubted. AI tools can vary in efficiency due to different use cases, but according to some successful implementations analysed, the average tax fraud detection accuracy is close to 80% (Ariyibi et al., 2024). Implementing such a system in Ukraine can be challenging, but is it worth it?

It is necessary to look closely at the most significant tax gaps found in Ukraine and roughly estimate the possible outcomes. Customs violations and VAT fraud are described in Table 1.2.

Each tax gap can be described from a dual perspective, the human factor and information asymmetry, both of which can be mitigated to a certain extent by implementing some AI tools and features.

Regarding customs undervaluation, both outcomes of AI are valuable. Cross-border data collection and evaluation can significantly reduce the ability to declare unfair customs values, moreover the origin of any product, as well as its price change can be easily tracked. The AI tool will take into account only raw data about products and carriers, no human based biases will occur, and the bribe possibility reduced. The EU TARIC database and Australian Border Force are good examples of such approaches. In general, the existing procedures are aimed to utilise AI capabilities to compare declared import values against historical trade information and current market prices in counterparty countries. Pattern detection is also useful to flag systematic undervaluation as well as fraudulent activities. AI models can mark suspicious shipments for manual or additional inspection based on risk scores or machine learning algorithms (European Commission, n.d.; Outram, 2024).

Table 1.2. Consequences of tax fraud in Ukraine in 2023

Customs violations & smuggling (estimated annual losses: USD 3-5 billion)	
Customs undervaluation	45% of imported goods are undervalued to reduce import duties and VAT.
Interrupted transit & phantom exports	Up to 30% of declared transit goods remain in Ukraine tax-free.
'Ant smuggling' (parcel splitting)	Accounts for 20% of illicit consumer electronics imports.
False classification of goods	15% of customs fraud cases involve tariff misclassification.
Smuggling via Free Economic Zones (FEZs)	Estimated USD 1 billion in goods re-enter the market untaxed.
VAT fraud & manipulation (estimated annual losses: USD 4-6 billion)	
VAT carousel fraud	Causes up to USD 2 billion in tax losses, with missing traders disappearing before VAT is collected.
Fake VAT Refunds via False Export Claims	25% of refund claims in high-risk sectors are fraudulent.
'Invoice mills' & fictitious transactions	Involves 40% of shell companies used for tax evasion.
Construction & services sector fraud	Estimated USD 1.5 billion in lost VAT, primarily in cash-based industries.
Product substitution	Reduces excise tax collections by 10-15% annually, particularly in fuel and alcohol markets.

Source: compiled by the authors based on (Institute of Social and Economic Transformation, 2024).

Interrupted transit & phantom exports utilise similar approaches, while the most efficient way to reduce such a tax gap is to continuously track items. Another method is based on AI's ability to track data integrity via end-to-end tracking of all customs and tax related documents, diminishing possible fraudulent changes, thus the amount of goods declared at any point of the track will remain unchanged until the goods are really delivered to the end customer or have left the territory during transit. If any amount of goods is missing, the system will automatically raise a red flag for the exact operation, carrier, customs broker or any involved party, which can be used for triggering both external tax and customs audit or more detailed AI algorithms. Most of the existing systems use IoT (Internet of Things) devices powered with AI models to track cargo in real-time and flag any route deviations or delays for additional investigation. Blockchain ledgers controlled by AI can be used to ensure data integrity and timely reaction on goods route milestones (European Parliament, n.d.; Singapore Customs, n.d.).

Parcel splitting is not as easy to track and control, hence it is termed as 'ant smuggling'. To mitigate the tax gap created by parcel splitting, AI cannot be used by itself, but can enhance existing systems and predictivity. The main opportunity to avoid 'ant smuggling' is to detect what and how the goods are shipped, especially by individuals or parcels with no cost stated. As already mentioned, AI can only be a supporting tool in this case, enhancing the detection of hidden compartments, excessive repetition of identical parcels, and unusual density patterns as well as part of X-ray scanning software. This can reduce the human factor in the possible detection of unwanted items and flag similar issues. An additional feature – facial recognition – can flag individuals who had been already caught red-handed in cases of illicit imports for additional examination and security checks. Such practices are implemented in e.g. USA and China (U.S. Department of Homeland Security, n.d.; WCO News, 2024).

The false classification of goods is mostly an intentional fraudulent activity to avoid paying the correct amount of taxes and custom duties, but in some cases it can be a simple human error. To reduce this type of tax gap, all invoices and goods should be checked, compared and linked, however in terms of human activities regarding customs this is impossible, and thus AI can give a helping hand. AI powered computer vision can be used for invoices scanning and verification of goods-to-invoice correspondence. Natural language processing AI powered models can provide cross-checking between official customs codes and product description to avoid any sort of misclassification. One more possible solution is to add AI features to automated tax and customs duty verification systems linked to invoices and documents filling systems, thus reducing both intentional and accidental misclassification – the most relevant examples being IBM Watson AI for Customs and India's ICEGATE System (Joubert, 2024; World Customs Organization, 2023).

Smuggling via free economic zones (FEZ) is much easier to detect and reduce, but involves more variables. AI is a big help here, utilising its full power in mapping relations between FEZ, goods, carriers etc., as it can easily identify suspicious patterns in trading across or involving FEZ, as well as detect the misuse of the FEZ status. Another benefit is mapping real and hidden relations between market players to avoid the possibility of fraud, and flag potential subjects for additional inspection (Government of Dubai, 2025; OECD, 2022).

VAT carousel fraud is related to continuous goods routes between a number of parties being the subject of export and import operations more than once. Such operations can be used to reduce VAT payments or even as a way to obtain fraudulent profits. In order to minimise such operations, AI is not only a possible but the necessary solution. AI tools powered with Graph neural networks can analyse the whole flow and route of any kind of goods, marking high-risk traders or trade networks. AI models are also capable of mapping relations between counterparts to identify if any circular transactions exist. Overall, the EU's and Spain's unique systems for VAT flow analysis can be used as examples (Agencia Tributaria, 2024; European Commission, 2019).

Fake VAT refunds via false export claims provide one of the most destructive fraudulent tax schemes in Ukraine. Several approaches already mentioned for tracking goods and monitoring real-time cross-border transit can be used here as well. AI may be used to match customs declarations and statements with real goods movement and VAT refund requests, flagging inconsistency and fraud. Pattern recognition is also useful in terms of industry benchmarks reviewing and predicting possible fraud. The last but not least is IoT involvement to control a goods route and by storing it in blockchain ladder AI tools can verify whether exports actually occurred. The most relevant examples can be found in the UK (HMRC 'Connect') and Korea (eTax) (Daeyong, 2023; Guilherme-Fryer, 2023).

Regarding 'invoice mills' and fictitious transactions, the most relevant solution was also described previously; the natural language processing AI-powered models should be used to verify if invoices and transaction records are consistent. Machine learning can also identify duplicate invoice patterns and flag supply chains that are involved in suspicious activities – the most relevant examples are GST in India and Digital Tax Audit in Germany (Deloitte, 2022; Zetran, n.d.).

Construction & services sector is also suffering from tax fraud, mostly due to cash operations involved. Cash is hard to track and quite difficult to administrate from taxation point of view. AI can help to detect the consequences of some activities that led to creating the tax gap. For example, AI driven tools can analyse bank transaction patterns to identify underreported

incomes or flag companies with excessive VAT credits. An additional AI feature is a reconstruction of financial flows for tax liability base recalculation and comparison (AI Singapore, n.d.; Proximity, n.d.).

Finally, product substitution can be also pointed to. This tax gap generator is mostly related to certain product types that are costly in terms of taxation and easily misclassified due to the existence of lower price products and non-taxable products, for example comestible and industrial alcohol. To reduce the tax gap, AI can also be used. Thus, tax statements are compared to industry-specific production and inventory data to avoid possible misclassification. Computer vision can be used to check barcodes and the appearance of the product itself. Market price tracking is also implemented to flag products declared at unrealistic values – such systems are employed in China and Brazil (General Administration of China Customs, 2024; Johansson Neto et al., 2024).

The implementation of any highlighted approach will be beneficial for both taxpayers and tax authorities. The additional money flow may be to cover budget gaps or as a part of economic development. Moreover, implementation of AI will bring long-term consequences by enhancing all the involved systems and simplifying the observance of tax and custom duties.

While the highlighted method of using AI can mostly be considered as knowledge sharing and best practices, one should also look at some AI tools already implemented in Ukraine. It should be noted that during wartime, most of the existing and planned projects have been suspended, frozen, or forgotten.

The first example of an AI-powered project started in 2019 and was aimed to reduce possible tax fraud related to agriculture. The main idea was to scan and classify agricultural lands in terms of their targeted usage, crop rotation, and exact boundaries of the land parcel. This approach was based on two primary sources, namely satellite and drones' images that were processed with AI tools to create an up-to-date map with additional information layers. Using this information, the tax authorities could track tax flows and possible violations. This was one of the pilot projects, but due to the full-scale invasion it is no longer feasible because the use of drones is prohibited and satellite images are used for defence purposes exclusively (Velykyi, 2019).

One more noted example of AI implemented into the Ukrainian tax administration system is the use by Ukraine's National Agency for the Prevention of Corruption (NAPC) of civil servants' declarations verification. This system is based on an automated verification mechanism and risk assessment for cross-referencing various registry data to identify potential discrepancies. By assessing the declaration's risk rating, the AI system can mark suspicious items for manual verification, reducing burdens and possible manipulations (Kyiv Post, 2023).

Ukraine is capable of leveraging AI and digital technologies to enhance efficiency, transparency, and service delivery within the tax administration, but the current situation and wartime conditions are limiting some possible sources of information and funding for AI implementation. New cases of AI utilisation and implementation of the existing best practices will arise not just to keep pace with, but lead innovation through local and European tax administration systems. This can become a valuable and extensive field for further research.

1.5. Conclusions

By integrating machine learning, blockchain, image recognition, predictive analytics, and natural language processing (NLP), the tax authorities can automate fraud detection, enhance compliance, and significantly reduce tax evasion in both customs and VAT systems. AI-driven solutions enable real-time anomaly detection, automated risk assessments, and cross-border data verification, making them essential tools in modern tax enforcement.

AI-powered network analysis, blockchain verification, and computer vision have already shown success in detecting customs fraud, including undervaluation, smuggling, and the false classification of goods. Similarly, AI applications in VAT fraud detection have proven effective in identifying carousel fraud, fake invoice schemes, and refund manipulations, helping the tax authorities recover billions in lost tax revenue.

Nevertheless, AI alone is not a complete solution. Fraud prevention cannot rely exclusively on automated detection, it requires a holistic strategy that incorporates human expertise. While AI can flag suspicious patterns, tax auditors play a crucial role in reviewing these cases, ensuring that legal principles and taxpayer rights are upheld. A balanced approach ensures that tax enforcement remains accurate, fair, and legally sound.

By combining AI-driven analytics with expert oversight, the tax authorities can build a more transparent, efficient, and data-driven tax system. This synergy helps minimise administrative burden, close tax loopholes, and promote voluntary compliance, ultimately strengthening fiscal governance and securing public revenues.

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