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Artificial Intelligence and Big Data in Accounting: The Case of Commercial Banks in Jordan

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Abstract The integration of Artificial Intelligence (AI) and Big Data analytics is transforming the accounting and financial practices of commercial banks, particularly in emerging markets like Jordan. As the banking sector shifts from a product-centered to a customer-focused approach, the ability to analyze large volumes of data becomes essential for gaining insights into customer behavior, preferences, and financial patterns. This research explores how AI and Big Data technologies are being adopted by Jordanian commercial banks to enhance accounting processes, improve decision-making, reduce customer churn, and personalize services. By leveraging predictive modeling, segmentation, and behavioral analytics, banks can refine credit risk assessments, optimize marketing strategies, and improve customer satisfaction. Despite the promising benefits, challenges related to data quality, technological infrastructure, and ethical concerns remain. This study provides a contextual analysis of how AI and Big Data are reshaping the accounting landscape in Jordan's banking sector and offers recommendations for their effective implementation.

Keywords: Artificial Intelligence, Big Data, Accounting, Commercial Banks, Jordan, Predictive Analytics, Customer Behavior, Financial Technology, Banking Innovation, Data-Driven Decision Making.

1 Introduction

Over the past few years, banking institutions have undergone considerable change. The rapid growth of technology has impacted how banks do business now compared to just a few years ago. Financial institutions are primarily producing revenue by selling their products, such as loans, mortgages, or saving accounts. However, banks are transitioning from a production-oriented "push" distribution focus to a customer-focused, market-driven business model. As financial markets become more deregulated, banks are offering new products to alleviate the problem arising from customer "churn" and competition in local markets.

To retain existing customers and increase the current share of customers' deposits, credits, and products, financial institutions need deeper insights into client behavior, which can be gained through segmentation techniques, predictive modeling, and identification of target groups (Dvorski Lacković et al., 2016).

There are many possible applications of bigger data solutions in the banking industry. A greater understanding of customers leads to gaining insight into clients' habits, purchasing patterns, and evaluations of a bank's services. Such relationships subsequently lead to the ability to predict potential churners and design promotional activities to retain them. Consequently, banks may avoid costly marketing efforts to untargeted clients. With insights into what service aspects customers prefer to evaluate banks against competition, banks can improve their services and lower costs (Liu & Han, 2022)

Predictive scores may also help to deny services to applicants with a certain propensity to default or minimize the credit amount to be offered. By understanding how different aspects of their services impact customer satisfaction, banks may anticipate customer behavior and offer tailored products at the right time regarding how potential benefits are stressed.

2 Overview of Artificial Intelligence in Accounting

AI is rapidly changing the accounting profession, shaping what accountants do, how their work is done, and even how firms are organized. However, accounting education is lagging, threatening the survival of the discipline in its current form. The framework is specifically designed for academics to reflect on AI's potential impact on accounting education, though others may find it useful too. Societal shifts are creating both

challenges and opportunities for accounting educators across multiple dimensions. Desired outcomes from AI are (i) benevolence on AI; (ii) avoidance of existential doubt; (iii) expansion of jobs; (iv) increased long-term positive employment ratio; and (v) equitable access for all (Mhlanga, 2021)

AI is fundamentally changing how work is done, worth, and even organized in firms. The accounting profession is not immune to these changes—indeed, it stands to be one of the most affected professions. AI may replace entry-level jobs, transform existing jobs, and create new jobs at various accounting and audit firms. AI products that change what accountants do, how they work, and how firms operate are considered "disruptive" and may threaten the survival of the accounting discipline unless countered. However, AI also offers unprecedented opportunities to improve accounting work, as it relieves accountants of tedious tasks and allows for the qualitative expansion of the profession's core activities (Lui & Lamb, 1970)

AI is based on data (specifically big data), which is defined as unstructured data easily acquired via the internet. Data widely accepted as the 21st-century oil theoretically augurs well for the growth of the global economy. Data, however, generate intelligent activities that could threaten human existence. Armageddon fears range from social media affecting civilization to other uses of AI, like deep fakes, jail-breaking AR goggles, and weapons of mass destruction. Accordingly, there are calls for self-assessment of AI's broad societal impact and the formulation of suitable and effective legal and ethical policy responses so that fears of a looming catastrophe do not materialize.

3 Big Data: Definition and Importance

Many definitions of big data exist, but it is generally defined as a large amount of data that cannot be processed with traditional database tools due to its large size and complexity. The commonly used definition indicates three dimensions (3V), namely: a high data volume (volume), high speed of data generation (velocity), and data in different formats, which are difficult to process and analyze using standard tools (variety). Big data are distinguished by their complex structure and unregulated sources, which stem from several processes in banking, i.e. e-banking, mobile banking, SMS banking, and ATM transactions.

Natural gas consumption and its determinant factors in Jordan Using traditional tools, data preparation, cleaning, and integration can last for several months due to unstandardized data. Innovative techniques are needed to clean the data in short time intervals to make them compliant for further analysis.

The importance of big data in financial institutions, such as banks, is reflected through its influence on decision making in business processes, marketing opportunities and strategies, fraud detection, risk measurement, predicting customer behaviors, and psychosocial factors influencing customer decisions. The value of data and analytical tools for making business decisions requires better understanding of collected data, available analytical tools, possibilities of improving existing processes and creating business models.

Big data is deemed as the fastest and biggest growing segment in global business. By gaining sustainable competitive advantage, the value of big data for increase of number of regular or potential customers and for observing customer's behaviors will be presented, and money-saving opportunities through better inventory management will be mentioned. The innovative financial technologies that are offered due to collected data will be presented (Dvorski Lacković et al., 2016)

4 The Role of AI in Financial Decision Making

Numerous aspects of financial decision-making and corporate governance in financial institutions have recently been transformed by digital technology. Users' medical data, shopping histories, and driving records are increasingly being analyzed and used to tailor marketing services. Similarly, as online banking, electronic bills, and mobile banking have proliferated, so too have consumers' payment behaviors and transaction data. An example is when a consumer uses a debit card to buy groceries at a supermarket, their payment data is recorded with details such as the grocery supermarket's property, location of the transaction, and the time of the transaction (Lui & Lamb, 1970)

This non-intrusive collection of data provides rich opportunities. Likewise, excess information can be fed into other intelligent digital tools to produce more accurate predictions of another comprehensive range of topics, including low-rated credit and subsequent defaults, loan applications' deliverables and requirements, and customer complaints and minimal rates (Liu & Han, 2022).

With data collection and processing technology development, such tasks that are time-consuming, financial resource-draining, and costly can be processed with a great volume of data in a wide set of dimensions. By adopting automation decision-making systems, decision-making tasks within financial institutions can also be promoted, as many factors can be considered to produce more accurate and fair decisions. AI technologies address decision-making tasks, including decisions regarding lending limits and interest rates, credit cards approval, money-laundering searching, bonuses, and fraud identification.

Nevertheless, it should also be recognized that such a rapid convergence of diverse technical instruments can lead to adverse adaptability and ethical governance risks. If excessive and redundant information about financial topics is acquired, with many dimensions, the decision-making institutions may be overwhelmed and incapable of achieving acceptable responses within a delay. Another potential dilemma is that the automation of decision-making governance and deployment technology within banks may lead to a reduction in the number of employees in financial institutions and thus a decrease in the population's purchasing power in the relevant demand-side industries. In addition, such rapid convergence may lay the foundation for

existing discriminatory issues. For example, the label of 'wilderness area' in a credit report is a criterion of low credit risk. If such criteria can be derived or reached through conversation records, such discrimination can be uncontrolled, generating social tension.

5 Big Data Analytics in Banking

The emergence of big data and advanced analytics has opened up new horizons in every sector of the economy, including financial services. Banks face new competition, new regulations, and have new opportunities for innovation thanks to data. As with industries such as telecommunications and retail, analytics is gradually becoming a management culture, emphasised across business units and hierarchy levels. Banks are beginning to take action across dimensions such as data accessibility, analytics usage, and automation. In a few years, banks will reach a new data environment and significantly enhance customer experience, operational efficiency, and compliance, as well as new product development. This trend is especially relevant to smaller banks, which are typically lacking in talent and technology. However, the role of data frameworks or marketing models and the impact of their goal orientation in business development were highlighted, as well as potential targets for the future (Dvorski Lacković et al., 2016)

Furthermore, regulatory capital constraint gives an opportunity to make better investment decisions. Banks need to identify issues in a timely manner to avoid loss of reputation and profitability, as well as better understand business performance. They can put forward a holistic view of customer experience across all of its business units. Analytics on big data can ascertain how the provision of service affects revenue in real time, refine and optimise the risk appetite in business and operations, and forecast business bottom-line figures and the chance of occurrences (Hassani et al., 2018)

Banks operate in a unique environment, which is regulated with focus on credit and operational risk. The rapid change in business complexity and the abundance of information further expose banks to risks. The need for timely identification and in-depth understanding of these risks is therefore crucial. As most of qualitative information comes from report documents, big data is especially relevant to sentiment analysis. Meanwhile, structured data is becoming increasingly essential, as it reveals hidden relationships among items or events and leads to reasonable risk mitigation actions.

6 Commercial Banks in Jordan: A Background

Jordan is classified as a developing country. Over the past decade, the Jordanian economy has undergone major changes, including structural transformations and modernization of economic policies. The banking sector is considered the backbone of the Jordanian economy due to its important role in securities transactions, issuing capital, credit control, and managing and investing funds. The banking sector in Jordan consists of several components, including capital provided by the Central Bank of Jordan. This sector plays an essential role in the national economy by contributing to economic growth and project financing (Younes Yameen & Sami Ali, 2016)

. The nature of the working environment and rapid developments in Jordan have resulted in the advancement of banking ideas that have made rapid progress over the past several decades in factories, agencies, and banks. The country's banking system has evolved into a modern, bank-based system in the three principal sectors of banking and financial institutions. Commercial banks provide various services to clients, including meeting their needs and providing financial growth. This paper focuses on the subject of commercial banks in Jordan, as they comprise the vast majority of Jordan's banks compared to industrial and investment banks. In addition, licensed and registered countries offer public services to the investing public (Kanakriyah, 2017).

. Commercial banks provide several financial services, including accepting deposits, providing loans, issuing debit and credit cards, and handling checks and money orders. They operate for profit and invest in securities or land, with profits primarily coming from loan interest, commissions on checks and letters of credit, and dividends on investments. Commercial banks are licensed by the central bank to issue cash and public money to the investing public, and they can conduct banking operations in Jordan and abroad.

7 Adoption of AI Technologies in Jordanian Banks

A set of questionnaires were developed in Arabic and distributed to the target group in Jordan banks to collect the most relevant data for this study. Three different means of collecting data were employed: by personal visit to the banks, through email with a covering letter inviting the banks to participate in the study and reassuring them about the confidentiality of the information provided, or self-administered questionnaires that the banks answered and sent back to the researcher. A letter of introduction was addressed to the chief executive officers of all commercial banks in Jordan, inviting them to participate in the study and assuring them that the information gathered would be kept highly confidential. Definitions of terms used in the questionnaire were briefly summarized, and the questionnaire was then translated into Arabic to accommodate the banking experts and employees who may not be fluent in English.

The researcher and research assistants visited the banks and personally handed out the questionnaires along with the introduction letter. The units of analysis were the banks themselves, which were asked to select a group of accounting experts and leading employees with higher degrees who use the accounting information systems to answer the questionnaire with high degree of reliability. Fifty-two banks were asked to fill the questionnaire. Twenty questionnaires were feed back; one was not included in the analysis as it was filled carelessly; therefore, 19 questionnaires were coded by the researcher to treat the data using statistical package. Another questionnaire was sent to audit departments in Islamic Sharia Banks. The banks self-evaluation approach using comparative financial accounts is considered one of the most popular methods of bank performance evaluation. However, the choice of relative indices to measure the bank's performance has been the subject of discussion for a long time. Many indices were used, but no standard, universally accepted lists were found. Therefore, the survey approach is adopted, and the expert questionnaire consists of 55 indices that measure bank performance, viz, input, output, and profit indices. Community-driven public banks are banks operating in public banks set up by communities and owned effectively by the communities.

To ensure that the research meets the expectations and standards of the faculty, it was reviewed carefully. Finally, the design was interviewed in a pilot study of 250. Consequently, it is ensured that the research design meets the criteria of content, construct, reliability, and validity.

7.1. Current Trends

Global accounting professionals have been vigorously debating the implications of artificial intelligence (AI) on accounting and auditing since ChatGPT, one of the most powerful generative AI language models, was made publicly available. Other business professionals have praised ChatGPT's capabilities in an age of increasingly automated digital transformation, while some accountants have raised concerns about whether text-generative AI models would render accountants obsolete. There are additional concerns about the potential misuse of generative AI text models to create misleading or illegal content, which could undermine public confidence and significantly impact professional firms and the auditing profession at large.

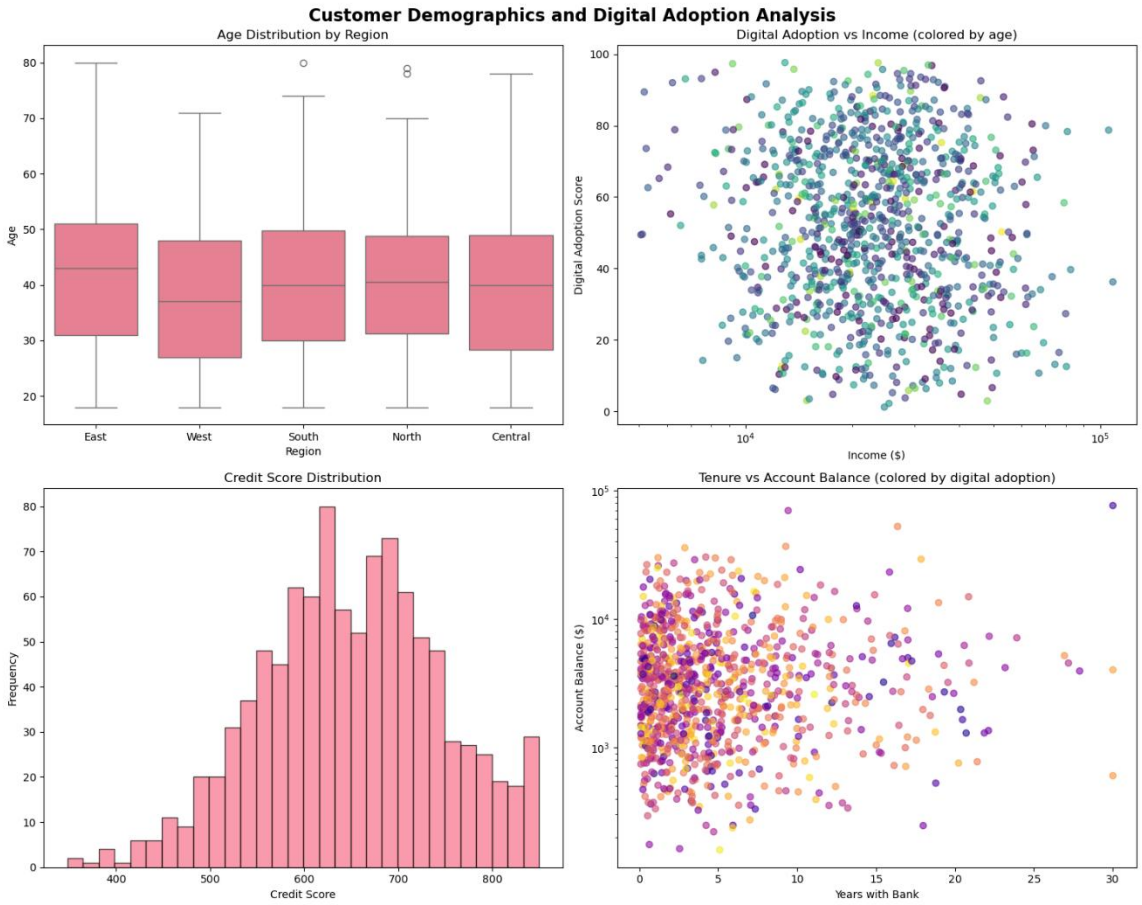
Notably, while many highly visible incidents of AI misuse have garnered huge media coverage and concern, there remains a dearth of knowledge about actual applications of AI in accounting, the extent to which AI is affecting accounting jobs, and how accounting programs, students, and professors are responding to the growing prominence of corporate interest in AI. This study aims to better understand pricing and wage setting in the AI-augmented accounting labor market. It highlights what is known and not known about AI's current and anticipated impact on accounting practice and education, as well as the ethical, regulatory, and economic considerations involved in understanding AI in accounting.

With respect to current trends and applications, while a sizeable body of scholarship on AI in accounting, audit, and advisory work existed prior to the release of ChatGPT, that work largely concerned AI as a futuristic agenda, rather than a significantly implicated technology in current accounting systems . At this intersection of the accounting profession and AI technology, it remains highly informed and significant to map professional technologists' experience of revised practices in an AI-augmented workplace. Also of particular importance is to track how accounting education adheres to, and wrestles with, the burgeoning expectations surrounding the teaching of AI . Understanding how these technologies and their attendant concerns come to shape the business of professional firms, and equally how accounting education (re)aligns to facilitate that burgeoning practice, is inherently significant—electrifying, perhaps, but fraught with urgency.

7.2. Challenges Faced

The continuous technological development and the increasing reliance on these technologies have resulted in great transformations in the economic and social structures of society, especially after the emergence of the phenomenon of electronic trading, the internet, and the World Wide Web . Over the past decade, the banking sector in Jordan witnessed major technological developments that led to the emergence of many banking systems based on the latest global technologies in banking and financial services. As a result, Jordanian banks developed new banking services with new forms and levels of risks, and an expansion of the information base that significantly affected the banking home bank accounting systems in Jordan. These systems provide the management with all accounting, financial, and statistical reports related to the bank's activities and the products of the banking services sector, which includes the thirty-five banks operating in Jordan. However, Jordanian banks constitute a gold mine for any hacker, which increases the dangers and threatens the security and integrity of the data in computerized banking systems. This has resulted in the emergence of new risks in the banking sector that are not completely similar to the apparent risks arising from traditional banking services.

The banking sector in Jordan is characterized by intense competition, and it was one of the earliest sectors in Jordan to use the computer and computer networks to improve financial and administrative performance. As with all computing and computer networks, this technology increased risks to a level that was not commonly known in traditional calculations. The total and integrated costs of this risk are difficult to estimate. In addition to average direct losses, the bank may face larger losses associated with adverse publicity and the considerable cost of defending against regulatory actions. The ultimate loss may exceed the defense costs, fines, and damages. Security problems are more numerous, more diverse, and pervasive than those confronting traditional information systems. In fact, the development of computers and systems made even an ordinary event like a power failure potentially disastrous, resulting in the loss of months of data. Client confidence may decline, which can result in the loss of customers and share prices. Rapid technological changes have stressed the rules governing the country's banks. Compliance and enforcement are often lagging behind changes in systems and processes. With the recent advancements in AI and Banking Information Technology, the study aims to assess the challenges and risks faced by some commercial banks in Jordan.



8 Impact of Big Data on Accounting Practices

The results of the main hypothesis show that big data has a significant positive effect on accounting practices, with an impact coefficient of 0.560. This means that for every 1% increase in big data, accounting practices will increase by 0.560, assuming the rest of the independent variables are constant (Kanakriyah, 2017)

. The t-value is 7.034, which indicates that the null hypothesis can be rejected, and thus, it can be said that big data has a significance effect on accounting practices. In order to apply the Big data technology in accounting practices, it is necessary to implement new provisions and changes in accounting, auditing standards, and procedures as well as establish the legal rules required to not only spread and maintain this technology, but also to ensure all data in its varied forms are safe. Furthermore, accountants and auditors need to be educated on utilizing the Big data technology. FinTechs should also compete by employing big data technology to provide low interest rates, online issuance of credit cards, tailor made loans, value added individual and corporate credit loans and their continuous follow up in competition with banks. The objective of the second sub-hypothesis was to test whether big data affects accounting practices. The results show that the value of the Pearson correlation coefficient is .726, indicating a strong positive correlation between the two dimensional variables with a significance level of .000, meaning there exists a statistically significant relationship. Data mining, real-time processing, deep learning, and machine learning were explicitly addressed in this hypothesis. As for the degree of importance of the dimensions, descriptive statistics revealed that all of the statements were above the midpoint of Likert scale (3), indicating that there exists a general tendency

onal approaches toward modifying processes and developing efficiency. The significance of employing big data analytics to extract valuable information for the organization's growth has previously been highlighted. The proportion of organizations deploying big data techniques on business-related endeavors has been represented as an organization's degree of data management. The measurement of business-based

data focuses on the characteristics and purposes of the organization's existing data management technologies . The organizations that have embraced big data analytics are examined exclusively in terms of their targets and gaps along with a comparison against the situation in other sectors. Additionally, a comparison of banks and non-banks is also pursued to understand the difficulty of generalizing lessons among person-to-person services. For mergers and acquisitions, for the prediction of stock movements, forecasts of interest rate movements, assistance in risk management, fraud detection, and bankruptcy prediction, big data is a critical component in meeting banks' and non-banks' business purposes. Involvement in cross-marketing, prospecting, support for product development, and customer analysis is less common. For risk and operational management, big data is employed less extensively than expected by both banks and non-banks. Fraud detection and prevention, macroeconomic risk assessment, and daily cash prediction are important fields in risk management for mid- to large-sized banks deploying sophisticated risk management architectures. In the banking sector, outsourcing and use of contractors for work other than IT processes account for a significant amount of data breaches, pointing to capability limitations. Hence, the perspective of organizations regarding their data management situations and the implications of these perspectives on their intended use of big data spans is outlined.(Liu & Han, 2022)

8.2. Reporting and Compliance

Reporting and compliance are seen as an important tool in monitoring the implementation of banks' accounting policies and procedures. All regulatory authorities require compliance to the banking regulations. Banks have to prepare their reports after applying the accounting policies mentioned in the manual of accounting policy and procedures prepared by banks against the norms of the Accounting laws and standards. They have to report to the banks authorities and regulatory authorities monthly, quarterly and annually as per the requirement of the authorities. Reporting is the presentation of the summary of the application of accounting policies in the monetary terms to the interested users to enable them to understand how the accounting information has been applied and what it portrays about the performance and position of Banks. Reporting, in turn, is grouped into compliance and consumption. Compliance means "to conform, acquiesce or yield". Compliance is done first before reporting. It is the application of the accounting policies in recording the day-to-day transactions. Reporting on compliance means the report stating how far the accounting policies were complied with.

Report on compliance prepared against the assessment of compliance is presented in the compliance section of the report on acceptance of external auditing. The report on compliance is presented to the board of directors, audit committee and regulatory authorities of the central bank. Reporting on compliance is seen as an important tool in tackling the financial crisis and monitoring the implementation of banks' accounting policies and procedures (Ismail Hossain, 2013). In Bangladesh, every bank is required to follow the Bangladesh bank guidelines in preparing reports on accounting compliance. Bangladesh bank is the central bank of Bangladesh. Four foreign banks did not comply with the Central Bank Bangladesh Bank Regulation, 1984 in respect of which their directors as well as chief executive officers were personally held liable by the sanction of fines and penalties. In Bangladesh, few studies have been found on compliance functions of banks (Shamim Hossain & Alim Baser, 2011).

H1a: There is a significant difference in the quality of reporting and compliance between traditional banks and internet banks.

H1b: There is a significant difference in the quality of reporting and compliance between local banks and foreign banks.

H1c: There is a significant difference in the quality of reporting and compliance between state owned banks and private banks.

9 Case Studies of AI Implementation

Commercial banks in Jordan have started recognizing the need for Artificial Intelligence (AI) and Big Data technologies in order to maximize their resources and provide personalized services to customers. In the Jordanian banking industry, many banks have been incorporating AI into their trends in recent years. Achieving control over human-relevant data has become a prerequisite for competitive advantage in banks. In order to capitalize on the strategic opportunity afforded by developments in AI, banks first need to invest in the construction of an integrated AI ecosystem for data acquisition and processing, therefore paving the

way for the application of AI-based solutions in a wide range of service schemes, customer-facing or otherwise. Civic services and industrial projects with a large customer base, internet-wide transactions, or significant social impact are ideal subjects and venues for the testing and training of AI solutions and frameworks. Likewise, the cooperation with local regulatory authorities in developing financial compliance paradises is a promising area for the use of cutting-edge AI. The collective impact of the suggestions would promote the construction of a healthy and benign AI ecosystem supporting both banks' interest and customers' needs and withstanding the potential abuses of AI technologies.

More recently, AI-based systems have been adopted in banks. It is predicted that credit rating statistics of up to 10,000 companies will be available for banks to assess the risk of handshakes with different companies. Banks can further enhance their productions by using AI to analyze real-time stock market data and market news. AI may be used to evaluate this data, identify problematic data, perform risk prediction, timely tracking, and further determine if it fits the standards of bank transactions. Furthermore, AI can warn of difficulties in bank transactions, prohibit inappropriate transactions in real time, and significantly increase banks' risk management levels. AI may handle the loan process when banks lend. Network algorithms handle the analysis of personnel social graphs as the data sources of banks, identify suspicious social graphs, assist in credit risk assessment, and identify fraudulent customers.

Banks may also benefit from AI in general big data processing. The vast amount of data in social networks requires more and more processing and storage capacity than storage systems can handle. High-performance storage must be installed and maintained by engineers and managers devoted to data storage. Banks can collaborate with social service networks and allow them to host the data. Libraries of AI algorithms and intelligent processing capabilities to analyze bank-held social data can be added to the network. More likely, AI can analyze the public sentiment towards a company or an enterprise publicly. Banks can assess the credit risk of companies by searching the social network-relevant term searches, hence assisting loaners in deciding whether to lend to a company.

9.1. Successful Implementations

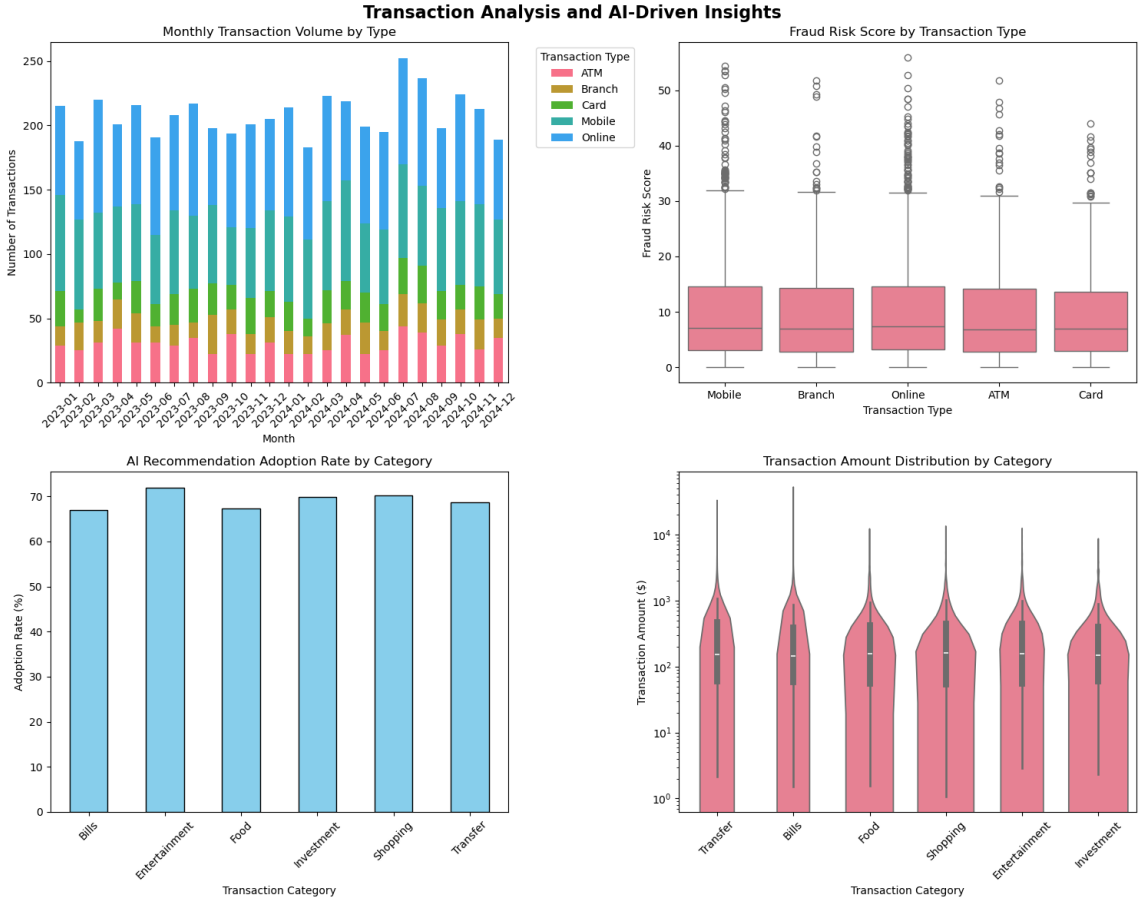
The modern world is characterized by rapid changes in all aspects. Thus, every civilization in particular and the world in general have become dependent on modern technology. Jordan offers adequate infrastructure to cope with the rapid development of modern technology. Success in providing such technology depends on the availability of suitable conditions. Banking values have increased with the evolution of banking services and substantial developments in banking operations. Banking services have expanded to cover a major part of the national economy, attracting substantial central master systems, required by customers' needs in light of fierce competition. This encourages managerial methods in banks and organizations to change accounting information systems from manual to computerized or semi-computerized, as computerization improves efficiency and quality (Kanakriyah, 2017). The objective of this paper is to examine whether such information systems affect the functions or banking methods (i.e. services, products, clients, design, promotion, and selling). The study proceeds as follows: A definition of banking operations, a brief examination of the principal characteristics of accounting information systems, and a literature review. A presentation of the survey methods utilized, a reporting of the research findings, a discussion of those findings, and a conclusion. The Jordanian banking sector began to function in 1964, and its growth, expansion, and evolution have kept pace with the more developed Arab and foreign banking systems. The number of banks at the end of 2005 reached 24, believing that Jordan offers adequate infrastructure to cope with the rapid development of modern technology. The banking sector is developing quickly with significant accumulations of funds on which many funds depend locally. There is widespread investment activity by individuals, companies, and financial institutions seeking a good return on their investment.

9.2. Lessons Learned

As a result of the case studies and interviews with a selection of Jordanian commercial banks regarding the application of AI and big data. The research offers Jordanian banks significant ways to keep pace with global banking development and provide a wide range of sophisticated smart banking services to improve the customer experience. The results show that, despite the difficulties facing Jordanian banks, more than half of them believe that AI/big data will help these banks outperform their competitors. Jordanian banks consider applying AI and big data to their operations in four major areas: risk management, internal auditing,

marketing, and customer service. The AI/big data systems being implemented can continually detect anomalies, categorize suspicious transactions, assess default credit risk, conduct sentiment analyses on customer posts and reviews, assist sales agents with chatbots, and offer personalized alerts. More than half of Jordan's commercial banks have an AI/big data system either implemented or on the way. AI has a greater impact than big data on these banks' operations even though banks are also aware of the importance of big data.

Adapting and implementing AI/big data systems is challenging. The primary barrier to and fear of AI/big data, according to Jordanian banks, is their reliance on the human workforce, which cannot be effectively placed by AI. Jordanian banks believe that AI/big data need not to be immediately concerned about the possible negative impact on performance. Jordanian banks classify the advantages of AI and big data into short-term (immediate) effects, mid-term (two years), and long-term (three years) effects on operations (more than three years). More than half of Jordan's commercial banks anticipate that AI/big data systems will enhance their development and risk management in the short- to mid-term. The interview results confirm that today's global banking sector is shifting toward a knowledge-based intelligent banking sector, supported by AI, big data, and similar financial technologies.



10 Regulatory Framework in Jordan

The regulatory framework in Jordan consists of various laws, regulations, and directives developed to provide the legal grounds and standards for different aspects of commercial banks' operations. The following paragraphs provide some of the key laws governing commercial bank operations in Jordan. The regulation of commercial banks in Jordan commenced with the establishment of the Central Bank of Jordan (CBJ) in 1964, by virtue of the Banking Law No.28 of 1964. The CBJ is responsible for formulating, implementing, and following up with the monetary policy, maintaining the stability of the currency in Jordan, preserving

and enhancing the stability of the financial system, and regulating the banking sector (Kanakriyah, 2017). Commercial banks in Jordan have occupied a significant position in the Jordanian economy, in terms of volume of assets, and providing employment opportunities. The interest in and attention to studying the impact of big data and artificial intelligence on the accounting and auditing processes in Jordanian commercial banks comes because of having the regulatory framework concerned with the accounting systems and their regulation in the various banks operating in Jordan.

The accounting regulation in Jordan consists of various laws, bylaws, directives, regulations, and decisions. The accounting legislation provides the legal grounds and standards for the regulatory effectiveness of the steps taken toward enhancing financial responsibility and improving public and private sector accountability. Financial accounting regulations involve the production of financial statements and books in general, as well as the best means to develop the quality of accounting systems and the manner of developing them, accompanying big data and artificial intelligence aspects compared to other developed countries. The Jordanian accounting legislative framework consists of the narrative and the technical material governing all aspects of the financial accounting system. It also includes the procedures adopted by organizations and institutions to record data, process them, and prepare comprehensible financial reports. Accordingly, commercial banks are required to adhere to the framework of laws, including the Banking Law No. (28) for the year 2000 and its amendments; the Financial Institutions Law No. (33) for the year 2010; and the Accounting and Financial Governance Law No. (1) for the year 2017.

The regulatory framework also includes by-laws and socalled instructions, such as the accounting instructions for commercial banks for the year 2002; the accounting instructions for mortgage finance companies; as well as the accounting instructions for non-banking financial institutions. In addition to the IASs issued by the IASB and so on. Financial statements sent out by companies don't usually provide digitized data and thus can't be efficiently analyzed. Generally accepted accounting principles have to be adhered to throughout the data gathering process. Enterprise knowledge of the legal structure has to be available in a meta-data repository to be able to query information about and access the data.

10.1. Banking Regulations

By observing the importance of the banking system for the global economy, financial regulations are considered essential to protect the money of individuals and companies from banks and other financial institutions as the custodian of funds. For this purpose, many regulations and monitors are imposed by countries or by international institutions. As far as the banking sector in Jordan is concerned, many banking regulations and instructions are imposed by the Central Bank of Jordan based on international instructions and other achievements. One of the more important regulations imposed on banks is to maintain a capital frame, meaning that a certain percentage of total assets should be preserved based on the average risk of the banking transactions. Also, many regulations were imposed to ensure the quality of both internal and external banking transactions; this includes instructions for record keeping, documenting, auditing, etc. In Jordan, these records clear transactions are stored in the ledger and the support for this transaction should be documented.

However, many of these regulations, controls, and instructions should accompany after ensuring that these transactions have already been secured; that means that the financial service providers should indicate beforehand the regulatory requirements in transactions before ensuring its compliance. On the other hand, and similar to the case for commercial banks in many countries, and by the increasing capability of financial data analysis and statistics, many financial transactions are becoming highly automated and very large in volume. Usually, large banks provide online trade, purchase applications that are powered by big data systems that handle these banking transactions. Also, a significant number of big data applications are seen in commercial banks like deleting some financial transactions records and changing the track pattern of money, etc. The governance and supervision of the financial transactions is crucial for controlling money laundering and in order to protect the economy from the negative impact of terrorism funding and criminals activities, and to ensure the complies of the banking transactions of the Jordan financial regulations.

10.2. Data Protection Laws

The regulation concerning personal data and privacy protection in Jordan mainly comes from a Data Protection Law promulgated on 05DI/2015. The Data Protection Law came into effect on 01/01/2018, which

aims to safeguard personal data privacy rights by setting forth general rules to determine its conditions, guarantees, and usages and granting judicial protection against any breach thereof. Notably, Article (1) of the Law states that the Law shall apply to any data processing procedures applied to any personal data or public body files, whether it was performed in Jordan or outside it as long as such data is related to persons residing or having dealings in Jordan, or regardless of the location of the processing if it was carried out for the purpose of making personal data available to any public body or establishment in Jordan. Besides that, the Data Protection Law imposed many obligations on data controllers that any person shall be considered a data controller if he has knowledge of any kind about any matter relating to the collection or process or using of personal data relating to any person. As for the obligations of data controllers, they must obtain the data subject's prior written approval before processing any personal data. The law enumerated exemptions of data processing without prior written approval from the data subject. It also forbade data disclosure for third parties unless the prior approval of the data subject was obtained. It also allowed the data subject to request data review and the application of any related rights which should be processed without delay. Later, banking sector had to regulate such legislation and principles, especially with the deployment of big data analytics and AI.

The Central Bank of Jordan (CBJ) issued instructions to comply with data protection laws and to maximize benefits from the use of big data analytics as early as 03/04/2018. The instructions contained data types, collecting sources, collection methodology, the data management process, data storage, accessibility and withdrawal, data protection measures, awareness, user rights, as well as big data analytics user roles and responsibilities, big data techniques, applications, challenges, ethics, and the effect of using such technologies (Lui & Lamb, 1970).

11 Ethical Considerations in AI and Big Data

Artificial intelligence (AI) and big data have become an integral part of our lives and are essential business tools in many industries, including accounting. However, their growing importance has created concerns the world over regarding their ethical use (Belle, 2019). These concerns are compounded by the fact that the use of AI and big data can have serious implications for privacy and autonomy. Similar concerns have arisen among potential AI adopters and users (Lui & Lamb, 1970). Tackling ethical concerns head-on can help to proactively shape how AI and big data are used ethically, and how concerns can be addressed if they arise.

The ethical algorithms have been used previously to address ethics surrounding the core business of accounting firms. Publicly accounting firms are required to maintain confidentiality and the privilege and keep the secrets of clients. The predictable and repetitive accounting services are simple and routine tasks that have easily outsourced by to computers across different zones. Accounting firms use a variety of tools, techniques, and procedures to extract huge data from structured, semi-structured, and unstructured social media platforms. The advancement of hardware and software technology, as well as the variety of big data analytics tools, have made it easy. With the help of big data, techniques can assist in providing valuable insights into how to do business with customers. Along with the advantages of utilizing AI and big data, there are ethical issues and concerns arise across the profession.

Such ethical issues and concerns have classified into seven categories as over-reliance, data confidentiality and algorithms confidentiality, clients' trustworthiness, lack of professionalism and integrity, severe data breaches, hacking and cybercrimes, and breaches of human rights or rights of minorities. Ethical concerns regarding the environment and take into account how it affects the wellbeing of future generations are discussed. AI and big data techniques utilized in the accounting profession and before their adoption take into account the ethical issues and concerns highlighted in the survey. Call for more scholarly research regarding the ethical side of AI and big data is made.

11.1. Privacy Issues

With the growth of mobile, storage, web-based, and cloud technologies, the need for information is more significant than ever. These developments have caused an information explosion that has far outpaced the capacity of governments to monitor and supervise cyberspace activities, leading to massive privacy issues. The problem of privacy has become more complex than ever with the challenge of protecting legal boundaries while utilizing freely available online information.

Privacy is unparalleled in its potential impact on organizational revenue, branding, and corporate structure and policies. Organizations that gain trust, loyalty, and a strong brand equity value can expect profits, growth, and an organization that can sustain itself long term. For effective service, organizations must not only actively address privacy breaches or issues but also consider that breaches, especially those in data repositories such as government and banking sectors, can be ruinous.

Regulatory breaches concerning customer data can incur heavy fines and even lead to business closure. Compliance and data protection, as core tenets of banking ethics, can be the main focus of organizations striving to build a safety net against breaching issues. However, organizations can be proactive in avoiding breaches through keen targeting and defense. Defense against data breaches is a multi-pronged approach. Employees must be repeatedly trained and educated on illegal security risks. Organizations must channel data into fewer powerful servers, preferably within their premises, cutting off access to data by third parties and cloud services.

11.2. Bias in AI Algorithms

Machine learning algorithms have become ubiquitous in high-stakes decision-making applications. Indeed, the ability of machine learning algorithms to learn patterns from data enables them to incorporate biases embedded within those data. Accordingly, a biased model can make decisions that disproportionately harm certain groups, limiting their access to financial services. In response to this problem, the field of Fair ML has emerged, focusing on studying, measuring, and mitigating unfairness in algorithmic prediction.

However, the underlying causes for algorithmic unfairness remain elusive. Indeed, researchers are still divided about whether the blame lies with the ML algorithms used for the predictions or with the data these algorithms are trained on. To contribute to answering the questions posed in the title, first, an overview of the problem and its relevance to the community has been discussed. Second, a targeted taxonomy was proposed to characterize data bias, allowing one to model different types of bias and test how they interact with three specific ML algorithms, and study hypotheses regarding the fairness-accuracy trade-offs this type of fairness-blind ML algorithms exhibit under different data bias settings.

Heretofore, the fairness-blind ML algorithms implemented in the experiments are a direct consequence of the targeted taxonomy. However, specific fairness-aware post-processing interventions that do not require access to the training data can optimize the output of a biased algorithm by producing a new decision threshold. As a conceptual proof-of-concept, a specific algorithm was utilized to ascertain the best threshold given a bidirectional naive Bayes model. However, in future work, one of the open questions is how to determine the best threshold mathematically, considering that the combination of certain methods tends to achieve this performance for models trained differently than the bidirectional naive Bayes models used herein.

In practice, the feasibility of the proposed counterfactual fairness measurements is elaborated through a real-world use case with three different ML algorithms trained to predict decisions taken in a banking fraud risk use case. Results demonstrate how predictions are affected by training set bias, illustrating that each bias setting entails specific trade-offs, affecting fairness in expected value and variance. Lastly, a case study in which privacy-preserving ‘crowds’ of untrusted worst-performing models are combined to provide ‘trusted’ predictions.

12 Future Trends in AI and Big Data for Accounting

A trend in artificial intelligence and big data analytics recently came to the forefront outside of the accounting domain: The auto-generate poem created by AI. However, as a double-edged sword, new AI applications create both advantages and worries in terms of accountability. This study provides a glimpse of this promising, ambiguous, and thorny issue through the research agenda in the accounting context.

It was noted that entrenched professional skepticism and the collaborative nature of professional skepticism assessment should be the primary foci in the future research of AI applications in auditing. Lack of understanding of AI methods may create suspicion of inability to interpret complex systems, and therefore reduce professional skepticism. Junior auditors may also lack data and experience for appropriate and critical questions. In terms of audit committee turnover, as the gain theoretical knowledge about AI applications, professional skepticism would tend to be reduced through calibration.

On the contrary, audit firm rotation and large audit firms may act as means to improve professional skepticism due to higher entry barriers and secretive predilection, and a longer association with client may weaken professional skepticism. It is expected to establish an objective measure for professional skepticism and perform experiments through interviews later. In collaborative contexts, the examination of collaboration within auditing teams would shed light on the future research of AI-assisted professional skepticism assessment, bringing new insights into elite dual-process modeling. Despite these specific ideas, it was acknowledged that the scope of future research should be broadened ultimately to explore this promising yet ambiguous facet of AI applications in auditing.

It was challenged to redefine accountants in the era of the gig economy, and listed drivers for changes across time to change basic notions of accountants fundamentally. Quality assurance, social media, and integrated reports might be the key developments in future accounting practices. It believed that micro-level studies would provide deeper insights on the evolution of assumptions about accountants. On the other hand, expert judgment-like tasks are elusive to computers, hence considered that future moves of AI on "system" and "process" level would be developing question-and-answer systems instead of replacing accountants altogether.

It was made a commendation on the emergence of big data technologies, which might turn big data into smart data for automatic and optimal decision-making and enhance capacity to analyze capability abundance and speed. In the short run, it was believed that large background knowledge databases should be constructed, and regulatory compliance and accounting loopholes should be identified as loophole-hunting data technologies. It was then highlighted that prior studies having discussed opportunities and tips for audit data analytics might be of broader implications than intended. For both advisable and avoidable paths, it was indicated that insights from more fields should be applied in accounting research.

12.1. Emerging Technologies

Emerging technologies have affected competition in all sectors, and the finance industry is no exception. It has undergone significant transformation with the advent of technologies such as the Internet and mobile devices (Lui & Lamb, 1970). FinTechs, or technology-powered financial services, are characterized as flexible, innovative, and often equipped with high-end technologies such as Big Data, the Internet of Things (IoT), and Artificial Intelligence (AI). These have resulted in the establishment of new business models and revenue streams, revolutionizing the provision of financial services, and stimulating incumbent banks to change their strategy and management (Mhlanga, 2021).

Technological advancement has promised potential benefits and value-added service convergence for consumers. In addition to traditional roles, the finance industry through FinTechs have offered ancillary services such as automated financial advisory and portfolio management, payments and settlement, insurance, transaction tracking, trade financing, and regulatory compliance. With regards to supply-side benefits, competitive effects through market entrance of new players, technology utilization, and competitive service provision have a chance of income stream enhancement and cost reduction. Yet, emergent risks and challenges such as elevated systemic risk, cyberattacks, exposure to data silos, knowledge gap, vulnerability to fraud, and dual regulation by FinTech and Banking regulators have emerged. This study pertains to the competition and marketing strategy effects of FinTechs. With the rapid acceleration of emerging technologies, it is noteworthy to understand their roles in shaping the competitive landscape of an incumbent market participant. Therefore, two questions are proposed: how do the emergence of financial technology firms shape the competition to retail banking sector incumbents, and how do the incumbents respond to such changes?

Based on the discussions, research is needed to identify the potential effects of emerging technologies in the financial services sector, the retail banking subsector in particular. Investigating the potential opportunities, threats, and challenges posed is crucial. In addition, the competitive effects and strategic responses of a handful of retail banks in an Asian emerging economy will be studied. The end is to provide the basis for a competitive strategy re-evaluation. An addition is to explore competitive situations and strategies in multi-tiered, different finance sectors in emerging economies.

12.2. Predicted Changes in the Banking Sector

The new information generation methods, the shortening of the information age, and the acceleration of information dissemination all accelerate the transformation and reform of the banking industry into the digital economy era. With the broad application of modern technologies such as big data, cloud computing, and artificial intelligence, the overall informatization level and architecture of the banking industry will usher in more comprehensively new changes. Most traditional industries and businesses, including banking, are facing bifurcations and even scruples brought about by technologies (Liu & Han, 2022).

The application of AI technology will bring profound changes, which will quickly penetrate all business sectors of the banking industry. It will be applied in several important links of banking services, such as credit, payment, marketing, anti-money laundering, and customer interaction, and become a vital productivity tool for banks to accelerate profitable growth. Banks will become more technology-driven, pattern-oriented, and data-intensive, and a large amount of data from external sources will enter the knowledge base of banks. Banks will rapidly expand their investment in natural language processing, machine learning, and knowledge graphs, and the development of the banking industry will be farther away from traditional banking services to professional retailing-driven businesses and from profitability-driven to commercialization-driven businesses (SALEEM & Mary Mathew, 2022).

Fueled by information connectivity, virtual communication, and data analytics, customers and relationship managers will connect more efficiently and effectively than ever. Banking business services will become influenced by social media, intelligent assistants, and other proliferated clients. Banking services will no longer be confined to physical branches, shared ATMs, and online portals, but will increasingly become decentralized and diversified. The human customer 2.0 with advanced AI will have more amazing and fascinating intelligence, learning ability, and critical thinking than today's human customer 1.0. Most customer behaviors will not be committed by humans but will be conducted by info agents, chatbots, and purchase agents.

13 Comparative Analysis with Global Practices

It is worth noting that the challenges of adopting AI technology in accounting do not differ much from those in other areas of the world. The accounting profession worldwide is dealing with similar challenges in adapting AI and other technologies. The profession of accountants faces some of the most rampant technologies of the 21st century. The ability to collect, create, process, protect, analyze, and exploit data is what would determine the survivability and success rate of organizations in this computer age. Most modern technologies used to manage organizations today are a result of the accumulation of data and the fast processing of this data by algorithms. A notion of artificial intelligence (AI), machine learning (ML), and big data analytics (BDA) refers to a set of technologies and solutions that can be used by accountants to enhance their capabilities to execute unique, scalable, and repetitive functions of accounting. Although still nascent and growing, AI, ML, and BDA would be the future of accounting. Major challenges are linked with the management of technological differences and the liability corporations would face as a result of the intelligent systems they employ. AI systems used by an accounting function may make a wrong prediction on tax planning and exposure, for example, leading to a gross reporting error with financial, legal, and reputational implications for the organization. As a response, regulators may require technological audits, ethical influencers to assess lived experiences, and job descriptions of AI systems as needed to trace responsibility (Kanakriyah, 2017).

13.1. International Case Studies

International companies are forced to create and adapt new systems to meet the challenges posed by new technologies. This is why, during the preparation of accounting information, a great need for completion and presentation arose. The number of credit banks exposes a greater demand for controls and information disclosure. The emergence of artificial intelligence provides reliable and cost-effective solutions and opens better ways to deal with the problem of uncertainty. Traditional methods of data processing are becoming increasingly inadequate due to the increase in volumes, as well as the increase in variability in terms of their content and speed of delivery. The explanation and interpretation of this information requires new methods of treatment and presentation (Kanakriyah, 2017).

Banks and financial institutions in developing countries are adopting various AI methods to enhance their processing capabilities of rapid and large volume data. Customer services and decision-making problems in these institutions require real-time processing of huge amounts of historical data as well as current data. To deal with this highly rich volume of data and the speed of its delivery, it is important to adopt AI paradigms such as neural networks and fuzzy systems. The combination of traditional methods with AI paradigms can reinforce the efficiency and effectiveness of the utilized method in improving and enhancing the quality of decision making.

The immense transformations in the banking world resulting from modern banking techniques and technological advancement have necessitated the emphasis on the utmost effective utilization of resources. As a result, the current study investigates the impact of accounting information systems (AIS) on the success of Jordanian banks. To achieve this purpose, the researcher developed a questionnaire which was distributed to the head offices of the eleven banks. Out of the total distributed questionnaires, 46 were valid for analysis. The data was analyzed using SPSS. In addition to descriptive statistics, a simple regression analysis was utilized. The study revealed that with all of its dimensions, AIS significantly affected banks' success. Following the findings, a number of recommendations were suggested to assist bank managers in the needed decisions to ensure and reflect the desired banks' success.

13.2. Best Practices

The following best practices were deduced based on the results of this study and the responses received from the directors/managers of the commercial banks in Jordan regarding its items in the study tool, which had significant arithmetic averages. Furthermore, deep information mining tools such as data warehousing and data mart, data mining tools such as OLAP, and statistical data processing methods and tools are all used in the accounting system, which is compatible with big data and AI systems. The use of big data in accounting ensures good accounting practice in a bank by providing intelligent services, rapid analysis, informed decision-making, controlling accounting inaccuracies, increasing data quality, and clarifying customer segmentation. Commercial banks are aware of big data opportunities and capabilities and believe they should make great efforts to invest in it. Other accounting financial applications such as e-banking and M-awareness are used based on the old accounting system that lacks deep financial information mining tools or big data concerning the decision-making process of banks.

Heads of departments in the banks should be aware of the great capabilities of big data on customer management availability and personalization. They also believe that data warehousing and data mining methods and procedures have to be applied to their banks, which will aid them in clarifying customer and stockholders segmentation. It also enhances the possibility of the banks' prediction, which is one of the major accounting practices in a bank, and increases the availability of personalized products and services toward customers, allowing them to expand their market base or contribute to the growth of the capital market in Jordan and the region.

Internal and external challenges hindered the use of big data and AI in accounting. These challenges vary between banks, but the most significant challenges are the legacy accounting system, investment cost, organic non-standardized data, and lack of skilled staff in data processing. Despite these challenges, most banks in Jordan have made great efforts to overcome them using parallel systems to the old one and up-skilling the accounting department's staff. Most current banks are aware of the current lack of accounting effectiveness and have made big efforts in their big data investments to reach their improvement, which will involve great efforts in the future. Commercial banks in Jordan are in the second wave of big data applications, exert substantial efforts to be competitive, and are big data-ready systems regarding big data applications in accounting financial concerns that are considered on-going and dynamic processes.

14 Conclusion

The study aims to identify the factors inhibiting the adoption of Artificial Intelligence and Big Data in accounting by commercial banks in Jordan. It aims to provide recommendations for overcoming these obstacles, making it one of the few studies exploring accounting professionals' technology risks in Jordan. Bank executives who have accounting backgrounds or expertise were interviewed in the semi-structured style using an interview guide and questionnaire over two months in 2022. Interviews were coded and analyzed using the thematic analysis approach to obtain the study's themes. Twelve factors inhibiting the adoption of

technology in accounting offices were identified, falling under the categories of attitudes and expectations, technical issues, work processes, control and inspection, perception of necessity, behavioral factors, planning, and knowledge and skills. Accordingly, the study recommended developing individual, working group, and organizational awareness while controlling and inspecting the adoption process.

The number of published papers on the topic has increased in recent years and is expected to rise in the future. However, attention given to accounting professionals' perspectives on the factors affecting the adoption of pronouncements is still limited. This study is significant because it seeks to address some of those calls. More importantly, this study explores the various factors affecting the adoption of pronouncements in Jordan, where such research has not been previously conducted.

Technological advancements have positively affected organizations. Interviews were conducted with the managers of selected commercial banks in the Amman Stock Exchange to investigate the adoption of Cloud Computing in accounting information systems. The analysis followed the qualitative thematic analysis approach to obtain nine themes that are both enablers and barriers to the adoption of Cloud Computing along with the benefits linked with this technology.

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