IMPACT OF IT INVESTMENT ON INDIAN AND EUROPEAN BANKS – AN
ANALYTICAL VIEW

by

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ABSTRACT

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ABSTRACT

Currently, technology is the primary facilitator of the financial market. It can be easily said that financial services are driven by technology. The primary trend of financial unbundling has generated a paradigm shift, allowing the minor player to compete with big giant banks. Moreover, much research has been done, and it has been in the area of how digital transformation or emerging technologies or total IT investment impact the financial services market. The research has been done with a single entity like Blockchain, data, or cloud and their impact on a specific market. There is a potential gap in the research as the research is limited to one market and precise technology. This research aims to examine the impact of IT investment on Indian and European markets and compare them in terms of financial attributes. For example, the Cost to income ratio has varied for Indian and European banks from 2017 to 2022.

This research has a hypothesis developed by theoretical aspects, which data-driven algorithms will test for validity. In the end, the study aims to understand the impact of IT investment on Indian and European banks and compare them.

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CHAPTER I: INTRODUCTION

The banking sector has undergone significant disruption due to advanced technology integration. This transformation has led to a paradigm shift in customer banking experiences. The advent of Automated Teller Machines (ATMs) and online banking platforms increasingly challenge the traditional concept of physical bank branches. Looking ahead, it is conceivable that the future of banking will pivot towards exclusively digital branches, supplemented by dedicated centres for dispute resolution. This technological impact has been a global phenomenon. Despite this widespread change, variations persist in key banking metrics, such as the cost-to-income ratio, revenue, and profitability percentages. Let us understand banking in the Indian context.

1.1 Overview of Indian Banking

As per Latei, D. K. R. (2021), The financial industry, particularly banks, significantly contributes to a nation's economic advancement. The expansion of this sector hinges on the array of services it offers to its clientele. It's widely recognised that a robust and efficient banking infrastructure is essential for the enduring growth of an economy. India's banks have faced considerable challenges recently due to changes in their structure, scale, and the varied nature of the nation's financial domain. The banking sector is fundamental to any economy's development. India's banking sector has navigated through several economic upheavals, including the recent COVID-19 financial crisis, which has globally impacted economies. This study examines the current state of India's banking sector. The article is divided into two sections: the first provides an overview and insights into the banking industry. In contrast, the second emphasises the need for immediate focus on enhancing India's banking systems. Furthermore, as per Dr. Sujatha P (2014), Banking has become a fundamental aspect of daily life. In the past, the banking sector operated within a sheltered framework, but now, the doors to extensive competition have been thrown open due to liberalisation, privatisation, and globalisation. The advent of contemporary banking institutions has introduced a fresh competitive edge. The era of banks relying on traditional walk-in business and comfortable office operations is over. Advances in information technology have increased customer awareness and heightened their demands and expectations, which are rapidly evolving. The internet's role in influencing customer choices and how products and services are delivered has added to the intensity of the market. Customers nowadays seek innovative banking products and cannot be easily misled by superficial changes in offerings. The balance of power in banking has shifted dramatically to customers like never before. Surviving in this

fiercely competitive market is a paramount challenge, requiring determination and innovative skills. This adaptation has led banks in India to adopt creative business strategies. This study focuses on the banking sector's historical context, necessity, framework, future prospects, growth drivers, and significant areas of concern.

As per Wikipedia (2023), Banking in India began to take shape in the mid-18th century, with early examples including the Bank of Hindustan, established in 1770 and dissolved between 1829 and 1832, and the General Bank of India, which started in 1786 but ceased operations by 1791.

The State Bank of India (SBI), the largest and oldest bank still in operation in India, originated as the Bank of Calcutta in mid-June 1806. It was later renamed the Bank of Bengal in 1809. This institution was one of three banks established by the presidential governments, the others being the Bank of Bombay, founded in 1840, and the Bank of Madras, established in 1843. These three entities merged in 1921, forming the Imperial Bank of India, rebranded as the State Bank of India in 1955 following India's independence. Before establishing the Reserve Bank of India in 1935, these presidency banks functioned as de facto central banks.

In 1960, the State Bank of India was assigned control over eight state-associated banks under the State Bank of India (Subsidiary Banks) Act of 1959, culminating in a merger on 1 April 2017. The Indian government nationalised 14 significant private banks in 1969, including the Bank of India, followed by another six in 1980. These nationalised banks now dominate India's banking sector, owing to their size and extensive networks.

The banking system in India is broadly divided into scheduled and non-scheduled banks, with scheduled banks listed under the 2nd Schedule of the Reserve Bank of India Act of 1934. These scheduled banks are categorised into nationalised banks, the State Bank of India and its associates, Regional Rural Banks (RRBs), foreign banks, and other Indian private sector banks. On 1 April 2017, the SBI consolidated its Associate banks, elevating its status as the largest bank in India and ranking 236th on the Fortune 500 index. The term 'commercial banks' encompasses both scheduled and non-scheduled commercial banks as defined by the Banking Regulation Act of 1949.

Despite its maturity in terms of product diversity and reach, the banking sector in India still faces challenges in extending its services to rural areas and the financially underserved. The government has implemented initiatives such as expanding the State Bank of India's branch network and leveraging the National Bank for Agriculture and Rural Development (NABARD) to offer services like microfinance.

- Post-Independence Period

Wikipedia (2023) also narrates the post-independence period of Indian banking. Between 1938 and 1946, the number of bank branches in India tripled, reaching 3,469, while deposits surged to 962 crore rupees. However, the 1947 partition of India significantly disrupted the economies of Punjab and West Bengal, leading to a temporary paralysis in banking operations. Following independence, the Indian banking sector transitioned from a laissez-faire approach to a more regulated framework. The Indian government, through the 1948 Industrial Policy Resolution, adopted a mixed economy approach, which included increased state involvement in various economic sectors, including banking and finance. Key regulatory steps included:

The Reserve Bank of India (RBI), established in April 1935, was nationalised on 1 January 1949 according to the Reserve Bank of India (Transfer to Public Ownership) Act, 1948.

The enactment of the Banking Regulation Act in 1949 granted the RBI extensive powers to regulate, control, and inspect banks in India.

This act also stipulated that new banks or branches could only be opened with an RBI license and prohibited common directorships across different banks.

- 1969 Nationalization

Despite these regulatory measures, all banks in India, except the State Bank of India (SBI), remained privately owned and operated into the 1960s. The banking sector had become a pivotal instrument for the Indian economy's development and a significant employer. This growth led to discussions about nationalising the banking industry. Indira Gandhi, the then Prime Minister of India, articulated the government's nationalisation intent at the All India Congress Meeting.

Subsequently, the Government of India enacted the Banking Companies (Acquisition and Transfer of Undertakings) Ordinance, 1969, which nationalised the 14 largest commercial banks, encompassing about 85 per cent of the country's bank deposits. This ordinance was quickly followed by the passage of the Banking Companies (Acquisition and Transfer of Undertakings) Bill in Parliament, which received presidential assent on 9 August 1969.

Dr. S. Vijaykumar (2017) provides the future outlook and states that the financial sector is transforming rapidly. The Central Bank is steadily progressing towards adopting the finest global banking practices, leading to enhanced regulatory norms and more robust supervisory frameworks. This shift will bring greater clarity and more comprehensive reporting. In the future, banks are poised to play a crucial role in economic growth, with emerging markets presenting substantial expansion opportunities. Although technological integration in banking advances swiftly, it focuses predominantly on metropolitan and urban areas. The advantages

of this technological progress have not fully reached those in rural communities. Introducing more applications and programs in local languages could help extend these benefits to rural populations. Utilizing standard messaging protocols for seamless transactions across different systems is also essential. The workforce surplus from technological efficiency should be redirected towards promoting new financial plans. Banks should establish a group of specialists combining industry and technology expertise to navigate this evolving landscape.

Dr. Manikyam (2014) states that India's financial sector faces several challenges and opportunities. With a diverse array of banking institutions, some struggle due to their limited size and operational scale. Keeping pace with international banking supervision standards remains a key priority, as adopting new global capital requirements demands advanced risk management, information systems, and technology capabilities. This scenario poses significant challenges for many players in the Indian financial market. The sector is also grappling with issues related to asset quality stemming from the country's economic and industrial restructuring. Although strides are being made to address these legacy challenges, considerable work is still required.

The sector stands at a pivotal moment, with vast potential for growth and innovation. There are opportunities to venture into new markets, adopt novel operational methods, enhance efficiency, and provide superior customer service. However, adapting to these changes will be challenging for many institutions.

The Indian banking landscape is marked by intense competition, evolving customer expectations, and waning customer loyalty. The industry is rapidly transforming, catering to various customer needs and preferences. While most of the population remains unbanked, others are accustomed to traditional banking methods. Meanwhile, a growing segment adapts to digital banking solutions like ATMs, online banking, and cashless transactions, highlighting the sector's expansion potential. Successfully navigating this dynamic environment requires a strategic balance of technology integration and traditional customer service, offering a sustainable competitive edge.

1.2 Overview of European Banking

As per Wikipedia (2019b), The modern banking system traces its roots to medieval and Renaissance Italy, particularly in prosperous cities like Florence, Venice, and Genoa. Notable banking families such as the Bardi and Peruzzi in 14th-century Florence expanded their influence across Europe. The Medici Bank, founded by Giovanni Medici in 1397, became one of the era's most distinguished institutions. The oldest continually operating bank is Banca

Monte dei Paschi di Siena, founded in 1472 in Siena, Italy, surpassing Banco di Napoli, which operated from 1463 until 2002.

Banking spread from Italy to the Holy Roman Empire and Northern Europe in the 15th and 16th centuries. Significant banking innovations occurred in Amsterdam during the 17th century and later in London from the 18th century. The 20th century saw transformative changes in banking due to advances in telecommunications and computing, enabling banks to grow in size and reach. The 2007–2008 financial crisis led to several major bank failures and sparked extensive debate regarding banking regulations.

First, let us understand the role of the European Central Bank in Europe.

Furthermore, Wikipedia (2019a) narrates that The European Central Bank (ECB) is a central component of both the Eurosystem and the European System of Central Banks (ESCB), and it's recognised as one of the European Union's seven institutions. As a globally significant central bank, the ECB primarily governs the monetary policy for the Eurozone. It manages the foreign exchange reserves of EU member states, oversees foreign exchange operations, sets monetary objectives, and defines key interest rates. The ECB Executive Board implements policies the Governing Council sets and can direct national central banks in these efforts. The ECB uniquely holds the authority to authorise the issuance of euro banknotes, while member states can mint euro coins with ECB approval. Additionally, the bank operates the TARGET2 payments system.

Established by the Treaty of Amsterdam in May 1999, the ECB aims to maintain price stability. With the Treaty of Lisbon in December 2009, it gained official status as an EU institution. Initially covering eleven members, the Eurozone has expanded over time to include several more countries, with Croatia being the latest addition in January 2023. The ECB's current President is Christine Lagarde, and its headquarters are in Frankfurt, Germany.

The ECB operates under EU law and has a capital stock of €11 billion, owned by the EU member states' central banks. The allocation of this capital stock was originally based on member states' population and GDP and has been adjusted over time. ECB shares are non-transferable and cannot be used as collateral.

Regarding its history, the ECB, which began operating fully with the introduction of the euro in 1999, succeeded the European Monetary Institute (EMI). The EMI, replacing the earlier European Monetary Cooperation Fund (EMCF), managed the transitional phase of adopting the euro and prepared for the ECB and ESCB's creation. Wim Duisenberg was the ECB's first president, who was succeeded by Jean-Claude Trichet in 2003. Under their leadership, primarily until 2007, the ECB effectively maintained inflation rates close to but below 2%.

As per P. Eric et.al Europe's financial sector is undergoing significant transformation, though its fundamental purposes remain unchanged. Today's adaptations are in the methods and entities carrying out these financial functions.

Drawing an analogy from physics, just as the constants of nature shape our Universe, the consistent operation of financial systems underpins countries' industrial development. Without effective financial systems, industrialized nations might not have achieved their current status, mirroring the challenges faced in less developed regions.

The key to a thriving financial and economic system seems to be competition, safeguarded by protected property rights. This concept is being enhanced in Europe, which already stands ahead in development compared to many global regions. Two major initiatives are underway: forming a Single Market for financial services and introducing the euro, both aimed at stimulating cross-country competition. Additionally, there's a push to blur the lines between different economic sectors, increasing competition within the industry.

Economic policies are critical in nurturing this competitive environment. However, information technology advancements and financial sector participants' creativity are just as vital.

These changes imply a reshuffling of roles for market players. While this shift may be challenging for some, it also opens up new opportunities for participation and growth in a dynamically evolving financial landscape.

Ilut B. et al. (2010) state that significant strides have been made in unifying the European banking system, but numerous obstacles remain. Challenges include restricted market access, biased treatment from regulatory bodies and authorities, and the resurgence of nationalistic tendencies during systemic crises like the recent financial downturn.

The journey towards an utterly unified banking sector in Europe is a complex, multifaceted endeavour with no clear end. An essential aspect of this journey is understanding the feasible extent of integration in such a dynamic and intricate sector. Future research will provide a strategic framework for further integration in the European banking sector. The ultimate aim is to establish an efficient European financial system, which will be crucial in funnelling resources towards the sustainable growth of the European economy.

Barisitz S. (2005) outlines his thoughts on ten European countries. Since the fall of communism, the banking sector in ten countries, including Hungary, Poland, the Czech Republic, Slovakia, Bulgaria, Romania, Croatia, Serbia, Russia, and Ukraine, has experienced transformative changes. Initially marked by major banking crises and challenging structural reforms in the 1990s, these countries have seen stabilization and growth in banking activities

around the millennium, aided by economic revival and, for some, the prospect of EU integration.

Key insights from this analysis include the dominant presence of foreign-owned banks in most of these countries, except where reforms have been slower. In particular, the Czech Republic and Slovakia show a significant presence of foreign banks, often entering post-crisis during regulatory cleanups. These foreign banks, primarily from Austria, Italy, Belgium, Germany, and France, play a major role, although state-owned banks still hold substantial assets in countries like Russia and Serbia.

Foreign investment in banks has generally boosted sector competitiveness and efficiency, bringing in expertise, technology, and financial stability. While foreign ownership is not the only way to achieve a viable banking sector, alternative paths might take longer for similar results. An exception is Hungary's OTP Bank, which has thrived amidst foreign competition.

Despite overbanking with too many small institutions and underbaking with limited service access compared to the EU average, consolidation and modernisation are ongoing. The integration of IT in banking, especially in Central Europe, is bridging these gaps by improving service efficiency and productivity.

A notable credit boom has occurred following stricter credit policies and restructuring in the 1990s. While this boom is seen positively as a structural advancement, it raises concerns in some countries due to potential risks in loan screening and impacts on inflation and external accounts. Regulatory responses have varied in effectiveness.

The banking landscape still features "agent banks" in some countries, particularly in Russia and Ukraine, posing risks due to insider lending and lack of transparency. Banking supervision is evolving towards risk-based approaches, and EU integration has aided in legal and institutional reforms.

Interest rate spreads remain higher than in the euro area, reflecting the higher risks but also contributing to greater profitability. The potential for market expansion remains high due to the lower per capita income and banking service access in Central and Eastern Europe.

Overall, Central European countries lead in legal reforms and financial intermediation following EU accession, while Southeastern Europe, particularly Russia and Ukraine, despite potential, face challenges in law enforcement and market development.

1.3 Research Problem

Numerous studies have focused on the banking systems in India and Europe, often examining them separately. These studies frequently consider financial parameters such as the cost-to-income ratio and revenue. However, there is a notable gap in research that simultaneously addresses both Indian and European banking sectors and their interrelated dynamics.

Furthermore, this research endeavours to uncover the prospective trajectory of the banking sector over the coming decade, mainly focusing on the influence of IT investments. It seeks to explore and predict the long-term implications of such investments on the banking industries in both India and Europe. By examining current trends, technological advancements, and investment patterns, the study will attempt to forecast how IT investment will shape the banking landscape in these regions in the next ten years. This work includes assessing potential changes in banking operations, customer engagement, financial products, and overall industry competitiveness due to technological innovation and digital integration in the banking sector.

1.4 Purpose of Research

This dissertation aims to study the impact of IT investment on Indian and European markets in the upcoming decade.

Recently, Hendra Et. al (2018) explores the influence of technological advancements on the financial performance of banking firms listed on the Indonesia Stock Exchange, aiming to validate the impact of technology on the development of these firms' financial health. Utilising secondary data, specifically audited financial statements, the study employs simple regression analysis as its primary data analysis technique. The findings indicate a significant relationship between information technology investments and the economic performance of the companies. It suggests that effective and efficient utilisation of information technology investments can enhance a company's financial outcomes.

Furthermore, Hendra et al. (2018) hold substantial value for corporate entities and organisations, emphasising the need for improved utilisation of information technology within their operations. While the scope of this study is confined to banking companies listed on the Indonesia Stock Exchange, it is recommended that future research expands the criteria and indicators to include aspects not covered in this study. Extending the research to encompass other sectors, such as manufacturing companies, and a broader sample population would provide more comprehensive insights.

Beccalli (2007) scrutinises the relationship between investments in information technology (IT) - encompassing hardware, software, and various IT-related services - and their effect on

banking institutions' performance. Despite these banks' substantial investments in IT, the findings indicate a negligible correlation between total IT spending and heightened profitability or efficiency, hinting at a paradox in profitability.

This research aims to contribute to understanding the impact of IT investment on the banking sector over the next decade. Additionally, it aims to provide a comparative analysis of the banking sectors in India and Europe concerning IT investment.

1.5 Significance of Research

Technology is increasingly integral in facilitating banking services, serving as a key driver in this digital era. It significantly influences the customer journey within the banking sector. There is a notable variation in IT investment among banks, influenced by their geographical location and development level, with examples ranging from banks in the UK and Europe to those in India. Our research aims to ascertain the tangible impact of IT investments in banks and project their trajectory over the coming decade. This investigation promises to offer valuable insights to a diverse audience.

- Theoretical Significance:
- From a theoretical standpoint, this study employs statistical models such as ARIMA, KPSS, and AIC. It allows researchers to analyse results from these models in conjunction, examining aspects like series stationarity, critical values behaviour, and comparison with KPSS. Theoretically, a stationary time series model is a valuable tool for future value prediction.
- Practical Significance:
- Banks: The study will enable banks to comprehend the correlation between IT investment and revenue over the next ten years, assisting in budget planning, expense management, and spending prioritisation.
- Marketing Teams: It will provide concrete forecasts for the next decade, allowing banks to adjust strategies and assess the impact of different scenarios.
- Risk Teams: The findings will assist risk management teams in understanding operational costs and revenue projections for the next ten years, aiding in the preparation for potential risks.
- Researchers: The data can be utilized for various data modeling and predictive analysis purposes.
- In summary, this study holds significant value both theoretically and practically, benefiting various groups across the banking sector.

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1.6 Research Questions

This research examines how effective IT investment has been and continues to be. Specifically, it looks to understand the impact of IT investment in the banking sectors of India and Europe in the coming decade. The key questions being addressed are:

1. What is the present cost-to-income ratio of banks?
2. What percentage of their budget do banks allocate to IT investment?
3. How will IT investment evolve over the next ten years?
4. What will be the effect of IT investment on bank revenues in the next decade?

CHAPTER II: LITERATURE SURVEY

2.0 Literature Survey Introduction and Approach

This thesis presents an exhaustive literature review encompassing various dimensions of the banking sector. It begins by exploring the fundamental definition of banking and delving into its core concepts and operational frameworks. The study then systematically categorises and examines different types of banking, including corporate, wealth, and investment banking, and analyses their respective capital requirements.

The discourse progresses to a detailed investigation of banking delivery channels, outlining their evolution and current state. This analogy is followed by an in-depth analysis of the risks associated with these channels. A significant portion of the review is dedicated to understanding the nuances of banking systems within two distinct geographical contexts: the Indian and European sectors. This comparative study provides insights into the unique characteristics and operational modalities of banking in these regions.

Finally, the thesis addresses the burgeoning influence of emerging technologies on the banking industry. It evaluates how technological advancements are reshaping banking practices, influencing customer interactions, and transforming the financial landscape at large. The study offers a foresighted view of the potential trajectories of banking in the wake of technological innovation, emphasising the implications for both the Indian and European contexts.

2.1 Theoretical Framework

- Foundation of the Research: This research is anchored in the critical role of IT investment within the financial sector. IT services have revolutionized the banking experience, making it more efficient and user-friendly. Understanding the current and future impacts of IT on banking institutions forms the core of this study.

- Conceptual Guidance: The study is steered by conceptual guidance that places significant emphasis on the values derived from the ARIMA model, KPSS test, and AIC model. These future prediction models are employed based on the stationarity of data, guiding the research towards its objectives.

- Literature Review: A comprehensive literature survey forms a pivotal element of this research. It encompasses the evolution of banking, leading up to the current impact of IT investments. This iterative process of research uncovers numerous insights, forming the knowledge base upon which hypotheses are constructed.

- Methodological Approach: The research employs methods like the ARIMA model, KPSS test, and AIC model, chosen for their precision in forecasting. The application of

these methods is contingent upon the stationarity of the data, a factor meticulously addressed during hypothesis testing.

- Interpretation of Results: The interpretation of findings is framed through the theoretical lens employed in this study. The results are analyzed with a focus on machine learning explainability. In particular, the AIC model is utilized for its accuracy, with the computation of p, d, q values via AIC ensuring high levels of precision.

- Communication of Ideas: This framework aids in systematically structuring the thesis, facilitating the clear and effective communication of complex ideas and relationships to the academic audience.

- Figure 1 - Source – Self Analysis
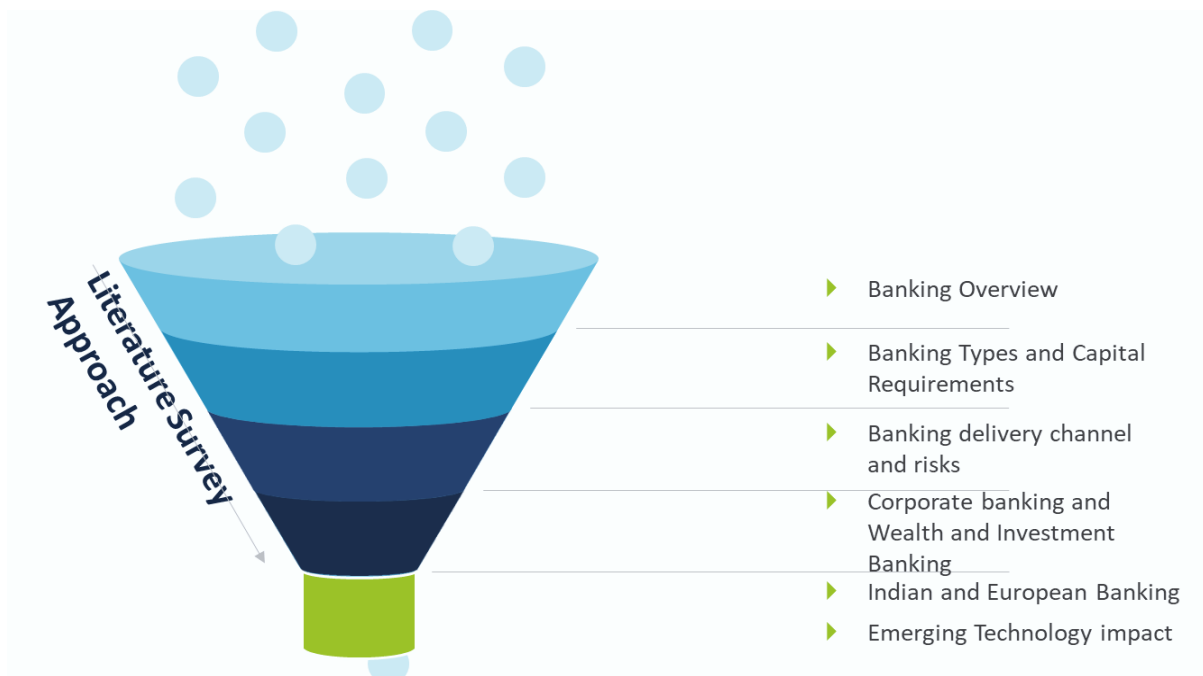
Figure 1 Literature Approach

2.2 Theory of reasoned action

- Behavioural Intention: In this context, the behavioural intention could be the decision by bank executives or IT investment decision-makers in Indian and European banks to invest in IT. This decision is influenced by their attitudes towards IT investment and the subjective norms within their respective banking sectors. The assessment must also encompass a behavioural analysis to understand the relationship between

operating costs and IT investment. It is essential to explore how IT investment correlates with operating costs within an organisation.

- Attitude Towards IT Investment: This component would examine how these decision-makers perceive IT investment - whether it is beneficial, cost-effective, and impactful for their banks' operations and customer service. Their beliefs about the outcomes of IT investment (like improved efficiency, enhanced customer satisfaction, etc.) and their evaluations of these outcomes (positive or negative) would significantly influence their intention to invest. Additionally, examining the alterations in revenue following significant IT investments is crucial. This analysis should focus on identifying trends in revenue performance: does it demonstrate an upward trajectory, or is there evidence of a declining trend?

- Subjective Norm: This involves understanding the perceived social pressures or expectations that influence these decision-makers. It includes beliefs about whether peers in the banking industry, stakeholders, or the market, in general, approve or disapprove of IT investments. The motivation of the banks to comply with these norms, such as maintaining competitive parity or adhering to industry trends, also plays a critical role.

- Application in Research: This topic will require assessing how these attitudes and norms have influenced IT investment decisions in Indian and European banks. This could involve analysing how decision-makers in these banks perceive the benefits and risks associated with IT investment and how industry standards or competition have influenced their decisions.

- This study employs the ARIMA machine learning model to forecast IT investment over the next decade. The AIC model is utilised to determine the p, d, and q values of the ARIMA model. Additionally, the stationarity of the data is assessed using the KPSS test.

- Impact on Banking Sector: The Theory of reasoned action framework can help in understanding the variation in IT investment strategies between Indian and European banks. It can provide insights into whether these investment decisions are primarily driven by internal beliefs about the efficacy of IT or by external pressures and norms.

- This study employs the ARIMA machine learning model to forecast IT investment over the next decade. The AIC model is utilized for determining the p, d, q values of

the ARIMA model. Additionally, the stationarity of the data is assessed using the KPSS test.

- Relation to Statistical Models and Predictive Analysis: The attitudes and norms identified through the TRA can be correlated with the outcomes derived from the ARIMA, KPSS, and AIC models. This correlation can help validate whether the intentions (based on attitudes and norms) align with the actual financial outcomes and trends in IT investment observed in these markets.

- In summary, by applying the Theory of Reasoned Action, this research can delve into the psychological and social underpinnings of IT investment decisions in the banking sector, providing a comprehensive understanding that complements the statistical and predictive analyses. Presently, the scope of this research is focused solely on objective criteria and does not incorporate psychological or social dimensions.

2.2 Human Society Theory

- Economic Factors: Analyse how the economic environment in these regions impacts IT investment. This involves examining economic stability, growth, and market demands and how they drive technological advancements in the banking sector.

- Cultural Influences: Examine the role of cultural factors in shaping banking practices and attitudes towards IT investment. Different cultural backgrounds might influence how banks prioritise technology and innovation.

- Impact on Society: Investigate the broader impact of these IT investments on society. This includes assessing how advancements in banking technology affect customer experience, financial inclusion, employment, and the overall quality of financial services.

- Technological Evolution and Society: Consider how the evolution of technology within the banking sector reflects broader social changes and advancements. This might involve looking at historical trends in technology adoption and how societal developments have influenced them.

- Comparative Analysis: Conduct a comparative analysis of the Indian and European banking sectors from a societal perspective. Understand how these regions' societal structures, values, and expectations differ and how these differences manifest in IT investment strategies.

- Policy and Regulation: Factor in how policy and regulatory environments, shaped by societal norms and values, impact IT investment in banking. This includes

understanding the role of government, regulatory bodies, and other societal institutions in shaping the technological landscape of banking.

- By applying a Human Society Theory lens, research can comprehensively understand the complex interplay between societal factors and IT investment decisions in the banking sector. It allows for a deeper exploration of how these investments are not just economic decisions but are also influenced by and impact the social and cultural fabric.

- This research does compare the Indian and European banks objectively; however, it does not consider the societal theory lens.

2.3 Brief About Banking

Adam Barone (2023) outlines that a bank, as a sanctioned financial establishment, can dispense loans and accept deposits for checking and savings accounts. Beyond these core services, banks extend an array of additional offerings such as Individual Retirement Accounts (IRAs), Certificates of Deposit (CDs), foreign currency trading, and provision of secure storage spaces, namely safe deposit boxes. The banking industry is diverse, comprising various categories like retail, business or corporate, and investment banks.

Barone further states that (2023), Banking has existed since at least the fourteenth century, providing everyone with a secure place for financial transactions. Banks make loans and charge interest on them using the deposited money. While the core business model of banking has remained relatively unchanged since the Renaissance, the variety of products and service areas banks offer has expanded.

He further states that Banking services include various options for storing money and borrowing funds. Individuals and businesses use current accounts for daily transactions, while savings accounts reward depositors with interest. Customers can also open certificates of deposit (CDs) for higher interest rates over a specific period.

Banks play a crucial role in lending money to individuals and businesses, which drives economic growth. Depositors' funds are lent out through business loans, mortgages, credit cards, and auto loans. Banks profit by charging borrowers a higher interest rate on loans than they pay savers. This profit helps banks generate returns for their shareholders, who are often the owners of the banks.

Adam Barone (2023) states that the banking industry consists of small local organizations and large international commercial banks. Traditional banks now offer both online services and physical branches, while online-only banks have emerged in recent years. Customers choose a

bank based on various factors such as interest rates, fees, and convenience. Shaffer S. (2004) provides his view on patterns in competitive banking. As per him, the critical function of banking in economic systems and the increasing concentration of banking markets make competition among banks a significant policy concern. Traditionally, antitrust policies in banking have been guided by the economic principle that competition is directly related to the quantity of competing entities. Nevertheless, the last two decades have seen both theoretical innovations and empirical instances that challenge this conventional view.

2.4 Types of Banks

Adam Barone (2023) puts forward three main categories of banks: investment, commercial, and retail. Investment banks focus on investment activities and financial services for corporations and governments. Commercial banks cater to businesses of all sizes, offering trade financing and cash management services.

- Retail banks provide services to the general public, including current and savings accounts, loans, mortgages, and credit cards. They may also offer specialised services for high-net-worth individuals. Examples of retail banks include HSBC and Citibank, while JPMorgan Chase and Bank of America are commercial banks with significant retail banking departments, such as investment banks.

- Investment banks provide corporate clients with complex financial services and transactions, including underwriting and facilitating merger and acquisition (M&A) activities. They act as financial mediators in these deals and cater to diverse clientele, such as large enterprises, Fortune 500 companies, retail and manufacturing segments, governments, and various types of bonds.

- Central Banks: A central bank is an autonomous organisation authorised by the government to manage the country's monetary policy and control the money supply. They play a crucial role in maintaining overall stability in the value of money and the budget and setting capital and reserve requirements for banks.

Adam Barone (2023) outlines the role of central banks as follows.

- Comparison of Credit Unions and Banks: Adam Barone (2023) further provides a comparison of credit unions and banks. Credit Unions vs. Banks: Credit unions, in contrast to banks, are not-for-profit organisations established and operated for the benefit of their affiliates. While credit unions offer finance services to their affiliates, they often have a narrower range of services than banks. They are typically tax-exempt and owned and operated by their members. Members purchase shares in the cooperative, and the funds are used to

support loans the credit union provides. Credit unions may have fewer physical locations and ATMs compared to banks.

2.5 Banking Delivery Channels.

A bank branch is a centralised location where all banking operations take place. Customers visit the branch to fulfil their banking needs, making it their most popular and significant channel.

The branch serves as a one-stop shop for various services and banking products. Customers can seek advice, clarify doubts, and receive assistance from the bank staff regarding banking operations.

As per Shikher T (2023), banking has multiple delivery channels, and let's look at them below.

Source – Self-Analysis based on Shuker T's theory
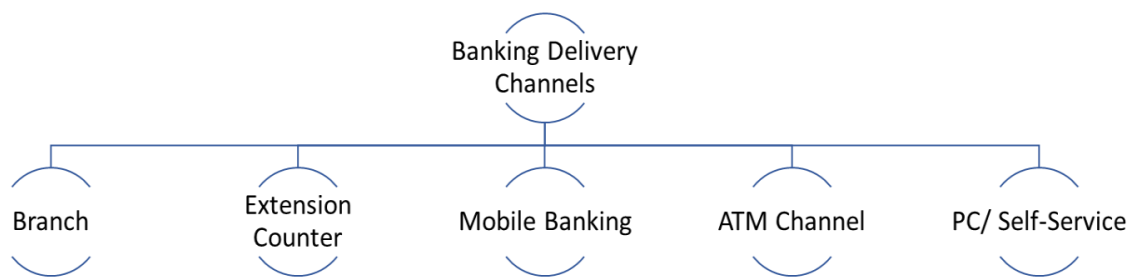
Figure 2 Banking Channels Delivery

- Branch

Furthermore, Shikher T (2023) describes that the branch acts as a sales and service channel, with bank employees playing a vital role in ensuring customer satisfaction. By establishing personal relationships with customers and enhancing customer relationship management, the branch contributes to the overall image of the bank.

- Extension Counters:

Shikher T (2023) describes this as one of the delivery channels. Extension counters are an extension of branch banking. When a branch deals with large business houses or institutions, it handles bulk transactions and provides banking services to the staff of these organizations, which can number in the thousands. If the organizations are not located near the branch, an extension counter is set up within their premises to facilitate convenient access to banking

services. Staff members are deployed at these extension counters, and the business conducted is considered part of the main branch's operations.

- Mobile Banking:

Many banks have introduced mobile banking services to reach a broader customer base in the competitive banking landscape. Mobile vans with necessary equipment and staff members provide door-to-door services in local areas. While the range of services is limited, customers can avail of cash receipts and payments, balance inquiries, and check collection services.

- ATM Channel of Banking

Automated Teller Machine (ATM) revolutionized banking by allowing customers to withdraw money anytime, without visiting a bank during working hours. ATMs provide cash withdrawals, deposits, balance inquiries, mini statements, check deposits, fund transfers, and additional services like bill payments and mobile recharge.

To access ATM services, customers must apply for an ATM card from the bank. The card contains a Personal Identification Number (PIN) known only to the customer. When the card is swiped, the account number is activated, and the ATM verifies the PIN before providing a range of services for the customer to choose from.

- Mobile Banking or Phone Banking, Tele-Banking:

Shikher T (2023) describes mobile as one of the crucial channels for the modern age. Mobile or phone banking services offer restricted banking functions to customers. Customers receive SMS notifications about account transactions, such as credits or withdrawals. Banks can enable customers to access phone banking or tele-banking services through an Interactive Voice Response (IVR) system. IVR automates caller interactions, allowing users to retrieve information, make inquiries, and request services using spoken words.

- PC Banking, Self-Service Banking:

PC banking, also known as Internet banking or online banking, provides a facility to perform banking transactions anywhere. Initially, customers could perform routine banking functions using a terminal, keyboard, and monitor connected to a telephone or cable connection. Over time, internet banking has evolved into a necessity, providing access to banking services beyond physical branches.

- Internet Banking, Online Banking, E-Banking:

Most banks now have websites offering internet banking services. The Reserve Bank of India has issued guidelines for internet banking that all banks must adhere to. While some public sector banks faced challenges implementing Internet banking due to their extensive branch

networks, lack of connectivity, and traditional practices, they have progressed towards web enablement.

Internet banking services can be categorized into three levels: information-only services, simple transactional websites, and fully transactional websites. Each level offers different functionalities, from disseminating information to allowing fund transfers, bill payments, and securities transactions. Security controls and legal infrastructure play a crucial role in ensuring the safety of fully transactional systems.

- Capital Requirements of Banks

Investopedia (2023) states that capital necessities are uniform regulations imposed on banks and other depository institutions. These regulations specify the minimum amount of liquid capital, such as effortlessly sold securities, that should be held proportionately to the institution's assets. Regulatory bodies, including the Bank for International Settlements (BIS), the Federal Deposit Insurance Corporation (FDIC), and the Federal Reserve Board (the Fed), establish the standards known as regulatory capital.

Furthermore, Investopedia (2023) states that Legislative reforms in capital requirements are often prompted by public dissatisfaction and a volatile investment climate. This is particularly true when the misconduct of a significant organisation is the underlying cause of a financial crisis, market downturn, or economic recession.

Regulatory bodies like the BIS, FDIC, and the Fed establish these standards. Reforms in capital requirements are often driven by public outrage and a fragile investment climate, especially when significant institutions' misconduct is perceived as the primary factor behind financial crises or economic downturns.

Uppal RK (2009)) studied the e-delivery channel of Indian banking. This study examines customer perspectives on electronic banking, drawing from a survey of 1,200 participants in Ludhiana, Punjab, across public, private, and foreign banks. It explored the necessity and quality of e-banking services, banking frauds, the future of e-banking, preferences for different bank types, the use of electronic channels, and the challenges e-bank customers face. Despite a high interest in e-banking among all bank groups, customers reported issues like lack of knowledge, poor network and infrastructure, problematic ATM locations, ATM card misuse, and account opening difficulties. The study suggests solutions such as customer education, seminars, better network and infrastructure, online shopping facilities, and improved ATM services to enhance the e-banking experience.

Harnado et al. (2007) studied the Internet delivery channel. As per him, despite the prevalent use of the Internet in banking, there's a noticeable lack of comprehensive studies quantifying its impact on bank performance. This paper addresses this by analysing how adopting transactional websites affected the financial outcomes of 72 Spanish commercial banks between 1994 and 2002. The study found that the positive effects on bank performance, particularly in cost reductions in staffing, marketing, and IT, become significant around one and a half years post-adoption. These savings lead to enhanced profitability, noticeable in return on assets (ROA) after one and a half years and return on equity (ROE) after three years. The research also indicates that online banking tends to supplement rather than replace traditional branch services.

- The Advantages and Disadvantages of Capital Requirements

Moreover, Investopedia (2023) states the advantages and disadvantages of capital requirements in the details mentioned below.

Capital requirements are not limited to maintaining bank solvency but encompass the broader goal of ensuring the stability of the entire financial system. In the contemporary landscape of domestic and global finance, it is widely acknowledged by regulation proponents that no financial institution operates in isolation. The repercussions of a sudden disruption experienced by one bank can potentially reverberate across multiple entities. Therefore, there is a greater need for rigorous criteria that can be uniformly implemented and utilised to evaluate the varying levels of institutional soundness.

Nevertheless, some scholars face opposition to capital requirements. Critics argue that elevated capital requirements possess the capacity to curtail bank risk appetite and rivalry within the financial domain. This is premised on the notion that regulatory measures tend to impose more significant costs on smaller institutions than their larger counterparts. The imposition of mandatory liquidity ratios on banks can impede their capacity to generate profits and invest, consequently limiting their ability to extend credit to their clientele. Sustaining specific capital levels may result in elevated expenses, leading to augmented costs for consumer services such as borrowing. Empirical illustrations of capital requirements in practise.

The global standards for capital requirements have exhibited fluctuations in both upward and downward directions throughout the years. It is observed that there is a tendency for an increase in their occurrence after a financial crisis or economic recession.

As per Investopedia (2023), Before the 1980s, banks were not subject to any universal standards for capital adequacy. The assessment of banks involved a multifaceted approach,

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where the capital was merely one of the contributing factors, and the minimum requirements were customised to suit individual institutions.

In 1982, Mexico's announcement of its inability to meet interest expenses on its national debt led to a collective country effort that resulted in the establishment of legal frameworks named the International Lending Supervision Act of 1983. The Basel Committee on Banking Regulation and Supervisory Practices, supported by central banks in the United States, Europe, and Japan, introduced legislation in 1988 that increased the minimum capital requirements for internationally active commercial banks from 5.5% to 8% of their total assets. Basel II was subsequently introduced in 2004, incorporating various forms of credit risk into the calculation of ratios.

Additionally, Investopedia (2023) states that, over time, a mechanism was developed to assign risk weights to different categories of assets, allowing financial institutions to reduce their capital requirements relative to their total properties. Erstwhile loans were assigned a risk magnitude of 1, meaning that a bank had to hold 8% of capital for each dollar of commercial loans on its balance sheet. Other assets, such as standard residential mortgages, mortgage-backed securities (MBS) issued by Fannie Mae or Freddie Mac, and short-term government securities, were assigned lower risk weights, ranging from 0.5 to 0.

Moreover, Investopedia (2008) also outlines the 2008 crisis and mentions Dodd-Frank's response. In response to the global financial crisis of 2008, the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 was enacted. The Collins Amendment, a provision of the Dodd-Frank legislation, aimed to safeguard the U.S. banking system from systemic shocks by imposing capital requirements on central banks.

Regulatory bodies establish the capital requirements for banks globally, and they are the same for all banks. Client deposits and savings accounts are the most significant liabilities for banks since they must be repaid to customers based on account terms. Client loans comprise most of a bank's assets, and the bank cannot simply lend to one group of clients while borrowing from another. Banks must maintain their capital, primarily obtained through shareholders and debt holders, to ensure the responsible use of funds and the security of customer deposits. Banking licenses are required to accept consumer deposits, as the lender assumes the risk when lending money. The capital requirement for a bank depends on factors such as the riskiness of its loans and the regulator's assessment of the bank's operations.

Furthermore, Investopedia (2023) adds that Banks often charge fees for various services, such as executing transactions, currency exchanges, or international money transfers, to offset related expenses. They may also offer additional services indirectly or directly, including

insurance and equities brokerage, for which they earn fees or commissions. These fees and commissions contribute to non-interest income, the second primary source of bank income.

Additionally, Investopedia (2023) states that banks' Operating expenses, which include personnel, facilities, equipment, computers, and telephones, are equivalent to their net interest income. The cost-to-income ratio compares expenses to revenue, with a higher ratio indicating higher expenses than income. Personnel expenses account for a significant portion of the overall costs. Considering all accounts and expenses, the cost-to-income ratio comprehensively evaluates a bank's performance.

Loan losses are another factor that banks must consider. Some clients may not repay their loans, typically ranging from 1% to 2% of the loan amount. The risk of fraud is also a consideration. Loan losses must be accounted for or absorbed by the bank, and they can significantly impact performance, even if expressed as a percentage.

Investopedia (2023) further concludes that establishing bank capital requirements is a global effort governed by regulatory bodies. Banks must maintain their capital to ensure the security of customer deposits and responsible lending practices. Fees and commissions from various services contribute to non-interest income, while operating expenses, including personnel costs, impact a bank's cost-to-income ratio. Loan losses and the risk of fraud also influence a bank's performance.

2.6 Retail Banking

Hugh Croxford (2005) captures the history of retail banking as follows:

- Consumer/Retail Banks:

The history of banking dates back to around 2000 BC when traders transported goods and merchants loaned money to farmers in the Babylonian and Assyrian regions. Banking practices were formalised in ancient Greece and the Roman Empire, where bankers in temples began providing loans and accepting deposits. Over time, banking practices became more sophisticated, including accepting deposits, lending money, currency exchange, and bookkeeping.

- Evolution of Retail banks,

As we know them today, they have evolved from two primary gene pools. Modern commercial banks originated from lending to farmers and expanded their operations to businesses and industries. They offered services such as settling accounts and clearing checks. The second gene pool consists of credit unions, building societies, and savings banks, which started as self-

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help credit unions and provided support for members' purchases of homes and necessities. Some building societies have transformed into banks in recent years.

- Challenges of Retail banks

Hugh Croxford (2005) further states that retail banks face challenges due to industry transitions and operating in a competitive market. Historical divisions between customer types have diminished, and banks now serve a broader range of customers. Regulatory changes and the deregulation of financial services in the 1970s and 1980s brought significant transformations to the banking industry. Banks had to adapt to changing demands, technological advancements, and increased competition. However, banks must maintain their core values of trust, honesty, diligence, and customer-centricity to thrive in this evolving landscape.

Lindbergh J. et al. (2008) studied the population ageing challenges and opportunities in retail banking. Their study explores how demographic shifts, particularly rising life expectancy and an increasing elderly population, affect the banking sector's demand for financial services. It presents a unique opportunity for banks to adapt their services to cater to these demographic changes. The paper projects how these shifts might influence banking scenarios by utilising demographic projections from the United Nations and applying well-established economic theories on life cycle behaviour. The research finds that an ageing population will likely result in higher asset accumulation and initial savings rates. However, as people age, their aversion to risk tends to increase while simultaneously facing more significant risks. This scenario necessitates households to effectively manage and diversify risks, spurring banks to develop products more closely aligned with the evolving needs of an ageing clientele.

Devlin F. (1995) studied the technology and innovation in retail banking distribution. Retail financial services distribution is gaining heightened attention in scholarly and professional circles, recognised as a critical determinant of market competitiveness. In the face of growing competition and deregulation, effective distribution strategies – focusing on customer communication and product delivery – are emerging as crucial elements for gaining a competitive edge. These strategies are increasingly seen as a source of differentiation, overshadowing the core service itself. The paper discusses recent trends in the UK's retail banking distribution, especially the rise of home and telephone banking. It particularly highlights the successful implementation of a telephone banking service by First Direct, a Midland Bank subsidiary, showcasing it as an example of current industry progress.

- Retail Banking Model

According to the Retail Banking Institute (2023), retail banking primarily operates under two business models: digital and conventional.

The emergence of branchless banking became a reality with the introduction of First Direct in the UK in 1989. This innovative model provided round-the-clock customer assistance through a contact centre. Subsequently, online banks like Egg Bank joined the trend in the late 1990s. The evolution of smartphones and specialized mobile apps gave rise to mobile-first banking options, leading to the establishment of companies such as Simple in the US and Monzo, Starling, and Revolut in the UK (Simple was purchased by BBVA in 2018 and discontinued in 2021).

To comprehend the shift towards digital banking, it is helpful to contrast the traditional and digital business models in retail banking. Traditional banks rely on physical branches and acquire low-cost capital through customer deposits. Unlike digital banks, which leverage the mobile phone network to provide services anywhere within a regulated region, traditional banks are often constrained geographically by the size of their branch network. Further details on bank business models can be found in the Business Models module.

Retail Banking Institute (2023) further adds that, Traditionally, banks were known for their secure vaults that safeguarded money and valuable possessions, hence the phrase "as safe as a bank" to describe a reliable structure in a town or city. Although some conventional banks are gradually transitioning certain aspects of their operations to cloud computing, they maintain their systems through technology centres based on mainframe computers.

Moreover, the Retail Banking Institute (2023) explains the business strategy of digital banks as below.

- The business strategy of digital banks

Retail Banking Institute (2023) further suggests that the bank app is the customer's interface in the branchless digital banking business model. In the digital bank concept, users initiate and confirm payments independently rather than depending on bank employees. The mobile-based strategy provided clients with 24/7 access to their services, which was an advantage over desk-based PCs or even laptops because individuals always have their phones with them. The primary method for responding to customer questions is through online chat through an app or on a bank website, while some digital banks additionally have a dedicated contact centre.

Although the lending component of the digital banking concept is possible, few prospective digital banks start with lending because doing so frequently requires permission from authorities.

Retail Banking Institute (2023) additionally states that Instead of starting with interest revenue, the digital bank business model first generates money from fees. A digital bank often does not have physical locations; nevertheless, it may provide cash deposits and withdrawals through ATMs or partners like the Post Office or a merchant.

In the UK, numerous new digital banks, including Monzo, Starling, and Revolut, began operations in 2015. Revolut and Monzo began as prepaid card providers, but Starling debuted later and had a full banking licence

Retail Banking Institute (2023) also states that digital banks' business strategy centres around the customer interface provided by the bank's mobile app. In the digital banking model, users can initiate and confirm payments independently, reducing reliance on bank employees. This mobile-based strategy offers customers round-the-clock access to banking services, leveraging the advantage of smartphones that are always with individuals, surpassing the limitations of desktop PCs or laptops. Online chat through the app or bank website addresses customer queries, while some digital banks also operate dedicated contact centres.

Furthermore, the Retail Banking Institute (2023) provides insight into the fact that instead of relying on interest revenue, the revenue generation model for digital banks primarily revolves around fees. Although digital banks typically lack physical branches, they may offer cash deposits and withdrawals through ATMs or partnerships with entities like the Post Office or merchants.

- Financial performance of online banks

As per Retail Banking Institute (2023), Many new digital banks have a strategy more in line with a tech company than a bank, such as establishing a Minimum Viable Product like a prepaid card and raising money through many rounds of funding. Almost all of these digital banks experience losses during the first few years of operation, but investors might overlook these losses if they believe the company has the potential to grow and serve many clients.

An example of a startup model is this. Contrarily, startups sometimes draw significant investments despite operating at a loss since they are expanding their market share, whereas older banks may be profitable but are not expanding their clientele.

Additionally, the Retail Banking Institute (2023) states that one or more entrepreneurs often start startup companies, and during the first few years of operation, the main goal is to get as much market share as possible, at whatever cost. Revolut has been in business since 2015 and has seldom been profitable, but as its client base grows and it enters new areas, it continues to draw investors.

- New models for the retail banking industry

Moreover, Retail Banking Institute (2023) describes the new model in Retail Banking Institute. The UK's Financial Conduct Authority thoroughly reviewed the retail banking industry and its business models in 2018. The findings revealed that established banks heavily relied on low-cost funding from consumer deposits and generated revenue through lending and fee-based services.

The revenue generation process in retail banking involves deposits made by customers, which serve as a source of funding for the bank. Retail banks utilise these funds to provide loans to customers at higher interest rates than those offered to depositors, creating a profit margin based on the interest rate disparity.

Additionally, Retail Banking Institute (2023) adds that, In addition to interest income, retail banks generate revenue through various fees for services such as account opening, brokerage, loan processing, and credit card usage. These fees contribute to the overall income generated by retail banks.

The Reserve Bank of India (RBI) regulates retail banks in India, oversees the mandatory reserve requirements, and provides the necessary funds for daily operations.

The fundamental principle of retail banking revolves around meeting the financial deficits of individuals and businesses by providing loans while simultaneously catering to the financial surpluses of depositors. The bank generates a spread between the interest rates it offers depositors and the rates it charges borrowers. Retail banks also offer additional services, often accompanied by fees, to supplement client accounts.

Furthermore, the Retail Banking Institute (2023) adds that banks assume the risk on behalf of lenders and borrowers by acting as intermediaries. The spread, the variance between the interest earned from debtors and the interest paid to depositors, is a significant revenue generator for retail banks.

Non-interest income, derived from various service fees, contributes significantly to a retail bank's revenue, typically ranging from 15% to 35% of the total net interest income. Services such as credit cards, factoring, securities brokerage, investment and taxation advice, payment services, insurance, and money transportation generate additional revenue through client fees. Additionally, the Retail Banking Institute (2023) provides insight into how banks generate revenue through the interest rate spread between depositors and borrowers and the fees charged for various services. While intermediation and service fees contribute to a significant portion

of a retail bank's income, customer access to necessary financial products and services remains critical for success.

- Return on Equity and Profit

The Corporate Finance Institute (2023) defines the ROE equation as Net Income divided by Shareholder Equity. ROE is a helpful tool for evaluating investment returns, as it can be compared to the industry average to identify a company's competitive advantage. It also provides insights into how effectively management utilises equity finance to expand the business.

A company that can sustain and grow its ROE over time is often skilled at creating shareholder value. This suggests that the company knows how to reinvest its earnings wisely to enhance productivity and profitability. Conversely, a declining ROE may indicate that management is inefficiently allocating resources to underperforming assets.

As per the Corporate Finance Institute (2023), it is a significant fact that the situation for banks is not as straightforward. All businesses aim to generate profits by earning more revenue than their expenses. Larger companies can anticipate more significant profits, which also holds for banks. Due to their size and economies of scale, central banks generate significant profits that align with their magnitude. While some individuals may express frustration over bank profits, it is a reality that should be understood.

Retail banks typically earn approximately 1% on their assets after taxes. Their primary assets consist of customer loan and mortgage accounts. However, if there are objections to the interest rates charged by banks, alternative options such as credit unions and building societies can be explored.

Furthermore, as per the Corporate Finance Institute (2023), funds are necessary to establish and sustain business operations, including banks. Investors contribute funding to banks in exchange for equity or ownership in the business. Equity, investment, and capital are closely interconnected, and the business's profitability is tied to investors' return on equity (ROE). ROE serves as a standard performance metric used to compare the performance of companies, banks, and other businesses.

Moreover, as per the Corporate Finance Institute (2023), While banks require investment and capital, the reasons differ from those of manufacturing enterprises that require funds for buildings, factories, inventory, and plants. In the case of banks, capital is necessary to meet regulatory requirements and safeguard customer deposits. Customers seek improved banking services, while shareholders, investors, and owners strive for higher ROE. A ROE of 10% is

considered insufficient, 15% is typical, and 20% is desirable. However, it is essential to note that investing in banks carries risks, and there is no guarantee of profitability

2.70 Retail Banking Performance Measurement

According to the Retail Banking Institute (2023), the return on equity (ROE) is commonly used to measure a bank's performance. It is calculated using Tier I capital, shareholder equity, and profit. However, to understand a bank's performance comprehensively, it is necessary to analyse the ROE over three to five years. Other metrics, such as return on assets (ROA), can provide additional insights but may not present a clear picture. Analysts and banks themselves utilize more complex measures, including risk-adjusted return on capital (RAROC), value-added return on net equity (VARONE), and return on economic capital (ROEC), which consider factors like risk management. These advanced metrics consider the risks inherent in banking operations, as effective risk management contributes to higher returns. While the ROE provides a valuable indication, these complex measures offer a more comprehensive evaluation of a bank's performance.

PwC (2011) defines retail banking performance below and provides the below-mentioned KPIs.

Source – PwC (2011)

Parent Metric	Name	Derivation	Basis	Purpose
ROA	Return on Asset	Net profit after tax/Asset	Assets	Asset Mgt. Without risk management
RAROA	Risk-Adjusted Return on assets	Economic Profit/Asset	Economic	Asset management with mitigated risk adjustment.
ROE	Return on Equity	Net profit after tax/Equity	Equity	GL return on equity without risk management
RAROE	Risk-Adjusted Return on Equity	Economic Profit/Equity	Economic	Return on equity with mitigated risk adjustment
RAROC	Risk-Adjusted Return on Capital	Economic Profit/Economic Cost	Economic	Fully risk-based profitability

EVA	Economic Value added	Economic Profit-Economic Capital	Economic	Risk-based profit.

Table 1 Retail banking performance and KPI

- Overview of Retail Banking Accounts

According to VikasPedia (2023), entrepreneurs often open bank accounts to conduct routine financial transactions. One such account is current, which allows unrestricted deposits and withdrawals without prior notice. It can be established at cooperative and commercial banks. Current accounts facilitate cheque payments to creditors and can accept customer-issued cheques for collection. In India, a current account can be opened with a deposit ranging from Rs. 5000 to Rs. 25,000. Current account holders typically do not earn interest on the funds deposited in the account. One notable benefit of a current account is the availability of an overdraft facility.

Moreover, VikasPedia (2023), from an employer's perspective, choose to remunerate employees through direct deposits into their current accounts. These accounts are also used for benefit disbursements, investment earnings, and bill payments through standing orders or direct debits. While traditional current accounts did not offer interest payments, the financial sector's evolution has led to building societies incorporating current accounts that provide interest on balances held.

- Customer Behaviour and Current Account

Furthermore, Huge Croxford (2005) describes customer behaviour in retail banking.

Once customers have acquired a current account, they tend to show reluctance to switch to another bank. There is a certain level of attachment and inertia in the banking relationship, and changing institutions requires a significant investment of time and effort, especially when current account offerings are similar across competing banks. Additionally, current accounts are location-independent, meaning customers do not need to change their account when they move residences. While customers' immediate banking needs are fulfilled with a current account, banks can promote their other offerings through periodic customer statements. However, this represents the extent of their advantage.

Moreover, Hugh Croxford (2005) also narrates about the Savings account as below.

- Savings Account

A savings account is a deposit account held at a financial institution that earns interest over time. Although savings accounts generally offer lower interest rates, they provide a secure and reliable option for storing funds for immediate use.

- Overview of Savings Account Mechanics:

Moreover, Hugh Croxford (2005) adds that Savings accounts and other deposit accounts serve as reservoirs of funds that financial institutions utilise for lending purposes. They are available at physical banks, online-only institutions, and investment and brokerage establishments. Interest rates on savings accounts may vary, with financial institutions reserving the right to modify rates without prior notice. Higher competitive rates often exhibit more variability.

Federal funds rate changes can prompt institutions to adjust their deposit rates. Some establishments offer high-yield savings accounts with higher interest rates for more extensive minimum deposits. Some traditional savings accounts may require a minimum balance to avoid fees or obtain the best-advertised interest rate, while others have no balance prerequisites. Familiarity with the account regulations is essential to prevent fee deductions.

Also, Hugh Croxford (2005) states that Funds can be deposited into or withdrawn from a savings account through various channels, such as online transactions, in-person visits, electronic transfers, direct deposits, and sometimes telephone communication. Some institutions limit the number of withdrawals per month, typically capping it at six. While this threshold was initially mandatory, it was rescinded in April 2020 by the Federal Reserve. Exceeding the limit may result in penalty fees, account termination, or conversion to a checking account. The withdrawal limit depends on the account's available balance.

Interest earned on savings accounts, like other types of accounts, is subject to taxation as taxable income.

Additionally, Huge Croxford (2005) defines the advantages and disadvantages.

- Advantages/Pros

Setting up and transferring funds is quick and uncomplicated, often linked to the primary checking account.

The entire balance in the savings account is available for withdrawal without restrictions.

- Disadvantages/Cons

The interest rate offered is generally lower compared to potential earnings from certificates of deposit, Treasury bills, or other investment options.

The convenience of accessibility may lead to temptation and an increased likelihood of frequent withdrawals.

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As per Kenton (2022), A payment mechanism is a system that facilitates financial transactions between buyers and sellers. In banking, payment systems are crucial as they enable the transfer of funds from one account to another. Payment systems can be classified into three categories: cash-based, paper-based, and electronic-based. Electronic payment systems have gained significant popularity in the modern era due to their convenience and speed.

- Making Sense of Payments

In a nutshell, Kenton (2022) unpacks how retail banking transactions work. Here's the essence of it: Today, monetary transactions hinge on the use of money, a simple, versatile way to conduct and store payments. But in the past, direct trade of goods or services was the norm. A surplus of goods, such as eggs from a farmer, would be swapped for something else, like milk. However, if a trade wasn't timely, perishable goods could spoil and be rendered worthless. That's where money shines—it maintains its value. Yet, companies sometimes still trade services, a throwback to the old barter system.

Payments typically involve transferring something beneficial or valuable to all involved parties. Often, they're preceded by an invoice or bill. The recipient generally chooses how they want to be paid, although legalities may require them to accept a certain amount of the country's legal tender. Foreign currency payments often come with extra exchange fees, varying according to the bank, card issuer, and government.

Kenton (2022) also delves into the different ways to make payments in retail banking:

2.71 Retail Banking Payment Types

Our history has seen many ways to make payments, which continue to evolve. Here are some of the popular methods in use today.

Source – Self Analysis
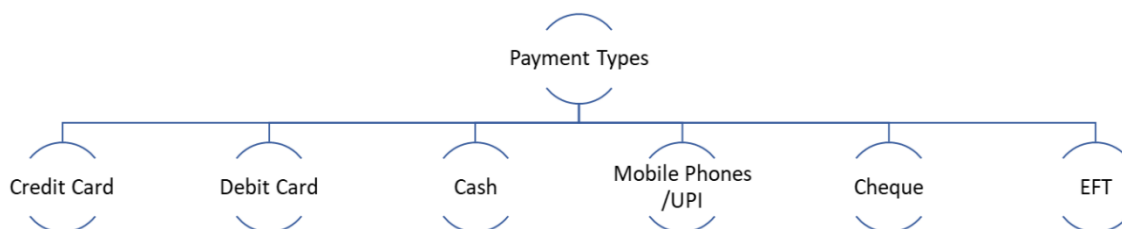
Figure 3 Payment Types

- Credit Cards

These standard payment tools offer a line of credit to users, who can spend up to a preset limit. When a transaction is made, the user's account details are sent to the seller's bank to authorise the transaction.

- Debit Cards

Though debit cards appear like credit cards, they work another way. When used, they deduct money straight from the user's bank account. The transaction can be rejected if there's not enough money in the account.

- Cash

Despite the rise of digital payments, cash still holds sway, particularly with smaller retail businesses. Cash transactions have downsides, such as being prone to loss, theft, or damage. Businesses handling large sums of cash may have to invest in added security measures.

- Mobile Phones

Contactless payments through mobile phones have made transactions more user-friendly. With the right software, a mobile device can share banking details with a seller's point-of-sale terminal, confirming the payment.

- Checks

Although they're not as popular as before due to digital advancements, checks still serve a purpose, such as when the payer wants a guarantee of payment. Writing a check involves providing bank details, including a routing number. Once the check is deposited, a clearinghouse makes the necessary adjustments to the accounts involved.

Electronic Funds Transfers

The concept of ACH and wire transfers, both modes of electronic fund transfers, are differentiated by their inherent characteristics. While ACH transfers usually apply to domestic transactions and may take more than a day to complete, wire transfers often get processed on the same day but might be limited by geographical restrictions. ACH transfers, unlike wire transfers, can typically be reverted.

Kenton (2022) discusses the evolving landscape of payment methods, highlighting the emergence of digital currencies and tokens within blockchain technology. These innovations allow for easy transaction execution with just an internet connection. In debt settlements, it's common for partial payments or discounts to be accepted, sometimes with added fees for delays or specific payment methods. Receipts are essential for confirming payments, which can be refused outside regular banking hours or on Sundays. Payments typically coincide with or

follow the delivery of goods and services, but larger or more complex deals may be structured over time, including options for prepayment.

In the context of mortgages, a significant revenue generator in the banking sector, the process from securing a mortgage to closing involves several steps: choosing the right mortgage type, obtaining pre-approval, house hunting, formal application, loan processing, underwriting, and finally closing the deal. The process is intricate, involving stages from assessing affordability to the final approval of the loan.

Kenton (2022) describes the complete cycle and states that once your application is approved, the closing process begins, during which all documents are reviewed and signed at the attorney's office or title company. During this stage, a closing disclosure form compares the estimated closing costs with the final expenses. A final walk-through of the property is done before closing to ensure all required repairs are done. This complex process eventually leads to you becoming the owner of the property.

Hasan et al. (2011) studied returns to retail banking payments. His study investigates how the development of a country's retail payment infrastructure correlates with overall bank performance—analysing data from 27 European markets from 2000 to 2007 shows that banks in nations with advanced retail payment services tend to perform better. This correlation is robust when widespread adoption of retail payment technologies is widespread. Using diverse retail payment instruments and electronic payment methods positively influences banking operations. The impact of these payment services is especially significant on the performance of savings and cooperative banks, though commercial banks also benefit. The study also notes that while retail services predominantly enhance bank performance through fee income, their effect through interest income is also beneficial. Moreover, a well-functioning payment service market contributes to more excellent bank stability. These conclusions hold across various regression models.

- Risks Arising from Retail Banking:

Per Analyst Prep (2019), the following are retail banking risks. The primary risk inherent in retail banking is credit risk, which pertains to the potential default of borrowers on their debts. In addition to credit risk, retail banking faces the following risk.

- Interest rate risk occurs when banks offer different interest rates to borrowers and depositors.
- Valuation of Property Risk: This points to the probability that a financial institution might not precisely ascertain the worth of a distinct asset, liability, category, or security.

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The peril of early repayment intensifies this hazard, which implies the potential for loaned money to be reimbursed sooner than planned. Clients may settle their loans early to capitalise on better conditions elsewhere.

- Operational Risk: These encompass oscillations in the volume of home loan business caused by shifts in interest rates, tactical hazards linked to introducing innovative business offerings (for instance, digital banking), and resolutions about consolidations or buyouts.

- Reputation risks arise from the bank's ability to deliver on promises to customers and regulators.

- The Negative Side of Retail Credit Risk

- Strategies to Counteract the Drawbacks of Consumer Lending Risk

Analystprep (2019) outlines the challenges in retail credit, noting its risks are typically stable but can escalate unexpectedly due to systemic events, causing significant financial losses. Advancements in consumer banking lead to new credit products that are hard to model and price because of limited historical data. Economic downturns and high interest rates can rapidly increase defaults and decrease property values, exacerbating bank losses. Additionally, operational errors in consumer banking, often due to automated decision-making, might increase exposure to high-risk individuals. Changes in legal and societal norms can also create environments conducive to defaults, complicating the recovery process for financial institutions.

. Analyst Prep's 2019 report examines strategies to mitigate risks in consumer lending. The Dodd-Frank Act of 2010, aimed at stabilizing the financial system and preventing crises like that of 2007/2009, is highlighted for its significant role. This Act established a Financial Stability Monitoring Council to oversee institutions critical to economic stability and allowed regulators to increase reserve requirements and dismantle risky banks. It also led to the formation of the Consumer Financial Protection Bureau, requiring banks to assess mortgage eligibility and borrowers' repayment capabilities, defining criteria for "qualified mortgages," including a maximum debt-to-income ratio and absence of risky loan features.

The report discusses credit risk scoring models using various statistical methods to calculate repayment probabilities and manage risk. These models help banks identify risky customers and automate customer evaluations, reducing the need for credit specialists. Different types of credit rating systems are used, including those by credit reporting agencies like FICO,

aggregated models from similar credit portfolios, and bespoke models tailored by individual lenders.

Crucial factors like FICO scores, income-to-debt ratios, and loan-to-value ratios are considered for home loan credit evaluations. Scorecard performance is continually monitored using tools like the Cumulative Accuracy Profile.

The study also emphasises a trade-off between creditworthiness and profitability. Banks balance the risk of default with the profit potential, moving beyond default-oriented scoring to consider product-specific profitability and overall customer earnings. Various scorecards are used for decision-making and profitability analysis.

Lastly, the client engagement cycle is crucial, involving marketing strategies, the vetting process, and account management. It is necessary to effectively engage with clients and manage their accounts.

2.72 Retail Banking Trends

According to Marous (2022), retail banking is experiencing six significant trends shaping its future. These trends include:

- Intelligent Decisioning and Communication: The use of data, artificial

Intelligence (AI) and applied analytics are crucial for identifying opportunities, refining decisions, and supporting contextual communication. By leveraging these technologies, financial institutions can improve back-office operations, reduce costs, enhance customer service, and deliver personalized and real-time communication and recommendations.

- Expansion of Open Banking APIs: Open banking is driving digital transformation

in the industry, influencing technology investments, data strategies, and partnerships with fintech firms. Financial institutions must determine the most suitable business model, build necessary capabilities, and establish partnerships to succeed in the open banking environment. This approach can improve customer experiences, streamline processes, foster innovation, and enhance customer retention.

- The Move to the Cloud: Despite concerns over security and governance, banks

and credit unions must embrace cloud computing solutions to store data, support analytics, and gain insights. Cloud adoption enables increased customer insights,

- Intelligent Process Automation efficiency, innovation, agility, and reduces security

and business continuity risks. It enhances both front-office and back-office transformation, augmenting human productivity

- Automation technologies such as robotic process automation (RPA) and digital process automation (DPA) offer significant efficiency gains and enhanced data for better decision-making. Financial institutions can automate work activities to improve new account opening, customer onboarding, and digital loan application management. Intelligent automation should complement RPA, enabling a seamless digital customer experience to maximise the benefits.

From Embedded Banking to Embedded Finance: Non-financial companies are increasingly interested in offering embedded financial services to retain customers and enhance relationships. Leading financial institutions collaborate with fintech and non-financial companies to provide banking-as-a-service (BaaS) offerings. Embedded finance presents a significant market opportunity, reducing customer acquisition costs and enabling companies to monetize without charging customers extra.

- Increased Focus on Cybersecurity: Cyber threats pose significant financial and reputational risks to financial institutions. With the rise of remote working and digital banking, the urgency to protect customer information and critical infrastructure from cyber attacks has grown. One emerging trend is the elimination of passwords, with the adoption of authentication apps, biometrics, and single sign-on (SSO) solutions. Passwordless authentication provides an additional layer of protection against cybercriminals.

These trends highlight the importance of leveraging technology, embracing open banking, adopting cloud solutions, automating processes, offering embedded finance, and prioritizing cybersecurity to navigate the evolving retail banking landscape.

Edward G. (2006) focuses on the recent transformation of retail banking in Europe, with special attention on the UK. It identifies regulation, competition, and advancements in information technology as key factors influencing changes across various European retail banking systems. The paper delves into two primary strategic topics: the shift in retail banking from a traditionally supply-centric approach to a more customer-driven strategy and the growing emphasis on adopting a culture centred on shareholder value. Ultimately, it summarizes the essential characteristics and strategic challenges presented by the emerging changes in retail banking.

Arkhipova N(2022) delves into numerous trends significantly influencing the evolution of banking services, the business models of financial intermediaries, and the sector's future, making it a subject of great interest in contemporary economic studies. The paper aims to identify trends in developing banking products within the modern economy, marked by regulatory instability, numerous technological innovations, demographic shifts, and rapidly

changing consumer preferences. Using data spanning most Russian regions from 2010 to 2020, the study creates an extensive database of balanced panel data. The findings reveal that income and credit history significantly impact regional loan volumes, reflecting a typical, inertial shift in how financial institutions and customers approach retail lending. Interestingly, non-financial socio-demographic aspects, such as healthcare quality and financial literacy, emerged as influential factors. These insights could assist credit institutions in managing risks, developing products, and planning expansion across different areas.

Grivas et al. (2016) analysed cloud computing's impact. According to that study, Cloud computing offers significant potential for banking institutions, providing transformative benefits in both customer-facing and internal operations. It can revolutionise customer service by allowing banks to tailor their products and services more closely to individual client needs, enhancing overall satisfaction and experience across various channels. This personalisation can be a key differentiator in a competitive market with slim margins and high customer turnover, strengthening brand loyalty.

On the back end, cloud computing can streamline processes by integrating a cloud-based IT infrastructure, improving information flow and eliminating data silos. This leads to more effective use of information, supporting front-end processes and increasing efficiency. Such flexibility and improved data management also aid banks in anticipating and adapting to industry trends.

However, successfully implementing cloud computing in banking requires careful planning and a comprehensive strategy that encompasses all aspects of the business. Without a holistic approach, the full benefits of cloud computing might not be realised. Additionally, this shift can prompt a review and update of outdated processes, contributing to further efficiencies and cost reductions.

In summary, cloud computing enables banks to enhance customer satisfaction and loyalty while increasing operational efficiency and profitability.

2.8 Corporate Banking

As per Peterdy (2023) from the Corporate Finance Institute, Corporate banking, also known as institutional banking, is a division within a bank that focuses on providing loans to corporations, financial institutions, and governments. It is typically part of the bank's investment banking arm and is often considered a "loss leader" for other investment banking products. Universal banks with large balance sheets and investment banking divisions, such as Citi, Bank of America, and JP Morgan, are significant players in corporate banking.

The primary business model of corporate banking is similar to that of commercial banking, which serves individuals and small businesses. However, corporate banking deals with larger-scale loans. The main products offered by corporate banks are revolving credit facilities (revolvers) and term loans. Revolvers function like credit cards for large companies, allowing them to draw and repay funds as needed. Term loans are used for various purposes, such as capital expenditures, M&A, and leveraged buyouts.

Furthermore, Peterdy (2023) states that, In addition to revolvers and term loans, corporate banks also provide other products such as bridge finance, letters of credit, trade finance, and cash management services. Corporate banking fosters stronger relationships and cross-selling opportunities with clients. Corporate banking differs from commercial banking regarding client focus and lending returns. Corporate bankers work closely with debt capital markets and often collaborate on financing deals.

Regarding career progression, corporate banking offers roles such as analysts, associates, vice presidents, and managing directors. Analysts are involved in deal-related work, financial modelling, credit monitoring, and loan market updates. Associates and vice presidents manage teams, oversee deal execution, and interact with clients. Managing directors are responsible for originating and managing client relationships.

Peterdy (2023) also states that corporate banking salaries are generally comparable to investment banking, but bonuses are lower. The career path within corporate banking may involve lateral moves to other areas within the bank. Corporate banking has limited overlap with private banking, which focuses on high-net-worth individuals, and debt capital markets, which deal with debt issuance. Corporate banking operates in mature markets where corporates have access to deep debt capital markets, while in emerging markets, bank debt is more prevalent.

- Liquidity and Profitability Brief

Moreover, Dr Avasthi (2010) talks about how bankers' evaluation of credit proposals includes considering the market risk involved and how it can be mitigated by preferring high-quality securities. Liquidity is a crucial principle in banking, as banks lend public money that depositors can withdraw at any time. To meet depositor demands, banks must maintain liquid assets, provide short-term loans, or accept efficiently marketable assets as security. When granting a demand loan, the borrower's ability to repay within a short period is assessed based on the nature of their assets. Liquidity is as essential as fund safety for banks, which grant loans based on readily marketable assets. The profitability of loans is a primary principle, as bankers

analyse the potential for earning substantial profits from advances, considering the difference between interest received and interest paid.

- Measurement of creditworthiness of Borrower by 5C's

Furthermore, Dr Avasthi (2010) discusses how interest paid on deposits forms a significant portion of a bank's income. Creditworthiness is assessed by analysing the five Cs (Character, Capacity, Capital, Condition, and Collateral). Character includes personal traits such as honesty, integrity, and reputation. Capacity focuses on the borrower's abilities and experience to run a business successfully. Capital represents the business's net worth, indicating its ability to withstand changes and borrow funds. Assessing the borrower's capital and obtaining it as collateral provides additional security.

Additionally, Dr Avasthi (2010) described the details of the condition, the purpose of credit, and lending sectors as below.

- Condition:

The banker assesses the economic and financial environment of the borrower's business to determine its present and future condition. Collateral, such as guarantees, mortgages, or pledged assets, is accepted by the Collateral banker to enhance the borrower's creditworthiness. The saleability of the assets determines the quality of the collateral. Several factors are considered when assessing creditworthiness, including evaluating the promoter's background and experience, management information, industry prospects, credit and market risks, regulatory compliance, exposure levels, and financial strength.

- Purpose of Credit: The purpose of credit should be productive to ensure the

  safety funds and provide a reliable source for repayment.

- Diversification of Risk: Banks follow the principle of diversification of risks

to mitigate unforeseen contingencies. By dividing credit among different industries and regions, the bank reduces the impact of disasters or adverse events. Collateral assets are obtained to secure credit and protect against adverse circumstances

- Lending Sectors:

Banks engage in two main lending sectors - Priority Sector Lending and Non-Priority Sector/Commercial Lending. The government mandates priority sector lending and requires a certain percentage of total lending to be directed towards sectors that may not have access to organised lending or can afford commercial interest rates, such as MSMEs and agriculture.

- Commercial Lending

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In his 2010 work, Dr. Avasthi provides a detailed discussion on commercial lending. Commercial lending is a crucial activity for banks in India, focusing on corporate and retail loans. Corporate loans are offered to profit-making entities based on their balance sheet and cash cycle. Retail loans are given to small entrepreneurs and individuals based on their means and repayment capacity. The RBI regulates exposure norms and interest rates, limiting exposure to specific industries or borrowers. Interest rates are determined through the Base Rate System or Marginal Cost of Funds Lending Rate (MCLR) System. Banks can offer fixed or floating interest rates, and penal interest may be charged for defaults.

- Priority Sector Lending

Dr Avasthi (2010) further elaborates that Priority Sector Lending is a mandate by the Government of India requiring banks to allocate a certain percentage of their loans to sectors that lack access to organized lending or cannot afford commercial interest rates. This includes small businesses, agriculture, and exports. Commercial lending is the primary activity of Indian banks and has regained importance with financial sector reforms. Banks offer corporate and retail loans based on the borrower's balance sheet, cash cycle, and repayment capacity. The RBI sets Exposure limits to manage risk, and interest rates are determined based on the MCLR system. Marginal Cost of Funds Lending Rate (MCLR) has replaced the base rate system, ensuring transparent and timely adjustments to interest rates. The marginal cost of funds, deposit rates, and repo rate influences the MCLR. Banks review and publish MCLR rates monthly, and new loans are offered with a spread over the MCLR. Existing loans have interest rates revised on the interest reset date. Loan documents specify the reset clause and spread of MCL.

- Commercial loan

As per Kenton (2022), commercial loans have the following factors:

A commercial loan is an arrangement where a business borrows funds from a financial institution, typically a bank, to cover operational costs or significant expenses. Small businesses often rely on loans due to limited access to bond and equity markets. These loans usually require collateral, such as property or equipment, and companies must provide financial statements to demonstrate their ability to repay. Commercial loans can be short-term but may be renewed. Creditworthiness is essential for loan approval, and interest rates are based on the prime lending rate. Renewable commercial loans can be extended indefinitely to support ongoing operations and repay the initial loan within the specified timeframe.

- Monetary Policy Brief

Dr Avasthi (2010) further gives a detailed narration about Monetary Policy and its impacts. The Reserve Bank of India (RBI) is responsible for conducting monetary policy in the country. Monetary policy aims to maintain price stability and promote economic growth. The RBI Act provides a basis for implementing the flexible inflation targeting framework, with a 4% Consumer Price Index inflation target. The RBI uses various instruments such as repo rate, reverse repo rate, liquidity adjustment facility, marginal standing facility, bank rate, cash reserve ratio, statutory liquidity ratio, open market operations, and market stabilisation scheme to manage liquidity and interest rates. The RBI publishes bi-monthly monetary policy statements and sets policy rates and reserve ratios. These rates and ratios can be adjusted based on economic conditions.

2.81 Credit Scoring Framework

As per Dr. Ramamurthy N (2020), Banks use the "Credit Scoring" framework to evaluate individual loan proposals in the retail sector. Parameters and attributes in the proposal are assigned marks, and an aggregate score, known as the "Credit Score," is calculated using different weights for each parameter. If the Credit Score exceeds the minimum threshold, the proposal is approved; otherwise, it is rejected. He further defines interest rate, Cap, and essential terms in credit types and the Appraisal process.

- Interest Rate: There are various methods of charging interest for loans, including fixed and floating rates. In a fixed-rate contract, the interest rate remains the same throughout the loan tenure, providing protection against market rate increases but preceding potential benefits from rate decreases. In a floating rate arrangement, the bank and borrower agree on a benchmark rate, and the actual rate payable is determined by adding an agreed-upon amount to the benchmark rate. They also assess the frequency of interest rate resets.

- Cap: A floating interest rate with a maximum limit set during loan sanction, providing an advantage to the borrower.

- Floor: A floating interest rate with a minimum limit set during loan sanction, providing a benefit to the bank.

- Collar: A floating interest rate with both minimum and maximum limits set; Furthermore, Dr Ramamurthy N (2020) defines Repayment methods

- Repayment Methods

Different methods exist for structuring loan repayments, each with advantages and disadvantages. Options include Equated Monthly Instalment (EMI), Fixed Principal, Step-up, Step-down, Balloon, Bullet/Lump Sum, Random, and Hybrid. Borrowers should choose a

method that suits their cash inflows, commitments, and tax consequences. The availability of these methods may vary by country.

- Security and Change Types

Moreover, Dr Ramamurthy N (2020) talks about Security and Charge Types: Banks usually require some form of security when they extend credit. This security can be the asset being financed or an additional asset. When the funded asset itself becomes security, it is called "Primary Security," while an asset not financed becomes "Collateral" or "Secondary Security." Different types of assets can be offered as security, such as shares, property, or life insurance policies. Each type of security has its method of establishing the bank's rights over them.

- Technical Terms of Credit

Understanding specific terms like Limit, Margin, Drawing Power, Liability, and Excess Drawing is essential. For example, when a borrower applies for a car loan, even if eligible for the total amount, the bank may require a margin amount, which the borrower must contribute. The remaining amount sanctioned by the bank is the loan limit. The drawing power or liability is the outstanding loan amount at any given time. If the outstanding amount exceeds the limit, there is an excess or above-the-limit amount. Banks set the eligible limit and impose margin requirements, ensuring the drawing power does not exceed the sanctioned limit.

- Types of Funded Finance

Dr Ramamurthy N (2020) briefs about Banks that offer various types of funded finance, including Cash Credit. Cash Credit accounts can be categorised into Open Cash Credit (OCC) and Key Cash Credit (KCC). Cash credit can be given against different types of security, such as goods, promissory notes, debentures, immovable property, or book debts.

Dr Avasthi (2010) also defines one more critical pillar of corporate banking: Corporate Finance.

- Corporate Finance

Corporate finance involves managing the financial activities of a corporation to maximize shareholder value. It includes planning, raising, investing, and monitoring finances to achieve the organization's financial goals. Corporate banking is essential for banks as it contributes significantly to their earnings. It supports corporate development and the economy by providing debt products, origination and structuring of debt transactions, personalized debt products, flexible repayment structures, and financial problem prevention. Banks' Common debt products include working capital loans, term loans, commercial paper, corporate bonds,

letters of credit, guarantees, factors, and forfeiting. Working capital loans help businesses manage cash flow fluctuations, and cash credit is a common form of working capital loan. Banks require borrowers to submit stock statements and book debts, which are used to calculate the drawing power for working capital loans. Precautions should be taken when valuing assets, considering unpaid stocks, avoiding double financing, and ensuring compliance with margin stipulations and sanctioned limits. In seasonal industries, DP assessment is based on cash budgets.

Esteban-Sanchez P. et al. (2017) studied corporate social performance and its relation to corporate financial performance: International evidence in the banking Industry. As per this study, the 2008 financial crisis highlighted the relationship between Corporate Social Performance (CSP) and Financial Performance (CFP) in banks, questioning the effectiveness of their CSR strategies. Research on 154 financial entities from 2005 to 2010 showed that banks with stronger employee relationships and governance had better CFP. However, the crisis weakened the positive impact of governance, suggesting its failure in crisis times. Unexpectedly, product responsibility didn't enhance CFP, but improved community relations did, possibly attracting investor interest. These findings suggest banks should integrate CSP more deeply into governance, reevaluate customer relations, and focus on community engagement. Regulatory reforms to define banks' product-related responsibilities are also recommended.

Bo S, J et al. (2011) did Research on the measurement of customer equity in the corporate banking business. As per this study, since joining the WTO and, particularly post-2006, China's gradual opening of its financial market has led to increased competition due to the entry of numerous foreign banks. This heightened competition has made practical and strategic customer equity management crucial for the survival and growth of commercial banks. Despite its importance, there's a notable lack of research on this topic. Addressing this gap, this paper refines existing customer equity measurement models, particularly those by Gupta and Lehmann, and applies them using survey and corporate data. Specifically, it calculates the customer equity for the corporate banking sector of the Harbin Branch of the China Construction Bank. This research not only aids in customer equity management but also holds significant theoretical and practical value.

Barth A. et al. (2021) studied corporate culture and banking. It conducts an empirical analysis of the impact of corporate culture in the banking sector. Using the Competing Value Framework, it identifies a clear link between banks embracing a competitive culture and their propensity for bonus-driven compensation models. Additionally, banks emphasising growth

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tend to exhibit higher stock returns, whereas those prioritising stability generally face lower bankruptcy risks. These observations corroborate existing theories about the influence of bank culture on their operations and underscore the critical role of corporate culture as a less tangible but significant element of governance, contributing to the overall stability of the banking industry—research on the measurement of customer equity of the corporate banking business. Fogilia A. et al. (1998) studied the Multiple banking relationships and the fragility of corporate borrowers. This study investigates the common Italian practice of multiple borrowing and its effects on the stability of corporate borrowers. It examines two contrasting views: one suggesting that multiple credit sources distribute risks beneficially, and the other proposing that fragmented loans weaken bank oversight, increasing borrower fragility. The study uses multivariate analysis to assess whether lending relationship structures and financial statements can differentiate between stable and failing companies. The findings indicate that having multiple banking relationships correlates with increased borrower risk. However, this impact is relatively mild compared to the influence of natural and financial factors on balance sheets. Andres P de et al. (2008). conducted a study using a sample of large international commercial banks to examine the dual role of boards of directors. A sophisticated econometric model was employed to address the common endogeneity issue in corporate governance research, proving its effectiveness over traditional methods like OLS. The study discovered a complex relationship between board size, the proportion of non-executive directors, and bank performance, characterised by an inverted U-shape. The findings suggest that the composition and size of bank boards are crucial to their capacity for monitoring and advising management. Specifically, more extensive but not overly independent boards tend to be more effective in their oversight and advisory roles, thereby enhancing value creation. These conclusions were reached after factoring in performance metrics, the banking sector's prominence in each country, ownership structures, and varying regulatory and institutional environments.

Atanasova CV et al. (2004) study revisits the discussion on how monetary policy shocks, influenced by asymmetric information and incentive issues, affect financial constraints, particularly in the UK's impact on small and medium-sized enterprises' access to bank credit. Utilising a disequilibrium model differentiates firms into 'borrowing constrained' and 'unconstrained' categories, considering both firm-specific attributes and macroeconomic elements like monetary conditions and business cycle phases. The findings indicate that firm assets are crucial as collateral in easing borrowing limits, and tight monetary periods see a rise in corporate credit demand but a decrease in bank loan supply. During such times, smaller

companies often shift to interfirm credit to bypass credit rationing. Notably, the early 1990s recession saw a higher prevalence of borrowing constraints than other periods.

O'Donnell A et al. (2002) studied the recent technological advancements that have notably influenced banking, mainly through the advent of technology-based and remote interaction methods. Much research has focused on retail banking customers' attitudes and usage of these remote channels. However, this study examines the preferences of corporate clients at a major UK bank, distinguishing between smaller and larger businesses. The study reveals that regardless of size, all customers favour personalised interactions. Notably, smaller business customers, who typically yield lower profits for banks, are less inclined towards adopting technological communication channels, showing a stronger preference for direct, personal interactions with their bank.

2.82 Corporate Banking Products and Concepts

Dr. Ramamurthy N (2020) defines various corporate banking products and concepts.

Open Cash Credit allows borrowers to withdraw funds up to the sanctioned credit limit as needed. Interest is charged on the borrowed amount, not the entire credit limit. It provides flexibility to the borrower, who can repay the amount anytime. The account operates like a current account, and the hypothecation of goods secures the advance. Overdrawing beyond the drawing power or limit is not allowed. It is usually sanctioned for one year and renewed based on satisfactory operations.

- Cash Credit

Furthermore, Dr Ramamurthy N (2020) talks about how Key Cash Credit (KCC) is similar to OCC (Open Cash Credit) but differs in a few aspects. KCC is secured by the pledge of goods, with the possession of goods held by the bank. OCC is a running account, while KCC functions as a loan account, and the amount is disbursed based on the value of pledged goods. Banks generally prefer OCC over KCC due to operational inconveniences and legal formalities associated with maintaining promised goods.

- Overdraft

Additionally, Dr. Ramamurthy N (2020) describes the Overdraft. The overdraft facility is similar to an Open Cash Credit (OCC) account in operation. It allows borrowers to obtain funds beyond the balance in their accounts up to a specified limit. Overdrafts can be granted against various securities such as government securities, debentures, fully paid shares, bank deposits, life insurance policies' surrender value, and other securities like National Savings Certificates (NSCs) and bonds.

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- Demand Loan

A demand loan is a term loan and differs from an operative account like OCC. It can be granted against various types of security, including the pledge of gold ornaments, other goods or produce, debentures or fully paid shares, immovable property or documents, and units of mutual funds. Features of a demand loan include a fixed amount, no subsequent debts except

- Term Loans

Moreover, Dr Ramamurthy N (2020) talks about Term loans. Term loans are advances granted for a fixed period, usually against the security of fixed assets, for purposes such as acquiring land, buildings, machinery, or expanding existing undertakings. They can be classified as short-term loans (up to one year), medium-term loans (one to three years), or long-term loans.

- Bill Facility

When the working capital need exceeds a threshold, one-third of the limit is typically sanctioned as a bill facility, including purchasing, supplying, and negotiating bills.

- Project Finance

Dr. Ramamurthy N (2020) elaborates on Project Finance: Project finance involves financing greenfield industrial projects, capacity expansion, construction ventures, infrastructure projects, and capital-intensive business expansion. Loans are approved based on the project's cost and viability and the promoters' credit standing.

- Non-Funded Finance

Corporate customers may require non-funded facilities such as a Letter of Credit (LC), Bank Guarantee (BG), and funded facilities. LC is a documentary credit issued by a bank on behalf of the buyer to pay for goods and services. BG is a contract to perform the promise or discharge the liability of a third person in case of default and can be issued for various purposes, including security deposits for tenders.

- Credit Appraisal

Dr. Ramamurthy N (2020) focuses on Credit Appraisal: Credit appraisal is a combination of art and science, involving the assessment of prospective borrowers through interviews and supported by financial statements and calculations. Trends in corporate finance have shifted from banks seeking borrowers to borrowers seeking favourable terms. The credit appraisal process includes external analysis, internal analysis, borrower appraisal, technical appraisal, management appraisal, financial appraisal, market appraisal, and economic appraisal.

Borrower appraisal is crucial and focuses on the borrower's capability and willingness to repay the loan. The Five Cs of the borrower - character, capacity, capital, collateral, and conditions - are assessed to determine creditworthiness. Character assesses honesty, integrity, and commitment, while capacity evaluates the borrower's ability to manage the enterprise successfully.

Dr. Ramamurthy N (2020) covers credit Appraisal in detail where he elaborates that,

In credit appraisal, capital refers to the borrower's contribution to the business as their margin. It signifies their ability to bear losses and not solely rely on the creditor for support. Meanwhile, venture capital funds prioritize innovative ideas over capital infusion. Collateral, whether tangible or intangible, serves as security for the loan and can include physical assets, reputation, or third-party guarantees. Conditions encompass pre and post-sanction requirements and compliance. The borrower's capability and willingness to repay the loan are assessed through the Five Cs: character, capacity, capital, collateral, and conditions. The borrower appraisal is crucial, and factors such as competence, initiative, and integrity are considered. Technical appraisal evaluates infrastructure, technology selection, and licensing requirements. Management appraisal examines the management's impact on credit quality, including goals, strategies, and past performance. Financial appraisal analyzes financial statements and ratios to assess solvency and repayment capacity, with cautionary signs to watch for. Manipulation of financial statements and warning signals, such as declining profitability or fake transactions, should be carefully evaluated.

- Market Appraisal

Natrajan R (2023) further talks about market appraisal, and he explains that it assesses the reasonableness of demand projections based on surveys, industry associations, and market infrastructure. Economic appraisal involves evaluating costs, benefits, risks, and funding to achieve value for money and inform decision-making. Environmental appraisal considers the potential adverse effects of projects on the environment and includes remedial measures. The working capital assessment can be done through methods such as the turnover method, first and second methods of lending, and the cash budget system. Competent management is crucial for project success, and different committees in the Indian system, such as the Tandon and Nayak Committees, have made recommendations to regulate bank credit and working capital finance. With liberalisation and reforms, banks now have more flexibility in assessing credit requirements while considering the principles outlined in previous committee reports.

- Turnover Method

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In his book Nayak Committee, Natrajan R (2023) further explains Turnover and lending methods, which recommends the Turnover Method, where the working capital limit is 20% of projected annual turnover, with 5% of turnover as margin money. Actual sales data, growth projections, and industry trends are essential for appraisal.

- First Method of Lending

Tandon committee norms for inventory and receivables, Chore Committee's lending methods. Banks can develop their norms, but many still follow the Tandon committee's approach.

- Second Method of Lending

Similar to the first method, but margin calculation differs. Final approved limits are within the cap set by these methods.

- Third Method of Lending

Introduces Working Capital Term Loan concept, but not widely accepted.

- Bank Guarantees

Dr. Avasthi (2010) further talks about Bank Guarantees.

Bank guarantees can be categorised into three types: Financial Guarantees (FG) are given instead of monetary obligations, such as earnest money deposits. Performance Guarantees (PG) ensure the performance of a contract or commitment and compensate for any loss incurred.

5.18 Deferred Payment Guarantees

(DPG) arise in purchasing machinery or capital equipment, where an advance is paid, and the remaining balance is guaranteed. Continuing Guarantees cover repeated transactions. Banks' guarantees include bid bonds, customs duty, advance payment, shipping, performance, and retention money guarantees. These guarantees serve different purposes and provide security in various financial transactions.

Factoring involves receiving advances against accounts receivables from a factor, with recourse or non-recourse options. The factor deducts a margin and charges interest on the advance, paying the remaining amount to the borrower. Forfaiting is a specialized form of factoring used in export transactions on a non-recourse basis. Exporters sell medium and long-term receivables at a discount to a forfeiture. Legally enforceable payment obligations evidence forfeiting and provide 100% finance of the contract value, protecting exporters from the risk of importer insolvency. The forfeiter collects future payments from the importer. While similar, factoring and forfeiting differ in nature, concept, and scope.

- Non-finance lending involves a Letter of credit.

As per Vakilsearch (2023), A Letter of Credit (LC) is a payment guarantee provided by banks and non-bank financial companies to facilitate international trade. It assures exporters of payment and protects importers by ensuring that payment is only made upon the presentation of specified documents. Different LCs include credit on sight, time credit, standby LC, revocable credit, irrevocable credit, and transferable credit.

LCs are essential in international trade due to the distance, legal differences, and lack of personal contact. They provide a reliable payment mechanism and are governed by international standards such as the Uniform Customs and Practice for Documentary Credits.

The process of using an LC involves the purchaser and vendor concluding a business transaction, the buyer requesting an LC from their bank, the issuance and verification of the credit by the buyer's bank, shipment of goods by the seller, submission of necessary documents by the seller, review of documents by the advising or confirming bank, payment processing, and the issuing bank debiting the buyer's account and sending the documents to the buyer.

Moreover, as per. Vakilsearch (2023), the benefits of using an LC for purchasers include payment assurance to sellers, protection in case of delivery delays or failure, and the possibility of obtaining a refund if the order is not fulfilled on time.

Letters of Credit are crucial in facilitating secure and reliable international trade transactions.

- Credit Rating:

Natrajan R (2023) discusses three areas related to rating for lending purposes: Credit Rating, Credit Scoring, and Borrower Rating.

Credit rating evaluates the creditworthiness of a debt issuer, such as a corporation or government, and assesses the likelihood of default.

Credit rating agencies determine credit ratings based on qualitative and quantitative information.

Credit ratings are not based on mathematical formulas but rely on the judgment and experience of the agencies.

Investors use them to determine the risk of investing in bonds or other debt securities.

Sovereign credit ratings assess the investing environment of a country, considering political and economic risk.

- Credit Scoring

Moreover, Natrajan R (2023) states that Credit scoring involves using statistical analysis of credit files to assess an individual's creditworthiness.

Lenders use credit scores to evaluate the lending risk to consumers and mitigate bad debt losses.

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Credit scores are primarily based on credit report information obtained from credit bureaus. They help lenders decide on loan approvals, interest rates, credit limits, and revenue potential. Credit scoring models can be static or dynamic, with dynamic models continually assessing and updating parameters and weights.

- Factors Influencing Credit Score:

Additionally, Natrajan R (2023) Several factors influence credit scores, including the amount owing on accounts, the number of accounts with balances, credit line utilisation, and the proportion of instalment loan amounts still owing

- Pros and Cons of Credit Scoring:

Credit scoring models provide unbiased and efficient appraisal processes, handle large volumes of proposals, and quicken decision-making.

However, flaws in the underlying algorithm or the model's inability to consider material impacts and disclosures can affect their efficacy. Mass defaults can mislead learning-system-driven models and may overextend the past into the future. Overall, credit ratings and scores significantly assess creditworthiness and aid lending decisions for corporations, governments, and individuals.

Another essential read is Navi.com (2023), which describes the critical corporate banking process called treasury management, explains the importance of a treasury management system in businesses, and highlights its functions and benefits.

A treasury management system helps maintain and optimize the financial health of a business. It identifies redundant expenditures and prevents financial fraud through security measures.

By managing financial needs and activities, it allows companies to focus on core responsibilities

2.83 Functions of Treasury Management:

Moreover, Navi.com (2023) defines the functions of Treasury management as follows.

- Cash Management: Provides real-time visibility into cash position and forecasts future cash needs.

- Risk Management: Monitors and manages risks associated with financial activities, such as foreign exchange and interest rates.

- Financial Reporting: Generates financial reports for tracking performance and making informed decisions.

- Compliance: Ensures regulatory requirements are met and implements internal controls and policies.

- Transaction Management: Supports processing of financial transactions and automates reconciliation and tracking.

- Debt Management: Tracks and manages debt obligations, including repayment schedules and interest payments.

- Types of Treasury Management Services: They consist of the following things.

- Account Reconciliation: Compares internal financial records with external statements.

Automation: Integrates routine tasks like payments and collections.

- Risk Assessment/Mitigation: Protects against fraud and losses and improves risk tolerance.

- Global Treasury Services: Facilitates monetary transactions involving foreign currencies.

- Account Sweep Services: Improves cash balances through investment sweeps.

- Consulting Services: Streamlines services and optimizes treasury procedures.

- Payroll Services: Automates payment-related activities, including payroll deposits.

- Merchant Services: Improves convenience and ease of business.

- Automated Clearing House: Furthermore, Navi.com (2023) defines automated same-day money transfers.

- ACH Fraud Detection: Detects fraudulent activities in ACH transactions.

- Wire Transfers: Facilitates large payment transfers.

Remote Deposit Capture: Scans and verifies deposits, reducing manual tasks.

- Benefits of Treasury Management are mentioned below.

- Improved Efficiency: Streamlines financial processes, saving time and reducing errors.

- Enhanced Cash Visibility: Provides real-time cash position information for effective management.

- Improved Risk Management: Monitors and manages risks associated with financial activities.

- Enhanced Compliance: Helps meet regulatory requirements and maintain financial reporting standards.

- Greater Control: Provides more significant control over financial resources for informed decision-making.

- Time Savings: Additionally, Navi.com (2023) Streamlines financial activities, saving time.

Treasury management is crucial for safeguarding financial interests, optimising cash flow, and promoting financial health in businesses. It involves risk mitigation, fraud detection, financial reporting, and automation of economic activities. Effective treasury management requires understanding the organisation's financial position and adapting to economic changes, enabling continuous business growth.

Stewart J. (2008) research delves into the widespread use of tax havens in contemporary economics, mainly focusing on treasury management subsidiaries. These entities, crucial in moving funds within global firms, often operate in tax havens or countries with similar fiscal features. The paper highlights how two recent European Court of Justice cases related to such firms in Ireland have validated these operations' legal and tax advantages. Analysing the financial activities and traits of 46 Irish-based treasury management companies from 1998 to 2005 shows that while financial transactions are substantial, they fluctuate significantly over time. These companies are notably profitable but typically have no employees. The paper concludes that despite legal support for low-tax regimes and treasury management operations within the EU, opposition from various EU and non-EU nations is growing, citing conflicts with anti-tax avoidance laws.

Arnaboldi M et al. (2004) studied Managing a public sector project: the case of the Italian Treasury. This study focuses on a case study at the Italian Ministry of Treasury, where process reengineering methods from existing literature were applied. The research explores various critical factors and strategies instrumental throughout the project, providing insights into their impact and relevance during reengineering. The findings are relevant in understanding the dynamics of implementing NPM ideas in public sector organisations.

2.84 Risk Management

Natrajan R (2023) discusses risk and risk management in the banking industry, primarily based on Basel I and II accords. It explains that banks face various risks, including credit, market, interest rate, liquidity, and operational risks. The risks can be inherent to the business or due to management or mismanagement.

The text further explores the nature of risk and regulation in banking. It distinguishes between a bank and a financial services company, highlighting that banking regulation is a subset of overall financial services regulation. Risk is defined as the chance of a bad outcome, and risk events and risk losses are described. Banks are subject to higher regulation due to the systemic risk they pose to the economy. The failure of a bank can have significant repercussions, leading

to a "run on a bank" and impacting the entire economy. Therefore, banks must meet minimum capital and liquidity requirements set by regulators.

The need for bank regulation is explained by the risk inherent in the system and the potential impact of bank failures on the economy. The text mentions that bank failures and runs were relatively frequent before regulation. Regulations were put in place to ensure banks are well-capitalized, reasonably liquid, and able to meet depositors' demands. The capitalization and liquidity required for banks became more refined over time, considering the risk profile of their lending activities.

Furthermore, Natrajan R (2023) states that the appropriate level of capital for a bank depends on its risk. Banks with riskier lending practices must hold more capital to cover potential losses. The text emphasizes that calculating the appropriate capital level for a bank involves considering the amount of risk it carries.

Overall, the text provides an overview of risk and regulation in the banking industry, highlighting the importance of managing risks and maintaining adequate capital and liquidity levels to ensure the stability of banks and the broader economy.

Fatemi A. et al (2002) This study formulates a model to evaluate the costs and benefits of corporate risk management choices, concluding that these strategies should aim to boost shareholder value. While management may prefer to hedge against all cash flow variations systematically, this approach doesn't always align with maximizing firm and shareholder value. Empirical evidence suggests the primary driver for risk management is to prevent financial distress. Nonetheless, there are associated costs that need to be weighed. Consequently, shareholders need to have a clear understanding of the risk management procedures employed by the firm.

2.90 Wealth Banking

- Wealth Banking Overview

Hawley (2021) discusses the nuances of private banking and wealth management, highlighting their appeal to high-net-worth individuals but emphasising their distinct offerings. Wealth management takes a comprehensive approach, customising financial strategies based on individual risk tolerance and goals and encompassing various economic aspects. Private banking, however, focuses on offering personalised services to wealthy clients through dedicated professionals, including investment advice, asset protection, and wealth transfer.

Private banking stands out for its personalised attention, often involving preferential treatment and direct access to account managers. It generates significant income for banks and attracts

affluent clients. In contrast, wealth management, offered by large institutions and independent advisors, primarily revolves around strategic investment advice and portfolio management. The critical difference lies in the scope of services: private banking includes a broader spectrum of financial guidance without necessarily conducting investment activities, while wealth management aims explicitly to enhance financial status through strategic investment planning and execution. The choice between the two hinges on the client's needs, whether they seek comprehensive banking solutions or a focus on managing investments.

Driga I et al. (2010) explore the expanding realm of private banking, primarily driven by a rise in wealthy individuals over recent years. Private banking extends beyond basic banking services like deposits and loans, focusing on personalised service from dedicated relationship managers or private bankers for affluent clients. As global financial markets open up, private banking clients gain access to a wider range of products, enhancing their portfolio's efficiency and diversification for optimal returns. Services offered in private banking include asset protection and growth, tailor-made financing options, retirement planning, and wealth transfer strategies for future generations.

As per Delta Wealth Advisors (2022), Wealth management is an advisory service designed to guide high-net-worth individuals or high earners who are not yet wealthy, often known as HENRYs (High Earners, Not Rich Yet), in managing their wealth. With the assistance of a financial advisor, these individuals can make informed decisions about investments, retirement savings, and other financial matters to achieve their short and long-term financial objectives. The fundamental aim of wealth management is to preserve and safeguard the wealth of high-net-worth individuals and grow it. Financial advisors at firms such as Delta Wealth Advisors can assist with various types of wealth management.

2.92 Types of Wealth Banking.

There are five key types of wealth management:

1. Financial planning,
2. Asset allocation,
3. Asset management,
4. Estate planning and
5. Tax accounting.

- Financial Planning

Delta Wealth Advisors (2022) further states that Financial planning is a type of wealth management that provides advice on financial decisions based on one's financial situation to

achieve both short-term and long-term financial objectives. It involves helping you with budgeting, investing, retirement savings, tax planning, and more.

- Asset allocation

Asset allocation focuses on developing an investment strategy tailored to your financial objectives and willingness to take on financial risk. The main idea is to balance risk and reward, adjusting the investment percentages accordingly.

- Asset management

Furthermore, Delta Wealth Advisors (2022) defines asset management, as the name implies, as the active management of your financial assets. Asset managers help you attain your financial goals by purchasing stocks, bonds, and funds and monitoring them on your behalf. It differs from asset allocation, which focuses on higher-risk, higher-reward investments.

- Estate Planning

Estate planning is another crucial component of wealth management, which involves creating a plan to manage your estate in the event of incapacitation or death.

- Tax accounting
- Tax accounting, a key aspect of wealth management, focuses on preparing tax returns and finding ways to minimize tax liabilities, especially for those with complex investment portfolios. Delta Wealth Advisors (2022) highlights that high-net-worth individuals often face intricate asset management challenges. Utilizing a financial advisor's expertise can simplify wealth management, allowing more time for personal interests and relationships.
- The primary benefit of engaging wealth management services is to reduce the stress associated with financial decision-making. Particularly in uncertain times, ensuring that you and your family's lifestyle remains secure is essential. A financial advisor acts as a skilled partner, guiding you through unforeseen challenges and preparing for future needs.
- Moreover, financial advisors provide insights on investment strategies that could lead to better returns, sparing you the task of extensive market research. Choosing the right financial advisor can greatly alleviate the burden of wealth management, ensuring a well-thought-out financial plan for the future.
- Strategies for Wealth Banking

- Navi.com (2023) describes wealth management as a multifaceted approach, particularly for individuals with significant wealth. It involves several strategic steps:
- Risk Analysis: Wealth managers assess a client's risk tolerance. This is based on a comprehensive evaluation of various factors, including investment objectives, personality, and financial responsibilities.
- Asset Allocation: The next step involves crafting a personalised asset allocation strategy to balance risk and reward, aiming to optimise returns in line with the client's risk profile.
- Investment Product Selection: Wealth managers, especially in areas like India, collaborate with major banks to access various investment options. They also explore specialised investment opportunities tailored to each client's unique needs.
- Research and Execution: The strategy includes ongoing investment performance monitoring, providing clients with detailed reports on their portfolio's effectiveness. This continuous oversight is vital in the fluctuating investment landscape.
- Overall, these wealth management strategies aim to maximise returns while managing risks and providing customised solutions to clients.
- Wealth Management Benefits

Furthermore, Navi.com (2023) states that wealth management, especially in rapidly growing economies such as India, offers many benefits that contribute to a growing demand for these services.

Firstly, wealth management provides a systematic financial plan. The advisor assists clients in achieving a strategic economic plan, guiding them toward wealth creation over the long term. This strategic guidance helps individuals formulate a systematic financial plan, encouraging disciplined and informed financial habits.

Secondly, wealth management services are instrumental in alleviating financial stress. Wealth managers use their knowledge and expertise to help clients navigate financial uncertainties. They assist in making critical decisions during challenging times, ensuring that individuals can manage their financial decisions even amid fluctuating market conditions. This expert guidance can lead to reduced stress and improved financial decision-making.

Lastly, wealth management services offer a flexible investment strategy. Wealth managers continuously devise and adapt investment strategies for their client's benefit. This flexible financial approach suits each client's financial needs and requirements. By simultaneously considering market conditions and categories, wealth managers can navigate market volatility,

making better investment decisions. This flexibility is critical to managing investments effectively, enabling clients to capitalise on opportunities and mitigate potential risks.

In conclusion, wealth management is an intricate and comprehensive process that requires expert knowledge and a keen understanding of a client's financial status and goals. By employing a suite of strategies and monitoring market conditions vigilantly, wealth managers can help high-net-worth individuals navigate the economic landscape, reduce stress, and make informed decisions that foster long-term wealth creation.

Cybo-Ottone A. et al. (2000) study explores the market impact of mergers and acquisitions (M&A) within the European banking sector, focusing on significant deals from 1988 to 1997. The findings reveal that these transactions result in considerable positive market responses, particularly for mergers between domestic banks and banks diversifying into the insurance sector. However, mergers involving securities firms or international partners don't typically elicit the same positive market reaction.

The study notes a marked contrast with the outcomes of similar activities in the US banking sector. This difference is attributed to the distinct market structures and regulatory environments in European Union (EU) banking, which share more similarities than the US banking system. The study's conclusions highlight the unique dynamics of the European banking market in response to large-scale M&A activities.

2.91 Disruption in Wealth Banking –

. In Deloitte's 2015 report on wealth management, several disruptive trends were identified that are shaping the industry:

- The Re-wired Investor: Modern investors, including Generation X, Y, and influenced baby boomers, demand personalised financial advice tailored to their unique goals and preferences. They actively research and desire transparent, easily understandable advice.
- Technology's Role in Financial Advice: The rise of 'robo advisors' shows how technology is changing the landscape, appealing to self-reliant investors and potentially expanding the market. However, human advice remains relevant for more complex financial needs.
- Analytics and Big Data: The wealth management industry is moving towards more predictive analytics, blending various data types to create detailed customer profiles. This allows for better client targeting and personalised advice.
- Advanced Analytics Impact: Improved analytics will influence key wealth management processes, enhancing business performance management, customer onboarding, retention, sales strategies, and supervisory practices.

- Goal-Based Advice: Shift from investment-focused advice to holistic, goal-oriented financial planning. Wealth management now encompasses broader life goals rather than solely focusing on market benchmarks.

- Democratization of Investment Solutions: The market sees a trend towards making sophisticated investment options accessible to all investors, not just the ultra-wealthy, leading to innovative startups offering new investment solutions.

- Catching the Retirement Wave: As people live longer and face rising healthcare costs, there's a growing need for comprehensive retirement planning. Wealth management needs to adapt to provide solutions for all stages of a client's life, not just accumulation.

- Ageing Advisors and Wealth Transfer: As financial advisors age, there's a need to train new generations who understand modern investors' needs. The impending transfer of wealth from baby boomers to younger generations also presents challenges and opportunities for wealth management firms.

- Transformed Investment Environment: Post-financial crisis, low-interest rates, low inflation, and high market volatility demand new investment strategies and enhanced risk management from wealth managers.

- Cost of Risk and Regulation: Increasing regulations and operational risks, especially related to consumer protection and cybersecurity, require wealth management firms to adapt and invest in compliance infrastructure.

- These trends point to a wealth management landscape in transition, where adapting to changing client needs, technological advancements, regulatory demands, and demographic shifts is crucial for firms to stay competitive and relevant.

2.10 Investment Banking

The (Exafin.net) 2023 report sheds light on the significant role of investment banking in the global financial landscape. It focuses on financial advisory, capital raising, and mergers and acquisitions (M&A), primarily serving corporations, institutions, and governments.

Investment bankers provide expert advice on market trends, economic analysis, and corporate finance strategies. They are crucial in underwriting securities, assessing issuer viability, and ensuring thriving capital raises for companies' growth and strategic objectives. Mergers and acquisitions are another crucial area, with bankers assisting in target identification, financial evaluation, due diligence, and negotiations.

Investment banks also offer services in equity and debt capital markets, leveraged finance, restructuring, and risk management. These banks help companies issue stocks or bonds,

manage significant debts, restructure in financial distress, and mitigate various risks. The sector is influenced by factors such as technological advancements, regulatory changes, globalisation, and market dynamics.

Technology is growing, with digital platforms and AI shaping investment banks' operations. The post-financial crisis era has brought stringent regulatory changes, demanding enhanced compliance and stability in the banking system. Investment banking, thus, remains a crucial, multifaceted industry, pivotal for efficient capital allocation and economic growth.

As Kagan (2023) notes, investment banks are central to significant financial transactions like corporate mergers and IPOs. They act as intermediaries for large-scale financial projects and provide specialised services to facilitate these operations. The sector, once separated from commercial banking by the Glass-Steagall Act until 1999, often includes combined operations. Investment banks underwrite securities, facilitate large-scale mergers, and offer expert advice on complex financial projects. They balance maximising company gains with complying with regulatory standards and managing risks associated with large financial transactions. Investment banks' functions have expanded over time, playing a critical role in the dynamic financial sector.

Huang R. et al. (2008) state that investment banks cultivate networks of investors through recurring interactions, leveraging these networks to facilitate their clients' needs. The research indicates that investment banks, particularly those with extensive investor networks, play a crucial role in helping companies issue shares to attract a broader investor base. Consequently, businesses seeking a larger pool of investors often prefer employing investment banks over managing share placements independently. Additionally, it's observed that companies are willing to pay higher fees to secure the services of investment banks that boast larger investor networks. The findings underscore the significant impact of investment banks' networking capabilities in securities offerings, highlighting their importance in connecting issuers with potential investors.

2.101 Investment Banking Divisions

- Gratz (2020) provides a comprehensive overview of the key divisions within investment banking, emphasizing their specialised roles and collective contributions to the industry. Investment banking encompasses various business units, each with distinct functions and expertise.

- The Corporate Finance division forms the core, focusing on strategic advisory services for corporations, governments, and institutions. This division specialises in mergers and

acquisitions, divestitures, capital structure optimisation, and financial strategies, offering guidance from inception to deal completion.

- The Capital Markets division, comprising Equity Capital Markets (ECM) and Debt Capital Markets (DCM), plays a vital role in issuing and trading securities. ECM handles equity security issuances, while DCM deals with debt instruments like bonds, guiding clients through financing strategies and market access.

- The Sales and Trading division connects with institutional investors, providing investment advice and executing trades across various financial products. This unit balances client relationship management with active market participation.

- The Research division offers insights and analyses on companies, industries, and economic trends, aiding investors in informed decision-making. Their research supports a range of investment activities and client needs.

- Risk Management is crucial for monitoring and mitigating risks associated with the bank's operations, ensuring financial stability and regulatory compliance. This division implements risk strategies and models to safeguard the bank's interests.

- The Operations division underpins the smooth execution of transactions, managing trade settlements, compliance, and system maintenance. This unit ensures accuracy and efficiency in all operational aspects of investment banking.

- The Technology and Innovation division has grown significantly, focusing on employing technological advancements for better efficiency, data management, and innovative financial solutions.

- Each division of an investment bank operates synergistically to provide comprehensive services, from financial advice to efficient execution. Their coordinated efforts ensure that investment banks can meet their clients' diverse and complex needs, playing a pivotal role in the global economy.

2.102 Investment Banking and Commercial Banking – A Comparative View

As per Gratz (2020), Investment and commercial banking are two distinct topics.

In the diverse banking landscape, two prominent sectors, namely investment banking and commercial banking, often capture the spotlight. They both hold essential positions in the financial ecosystem but differ significantly in terms of operational focus, client base, and the services they provide. Recognizing investment and commercial banking differences is vital for individuals seeking financial services or mulling over a banking career. This article will scrutinize these sectors and pinpoint their fundamental contrasts.

Investment banking primarily delivers financial services to entities such as corporations, governments, institutions, and affluent individuals. This sector involves capital raising, financial advisory, mergers and acquisitions, underwriting, and securities trading. Investment banks function as intermediaries, connecting entities seeking capital and investors hunting for lucrative investment opportunities.

Furthermore, as per Gratz (2020), a key role in investment banking is financial advisory, where investment bankers offer strategic advice on mergers and acquisitions, optimize capital structure, and formulate corporate finance strategies. Their expertise facilitates valuation, negotiation, due diligence, and deal structuring processes to enhance value and realise the client's strategic objectives. Investment bankers scrutinize market trends, industry dynamics, and financial data to provide informed recommendations, thereby assisting in executing complex transactions.

Capital raising is another crucial facet of investment banking. Investment banks enable companies and governments to amass funds by underwriting the issuance of securities, such as stocks or bonds. By leveraging their extensive connections and proficiency in securities markets, investment banks ensure the successful allotment of securities with investors. They gauge market conditions, determine pricing, structure offerings, and market the securities to potential investors.

Additionally, Gratz (2020) states that investment banks also partake in trading activities, buying and selling financial instruments, like stocks, bonds, derivatives, and commodities, on behalf of clients or for their proprietary trading desks. They utilize their market knowledge, research capabilities, and trading expertise to generate profits through proprietary trading and market-making activities.

Conversely, commercial banking mainly delivers financial services to individuals, small and medium-sized enterprises (SMEs), and corporations. This sector's role includes accepting deposits, providing loans, offering transactional services, and managing customer relationships. Commercial banks act as safe custodians for depositors' money and offer indispensable financial services that support the daily operations of businesses and individuals.

Furthermore, Gratz (2020) states that a primary function of commercial banks is accepting deposits. They offer a secure place for individuals and businesses to deposit their funds, presenting various account options like checking accounts, savings accounts, and certificates of deposit. Commercial banks pay interest on deposits and grant depositors convenient access to their funds via checks, debit cards, and electronic banking services. Commercial banks also extend lending services, providing individual loans and credit facilities. Additionally, they

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cater to corporations, institutions, governments, and affluent individuals on one hand and a wider customer base, including individuals, small businesses, and large corporations, on the other.

Regarding focus, investment banking focuses on capital markets, financial advisory, and facilitating complex financial transactions. Meanwhile, commercial banking directs its attention towards deposit-taking, lending, and providing essential banking services to individuals and businesses. Additionally, Gratz (2020) states that the services offered by investment banks encompass a wide range, including financial advisory, capital raising, underwriting, and trading of securities. In contrast, commercial banks extend deposit-taking, lending, transactional services, and cash management. Investment banks typically have a leaner organizational structure with fewer hierarchical levels, reflecting the need for swift decision-making and flexibility. Due to their size and focus on retail banking operations, commercial banks might have a more hierarchical structure.

Career prospects, investment, and commercial banking opportunities differ based on their operational nature and client focus. Investment banking offers roles in financial advisory, capital markets, sales and trading, research, risk management, and technology. These positions demand strong analytical skills, financial acumen, and the capacity to work in fast-paced, dynamic environments. Commercial banking provides career opportunities in retail banking, corporate banking, credit analysis, relationship management, operations, and risk management. These roles require customer-oriented skills, credit analysis abilities, and a comprehensive understanding of financial products and services.

2.103 Investment Banking Trends and Outlook

As per Gratz (2020), Investment banking adapts continually, responding to shifting market circumstances, regulations, and tech progress. Looking forward, we can identify significant influences that are defining the field. They include:

- Technological Innovations

The financial sector is seeing a digital revolution, making processes more effective, improving customer experience and, thus, promoting competition. Technologies like AI, machine learning, fintech and automation are pivotal in this transformation.

- Stronger Regulatory Adherence

With stringent laws for investor protection and financial stability, banks must stay compliant with evolving frameworks. This framework necessitates solid compliance systems and skilled personnel.

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- Sustainable Investments :

Increasing environmental, social, and governance (ESG) concerns are shifting the industry towards more sustainable financial products. Banks are incorporating ESG factors into their offerings to fulfil evolving investor needs.

- Evolving Customer Expectations

Client demands are transforming due to technological progress, demographic changes, and shifting market circumstances. Banks must ensure personalized, data-driven insights and solutions to maintain their client base.

- Global Transactions and Developing Markets

Emerging economies and cross-border dealings are pivotal for the industry's growth. Countries like China and India present ample expansion opportunities.

- Consistent M&A Activity

Despite industry fluctuations, mergers and acquisitions remain significant, with firms seeking strategic partnerships and access to novel technologies.

- Diversity and Talent Management

Emphasis is being placed on fostering diverse, inclusive workspaces and nurturing talent for driving innovation and informed decision-making.

- Geopolitical and Economic Instabilities

Global events and economic uncertainties continually influence the sector, affecting deal activity and investor sentiment. Overall, the investment banking sector's future appears positive, bolstered by tech advancements, emerging market potential, and a continuous upward trend.

2.104 Outlook of Investment Banking:

As per Gratz (2020), The future of investment banking appears promising, fueled by tech evolution, untapped markets, and rising demand for financial amenities. Despite encountering hurdles like regulatory adherence and geopolitical volatility, firms excelling in digital evolution, sustainable finance, and customer needs adaptation are likely to prosper. Critical strategic investments in tech, human resources, and creativity are essential for successfully navigating this changing panorama and delivering value in our swiftly shifting world. Major transitions occur within investment banking, demanding flexibility, resilience, and inventiveness. Crucial factors shaping its future will be the acceptance of the digital revolution,

sustainable finance incorporation, adaptation to evolving customer needs, and successful negotiation of geopolitical volatility. Staying updated with industry movements, harnessing technology, and prioritising customer-focused strategies enable investment banks to capitalise on opportunities, thereby thriving in a more intricate and globally interlinked financial environment.

Courchane M. et al. (2002) study explores the decision-making process for banks investing in Internet banking (IB) technologies, focusing on the significance of bank size and the unpredictability of investment profitability. It suggests that larger banks are more inclined to adopt IB services earlier than smaller ones, mainly for strategic benefits, acting as pioneers in the market. The study also points out that large and small banks are more likely to invest early when there's less uncertainty and more clarity about potential customer demand. The hypotheses were tested using data from 1,618 commercial banks in the Federal Reserve's tenth district in 1999. The results indicate that a bank's relative size and demographic data, which could predict future demand, significantly affect the likelihood of adopting IB services.

Mamatzakis B. et al. (2014) research delves into the elements influencing the performance of investment banks in the G7 countries and Switzerland, with a particular emphasis on risk, liquidity, and investment banking fees. Utilizing Stochastic Frontier Analysis (SFA) for panel analysis, it was found that these factors play a significant role in determining performance. The study also incorporates the financial crisis period, employing dynamic panel threshold analysis to examine regime shifts. The findings reveal varying regimes, especially during the economic crisis. A significant observation is the positive impact of the Z-Score on banks with low default risk and a similarly positive influence of the fee-income ratio on banks with lower fee levels. Conversely, liquidity demonstrated a negative effect on bank performance. An interesting pattern emerged, showing banks moving between the two risk-related regimes before the onset of the financial crisis. The study's results support the notion that recent regulatory changes concerning capital adequacy and liquidity are beneficial and could improve bank performance.

Jain B.A. et al. (1999) study explores two critical yet under-researched areas in financial economics concerning the initial public offering (IPO) market: the existence of a need for monitoring by lead banks and the impact of such monitoring on the post-issue performance of IPOs. The research supports the need for lead underwriter monitoring in the IPO arena. It investigates factors that might motivate lead underwriters to engage in post-issue tracking, focusing on the lead investment bank's reputation and the issuance of warrants to the underwriter by the issuing firm. The findings indicate a positive relationship between the reputation of the lead bank and the post-issue performance of IPO firms. Additionally, the study

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assesses the role of independent analysts in monitoring, finding that a higher number of independent analysts tracking an IPO correlates positively with its post-issue performance. These findings suggest the effectiveness of lead bank and third-party monitoring in the market for new issues.

Dunbar C.G. (2000) investigates the influence of various elements on the market share of investment banks serving as book managers in initial public offerings (IPOs) from 1984 to 1995. For well-established banks, several factors are crucial in affecting their market share: the first-day returns of IPOs, the one-year abnormal performance, the extent of compensation beyond norms, their expertise in specific industries, the standing of their analysts, and their involvement in IPOs that were later withdrawn. These aspects are particularly influential in IPO markets characterized by lower transaction volumes. Conversely, these factors have a comparatively reduced impact on newer and less established banks, both statistically and practically. This aligns with the idea that these banks have less reputation at stake, and hence, changes in market share are less strongly tied to these factors.

2.105 Investment Banking Regulation and Compliance

As Gratz (2020) outlined, investment banking operates under stringent global regulations like the Basel Accords, the U.S. Dodd-Frank Act, and the EU's MiFID II. These frameworks enforce capital adequacy, risk management, market transparency, and investor protection. Key components also include anti-money laundering (AML) and Know-your-customer (KYC) practices and data protection laws like the EU's GDPR. Investment banks, therefore, must maintain robust compliance departments to navigate these diverse regulatory landscapes effectively.

Geddes A. et al. (2018) studied the multiple roles of state investment banks in low-carbon energy finance: An analysis of Australia, the UK and Germany. As per this study, the rapid deployment of low-carbon energy technologies is critical for climate change mitigation, but there's a notable gap in funding. Through 52 interviews, this paper explores how State Investment Banks (SIBs) are pivotal in bridging this financial void and attracting private investments. It focuses on three SIBs: the Clean Energy Finance Corporation in Australia, Kreditanstalt fuer Wieder Aufbau in Germany, and the Green Investment Bank in the UK, examining their activities and financial tools compared to the funding needs of low-carbon developers. The study reveals that SIBs do more than provide capital and mitigate risks. They play a broader role in fostering private investment in low-carbon projects by facilitating

financial sector learning, building trust in projects, and often being the first to invest, helping projects establish a proven track record.

2.11 Indian Banking System

As Singh (2023) described, India's banking system features a mix of public, private, and foreign banks with significant state ownership. The sector has grown substantially, benefiting from initiatives like the Public Credit Registry and digitalization trends. The Reserve Bank of India regulates this diverse landscape, which includes Development Financial Institutions and NBFCs. Despite challenges, the sector has expanded considerably, showcasing its pivotal role in India's economy.

2.111 Types of Banks

As per Testbook (2023), The Indian banking system is diverse, consisting of:

- Primary Regulatory Authority

    The Reserve Bank of India (RBI) oversees the nation's banking operations, controls monetary policy, ensures financial health, manages currency production, handles foreign currency reserves, and offers governmental banking solutions.

- Common Financial Institutions

    State-Controlled Banks: Owned primarily by the government, they aim to provide inclusive financial services to all citizens.

- Privately Held Banks

    Either older banks, pre-dating market liberalisation or newer, or post-liberalization establishments owned by individuals or corporations.

    International Banks: Institutions based abroad but operational in India, complying with local banking rules.

- Membership Based Institutions

Collaborative Banks: Member-owned, addressing specific shared interests, further categorized into city-centric or countryside-focused entities.

- Rural - Focused Banks

Joint ventures between central and state governments and state-owned banks target rural financial needs.

- Sector Specific Banks

For instance, NABARD focuses on agriculture, while SIDBI targets minor to medium businesses.

- Payment Banks

New-age institutions emphasise financial accessibility, offering basic banking, remittances, and electronic payments with a deposit cap of Rs. 2 lakhs.

2.112 Services from the Indian Banking System

Testbook (2023) further narrates the services India's banking sector provides a plethora of services:

- Saving Instruments

Multiple deposit options include standard savings, business accounts, time-bound deposits, cyclic deposits, and tax-beneficial savings schemes.

- Borrowing Options

Diverse lending choices include mortgages, vehicle finance, personal borrowing, educational financing, and commercial loans.

- Electronic Payment Checks

Credit: Bank-issued cards for buying now, paying later, often with perks or cash-back features.

- Debit

Direct fund access cards linked to personal or business accounts for withdrawals and payments.

- Digital Transactions

Convenient online and mobile banking tools enable tasks like fund transfers, bill settlements, and others, including RTGS and NEFT.

- Investment Avenues

Options such as mutual funds, insurance policies, and time-bound deposits aid in wealth accumulation and long-term planning.

- Cross-Border Finance

Services include currency conversion and money transfers for both individuals and businesses internationally. Global Business Services: Facilities like credit letters, bank assurances, and global trade funds assist firms in international business activities.

2.113 Indian Banking System -High-level Analogy

According to IBEF (2022), the Indian banking sector, a mix of public, private, and foreign banks and regional rural banks, is a substantial part of the nation's financial system. It boasts over 217,000 ATMs, with many in rural and semi-urban areas. The sector's assets reached $2.67 trillion in 2022, reflecting significant growth. Initiatives like the Public Credit Registry and 'Pradhan Mantri Jan Dhan Yojana' are enhancing financial inclusion and information systems, with the latter opening over 45.60 crore accounts. The microfinance sector has seen a 10% increase. The banking system's unique mix of socialist and capitalist policies results from national development plans and a focus on domestic priorities. This diverse framework contributes to the sector's distinctive strengths and challenges in India.

Deoalkar (1998) discusses the Indian banking sector's evolution and structure, emphasizing the government's predominant control and the impact of liberalization in the 1990s. The sector includes public, private, foreign, and cooperative banks, development financial institutions (DFIs), non-banking financial companies (NBFCs), and capital market intermediaries. Public sector banks, such as the State Bank of India and nationalized banks, play a significant role, while cooperative banks cater to specific demographics. The Reserve Bank of India oversees all banking operations, imposing strict regulations. Following economic liberalization, there was a focus on increasing efficiency and consolidating banks. DFIs and NBFCs have also been essential in supporting long-term investments and diverse financial activities. The complex and extensive nature of India's banking system, characterized by a mix of socialistic and capitalistic policies, reflects its unique socio-economic landscape.

Tzeremes N. G. (2015) studied the efficiency of the Indian banking sector from 2004 to 2012, utilizing recent advancements in conditional and unconditional directional distance methods by Daraio and Simar (2014). In the study, a conditional directional distance estimator examines the dynamic impacts on the industry's performance. Findings reveal that foreign banks outshine national and domestic private banks in performance. A notable technological advancement is observed before the Global Financial Crisis, but this progress seems to wane during and after the crisis. National banks struggle to maintain the high performance achieved post-restructuring of the industry. The research also underscores the influence of ownership structure on the technical efficiency of banks.

Dr. Shukla S. (2014) states that Banks and financial institutions engage in financial intermediation, allocating available funds to viable investment prospects. They generate liabilities and assets in their business, influenced by market conditions and regulatory

standards. A balanced portfolio of liabilities and assets is crucial for these institutions to thrive and grow.

Source -   Market Size in India - Growth in Deposits IBEF(2022)

Growth in Deposits (US$ billion)

FY	US$ billion
FY16	1,149.19
FY17	1,180.19
FY18	1,347.18
FY19	1,400.03
FY20	1,936.29
FY21	2,060.31
FY22*	2,101.93
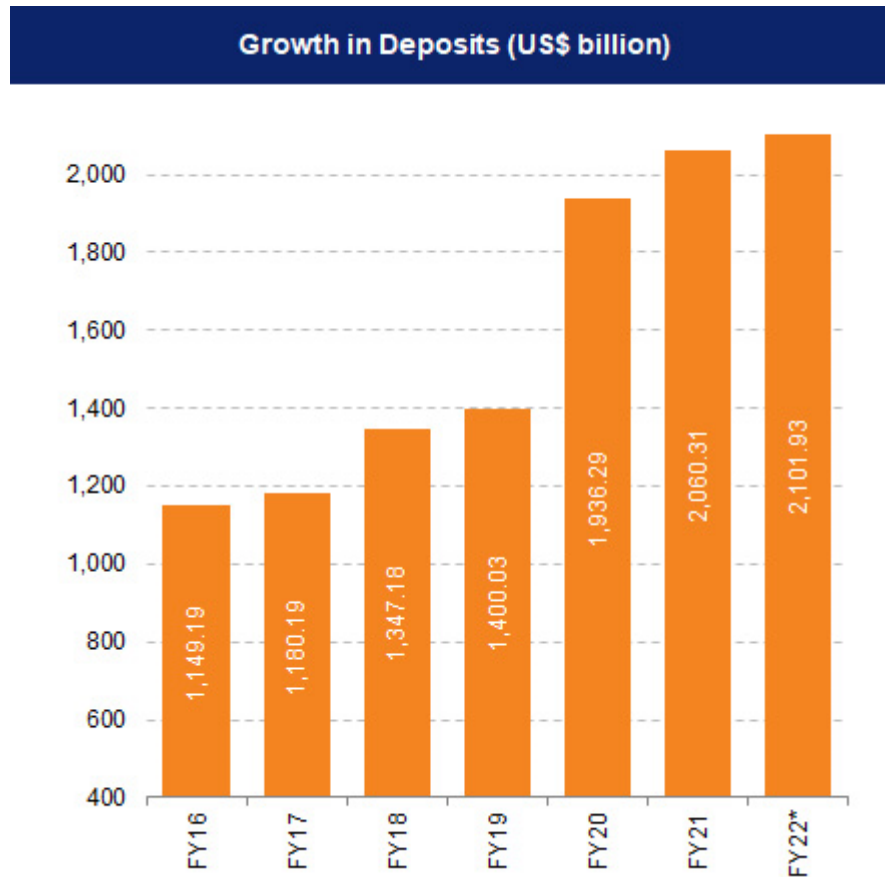
Figure 4 Market Size in India - Growth in Deposits IBEF(2022)

External economic and non-economic factors beyond a single institution's control often affect the financial landscape. This paper examines the performance of the Indian banking system during the global economic crisis, comparing it with selected international markets. Additionally, the study explores how banks and financial institutions must adapt their business and operational strategies during economic downturns, turning challenging economic situations into potential business opportunities.

Fatma M. et al. (2016) research focuses on how Corporate Social Responsibility (CSR) activities in Indian retail banking influence customer buying decisions. It also examines how customer awareness affects the relationship between CSR and purchase intentions. The findings indicate that having a socially responsible image can positively impact customers' willingness to purchase. The study reveals that while corporate ability significantly impacts

purchase intentions, CSR activities influence customer decisions, mainly when customers know these activities. This paper adds to the CSR discourse by exploring the real-market impact of CSR on consumer behaviour, something not extensively covered in prior research. It emphasizes the importance of CSR awareness among consumers and its potential to shape their purchasing choices.

Kaur S. et al. (2015) state that the Indian banking sector, traditionally dominated by government control, underwent liberalization in the early 1990s. This shift introduced competitive dynamics and tighter regulations, emphasizing the need for banks to enhance their productivity to thrive and grow. This study evaluates the Indian banking sector's performance, focusing on productive efficiency from 2009 to 2013, using Data Envelopment Analysis (DEA), a non-parametric frontier methodology. The study assigns efficiency scores to various bank groups by assessing inputs and outputs in monetary terms. It finds that the State Bank of India (SBI) and its associated banks lead in efficiency, closely followed by private and nationalized banks. The findings indicate consistent trends across the studied period, although the gap in efficiency between different bank groups narrows over time.

Goyal J. et al. (2019) studied the Efficiency and technology gaps in the Indian banking sector: Application of meta-frontier directional distance function DEA approach. As per this study, the Indian government's objective to elevate Indian banks to globally competitive standards has spotlighted efficiency as a crucial factor for success amidst intense competition and evolving business environments. This study evaluates the efficiency of the Indian banking sector in 2015-16, focusing on different ownership types: public, private, and foreign. Using a meta-frontier DEA approach with data from 66 banks, the study finds the sector's efficiency at 73.44%. It also uncovers varying production functions across these ownership categories. Foreign banks align most closely with the industry's efficiency benchmark, followed by private sector banks, while public sector banks lag. These findings underscore recommendations by the Reserve Bank of India and the Ministry of Finance for public sector bank consolidation, suggesting that such consolidation could lead to increased efficiency and industry improvement.

Sanyal P. et al. (2011) study delves into how ownership and competition have influenced the productivity of Indian banks since the economic reforms of 1991. It reveals that private banks in India outperform public and foreign banks in terms of productivity and growth, particularly the newer private banks. However, increased competition positively impacts older private banks' productivity while adversely affecting other banks, especially the newer private ones. Post-1998, the productivity gap between private and other bank types has widened

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significantly. In this later period, private banks, including those showing initial productivity advantages, experienced declining productivity and growth rates due to intensifying competition.

Saha A. et al. (2000) state that the Indian banking landscape is undergoing transformative changes due to the financial sector reforms initiated by the Government of India and the Reserve Bank of India since the early 1990s. In this evolving environment, where Public Sector Banks still hold a dominant position, efficiency is becoming increasingly crucial for success as the banking system enters a new era. Recognizing the growing importance of efficiency assessment for investors and regulators, this study proposes an empirical approach to evaluating bank efficiency. The study recommends the adoption of Data Envelopment Analysis (DEA) as an effective method for assessing the relative efficiency of banks in India

2.114 Issues in Indian Banking

. Deolalikar (1998) highlights critical issues in the Indian banking sector as of 1998. Public sector banks' Non-Performing Assets (NPAs) were significant, around Rs457 billion, with a central portion being hard to recover. Although the NPA percentage of total assets was low, the problem was more pronounced when compared to risk assets. Solutions to tackle NPAs vary globally. In India, alternatives like converting loans into equity are underused. Priority sector lending contributes notably to NPAs, with recovery challenges in sectors catering to weaker sections. Additionally, industrial sickness, often due to management issues, inadequate project appraisal, or external factors like resource scarcity and policy changes, was a concern. The RBI's focus on monitoring industrial rehabilitation and the growth of outstanding bank credit despite a reduction in sick units were notable trends.

As per Testbook (2013), the banking industry in India is confronted with multiple obstacles that affect its progress and reliability.

2.115 Challenges in the Indian Baking Industry

The fundamental difficulties are as follows.

- Bad Loans

A significant hurdle arises when debtors default on loan repayments, undermining bank earnings and cash flow.

- Digital Threats

Concerns about online threats and information compromises grow with greater reliance on digital platforms. Hence, the onus is on banks to fortify their digital defences and safeguard user data.

- Regulation Hurdle

The intricate web of rules governing the industry in India necessitates diligent adherence, often demanding substantial effort and time.

- Emerging Competitors

Traditional banking practices face threats from modern entities like digital-only banks and financial technology firms offering cutting-edge solutions.

- Broadened Outreach

Even with advancements, a substantial portion of India's populace, predominantly in remote regions, remains without essential bank facilities.

- Talent Crunch

Recruiting and maintaining a competent team remains challenging, with many institutions grappling to onboard skilled individuals.

2.12 European Banking Overview

Goddard et al. (2007) explore the evolution of European banking in response to globalization, technological advances, deregulation, and European unification. Their study highlights:

- Structural changes within the banking sector are marked by a significant decrease in bank numbers and a surge in total banking assets, particularly in the largest EU15 countries.
- Challenges and impacts of European unification on the financial system's stability.
- Strategic adaptations by banks include product diversification, market expansion, and mergers.
- Increased competition within the industry and the emergence of relationship banking.
- The influence of ownership and technology on cost structures, efficiency, and profitability.
- The role of the credit channel in monetary policy and the transmission of interest rates.
- The complex shifts in European banking include increased activities of non-banking entities and the blurring lines between banks and financial intermediaries.
- The degree of integration in the European banking market and its ongoing challenges, especially in retail banking.

- The potential impact of banking integration on systemic stability and cyclical lending behaviours, can exacerbate economic fluctuations.

This comprehensive analysis reveals significant shifts in European banking, driven by integration efforts, legislative changes, and market liberalization, which have fundamentally altered the industry landscape.

- Banking Integrations in the EU

Goddard et al. (2007) discuss the complexities of banking integration in Europe, highlighting regulatory and supervisory challenges due to the rise of pan-European banks. The debate centres on whether international banks should be regulated by their home or host countries, with potential conflicts of interest and adherence to varying standards being key issues. There's a suggestion of moving towards a unified regulatory framework or a consolidated supervisor, but this seems unlikely shortly.

Their study also examines the varied impacts of bank consolidation in Europe. Stock market reactions suggest a preference for targeted mergers over broad consolidations. Domestic mergers initially receive positive responses, driven by expected cost reductions and market control but often fail to improve bank efficiency or performance significantly. Conversely, international mergers typically receive negative market responses, though those involving banks with aligned objectives show more promising outcomes.

The paper notes a research gap in comparing investor expectations with actual post-merger performance, suggesting a need for more comprehensive studies to determine the most effective consolidation strategies and understand the effects of both national and international mergers on financial system stability

2.121 Competition in European Banking

In the evolving European banking landscape, many top banks have adapted to competitive changes by expanding their operations, either organically or through mergers and acquisitions. This expansion strategy enables them to reduce costs, achieve economies of scale, and address operational inefficiencies. As traditional interest margins yield lower profits, banks are increasingly focusing on alternative sources of income, such as fee-based services. This shift has led to a significant rise in non-interest income.

Despite efforts to extend operations beyond domestic markets, the preference for subsidiaries over branches reflects ongoing challenges in achieving complete market integration. Legislative efforts like the 2001 European Company Statute are aimed at removing such barriers.

The sector's deregulation and integration might lead to changes in market size and focus, impacting the growth of firms. This expansion could result in either a fragmented or concentrated industry, with academic views diverging on the relationship between bank size, market dominance, and performance. The debate continues over the influence of collusion versus efficiency in banking.

The effect of market concentration on financial stability is also debated. While some argue that concentration promotes safer financial practices, others believe it could encourage riskier lending. Modern competition analyses in banking focus on observed behaviours over static models, with studies showing banking markets as neither entirely competitive nor monopolistic. This ambiguity suggests the need for more research into competitive health indicators. Additionally, understanding profit dynamics over time, rather than solely focusing on current market equilibrium, is crucial, as studies reveal consistent profitability among banks in the US and Europe across years, challenging traditional competition models.

2.122 Relationship in the EU

In the banking sector, "relationship banking" is a key area of focus, where banks maintain consistent interactions with the same customers over time. This approach offers advantages like reduced customer switching due to various tangible and intangible costs associated with changing banks. Longer relationships also enable banks to gather more customer information, although this can sometimes lead to exploitation risks during contract renewals.

Competition among banks affects their inclination towards relationship lending or transaction-based approaches. Increased competition might drive banks towards relationship lending to better assess borrowers amid fewer loan applications. However, intense competition could also tempt banks to extend their market reach, prioritizing transactional lending over client quality. This dynamic changes when considering competition from other financial entities like investment banks, which might influence the prevalence of relationship lending.

Empirical studies offer further insights. In Germany, for example, small and medium enterprises (SMEs) with long-term relationships with a single bank enjoy benefits like lower costs and collateral requirements. Conversely, SMEs engaged with multiple banks may not reap the same benefits. Additionally, the duration of a bank relationship can impact its sustainability due to increasing complexities. In Belgium, the loan rates for SMEs appear to be influenced by their geographical proximity to banks, underscoring the significance of location in banking relationships.

2.123 Efficiency and Ownership

Research into the cost structure and efficiency in banking reveals that operational efficiency is key to cost savings, more so than capitalizing on economies of scale. Studies indicate that operational inefficiencies could lead to a cost difference of up to 30% between average and best-practice banks. The efficiency varies across banking types and countries, influenced by factors like universal banking systems, market power, and technological advances.

Earlier studies suggested smaller banks could reduce costs through economies of scale, while larger banks had less to gain. However, recent findings indicate that larger banks also benefit from scaling up. Market power seems to negatively affect operational efficiency, and the intensity of competition impacts efficiency differently across various types of banks in Europe.

Technological advancements have significantly reduced banking costs and reshaped customer access, leading to innovations like ATMs and Internet banking. These advancements are crucial in reducing costs, with some studies finding an annual cost reduction rate exceeding 3% in European banks.

Altunbaş et al. (2001)'s study using advanced methods shows that scale economies are present in smaller banks and those within a certain asset range, with potential cost savings from reducing managerial inefficiencies. Moreover, technological progress has been beneficial, especially for larger banks, aiding in consistent cost reductions.

2.124 The monetary transmission mechanism and interest rate pass-through

Banking research has closely scrutinized cost structures and efficiency, with earlier studies like Berger and Humphrey's (1997) investigating how banks could minimize costs through optimal sizing and operational improvements. Efficiency in banking is twofold: maximizing the utility of existing resources and choosing the most cost-effective inputs. Various methodologies, including data envelopment analysis, help determine banks' cost functions. Historical analyses showed that while smaller European banks could save costs through economies of scale, this wasn't as applicable to larger banks. More recent studies, however, indicate that larger banks also benefit from scaling up. Yet, operational inefficiencies present a more significant cost-saving potential than mere scaling, with a notable cost disparity of up to 30% between average and best-performing banks.

Operational inefficiency causes vary across different banking systems, with those in unified banking environments tending to be more efficient. Efficiency also varies based on the type

of banking—specialized, universal, or conglomerates—each with distinct operational dynamics.

Efficiency discussions have expanded to include profit-centric performance, underscoring the significance of operational efficiency for shareholders. The influence of market power on efficiency is contested; strong market power might hinder operational efficiency. The impact of competition also varies, influencing efficiency levels differently across the diverse European banking landscape, which encompasses public, private, cooperative, and mutual banks.

Technological advancements have significantly impacted the banking sector, leading to innovations in customer service and backend operations. Studies have shown that technological progress has been a primary driver in reducing banking costs annually by more than 3%.

Interest rate changes and their influence on banking activities, such as lending, are another area of focus. Banks show varying sensitivities to interest rate shifts, especially smaller or less liquid ones. The rate of interest rate adjustments following official changes is often slow and inconsistent, particularly in retail banking, pointing to the need for further exploration into the implications of these adjustments for consumers.

2.125 Outlook for European Banking

Vanya Damyanova (2023) provides the outlook for 2023, which is as follows.

- Banking Sector Stability

European banks are generally prepared to face complex economic and market conditions. They stand apart due to their diverse investment strategies and funding methods, especially compared to some US banks that have recently faced issues. Credit Suisse was an exception among large European banks, but the chance of its problems affecting the wider industry remains minimal despite market apprehensions. The overall perspective on European banks is somewhat upbeat, with fewer banks receiving a "negative" forecast than in previous quarters.

- Impact of Market Upheavals:

The crises faced by US banks and the merger between Credit Suisse and UBS, facilitated by the state, have raised concerns about the solidity and fluidity of the banking sector. Institutions likely to be most influenced by these changes in market perceptions include niche banks, private institutions, those with surplus funds, investment banking entities, and those currently facing challenges. Potential outcomes might be an increase in the release of secured obligations and a postponement in the release of specific securities, which were contentious during the

Credit Suisse-UBS merger. Minimal Danger from Bond Losses: Potential bond losses aren't seen as a widespread threat to European banks because of their robust financial standing. As of September 2022, the industry's capital ratios stood firm at 15%.

- Loan Concerns:

In terms of their lending practices, European banks face the highest potential for loan quality degradation in areas like unsecured consumer lending, small business lending, and commercial property loans. Rising living expenses might hamper the ability of individual consumers to service their debts, while reduced consumer demand could hit small business loans. Financing for commercial properties is also seeing challenges.

- Potential Challenges for 2023

For the current year, European banks must be wary of risks like rising interest rates, extended economic downturns, consistent high inflation, and more market disruptions. Even with the banking industry's robustness, significant changes in financial policies might strain many entities, mainly if there are unanticipated rises in costs related to deposits and funding. Elevated interest rates could destabilise the broader financial arena by impacting borrowing and liquidity in non-traditional banking sectors. A drawn-out recession degrades loan quality from a wider economic perspective, while sustained high inflation could lead to more extraordinary operational expenses.

Uhde A. et al. (2010) study explores the impact of credit risk securitization on European banks' systematic risk between 1997 and 2007. Using data from 592 securitizations by 54 banks across EU-15 and Switzerland, it's discovered that securitization notably increases banks' systematic risk. This finding persists even when compared to similar non-securitizing banks. Further analysis reveals that the rise in risk is more significant in larger, repeat securitizes. However, securitization plays a more vital role in smaller and medium-sized institutions. Initially, banks were more likely to retain a significant portion of credit risk to signal quality. Lastly, the study notes a more pronounced risk-shifting effect in securitizations when initial systematic risk levels are low.

Williams J. (2004) research analyses the management practices of European savings banks from 1990 to 1998, using a methodology similar to Berger and DeYoung's 1997 study on US banks. The study explores the dynamic connections among loan loss provisions, efficiency, and capitalization in these banks, effectively testing the applicability of the US findings to the European context. It identifies prevalent management behaviours, such as poor management, bad luck, skimping, and moral hazard. The findings indicate that bad management is the

primary concern for European banks, diverging from the US patterns. Notably, European banks show no tendency towards skimping behaviour. Additionally, the results vary based on the number of time lags considered in the analysis, highlighting a distinct management style in European banks compared to their US counterparts.

Cipollini A. et al. (2012) analyze various factors affecting bank financial distress, focusing on a diverse set of 308 European commercial banks from 1996 to 2009. We explore elements at different levels - bank-specific (like liquidity and credit risks, bank size, income diversification, and market dominance), industry-wide (banking concentration), and macroeconomic (like real GDP growth). We identify financial distress in banks by observing those falling below a certain level in the empirical distribution of the Shareholder Value Ratio. To analyse this data, we utilize a panel probit regression model. We address the issue of residual autocorrelation, common with overlapping data, by applying the Bertschek and Lechner (1998) method for a more robust covariance matrix estimation. Our findings indicate that a bank's credit risk, liquidity risk, and market power significantly influence its Shareholder Value Ratio, especially in distressed situations. Additionally, we assess the predictive accuracy of our model during the 2008–2009 financial crisis period.

Casu B. et al. (2010) study assesses the impact of European Union deregulation policies on banking sector efficiency and performance through financial integration and convergence. It utilizes data envelopment analysis (DEA) to investigate bank cost efficiency dynamics. Applying dynamic panel data models, specifically the Generalized Method of Moments (GMM), the study examines the concepts of β-convergence and σ-convergence, which measure the rate of banking market integration. Additionally, a partial adjustment model assesses the movement towards best practice efficiency. The results indicate a convergence trend in efficiency levels towards a European Union average. However, there is no clear indication of an overall enhancement in efficiency levels that would align with the best practice standards.

Tunay B K. (2015) et al. research examines how Internet banking influences bank performance in Europe, using data from 30 European countries from 2005-2013. The study employs the Demitrescu-Hurlin panel causality test, utilizing ROA (Return on Assets) and ROE (Return on Equity) as performance indicators. The analysis includes the entire sample comprising Euro Area countries and other European nations and evaluates two sub-samples separately. The findings reveal a significant correlation between Internet banking and bank performance in the Euro Area. However, this causation is not notably substantial for the non-Euro Area European countries. The relationship between internet banking and bank performance remains significant when considering the entire sample.

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Andrieş A. M. et al. (2012) study examines the impact of European integration on the cost efficiency of EU27 banking markets from 2003 to 2009. The findings show evidence of both beta and sigma convergence throughout this period, with more significant convergence during the crisis years (2008-2009) compared to the pre-crisis years (2003-2007). This variation is attributed to a "catching up" process before the crisis and a "lagging " process during the crisis. The results indicate that European integration positively influenced cost efficiency and efficiency convergence before the crisis, but this effect was less pronounced during the crisis. The crisis impacted EU banking systems differently, with variations in how cost efficiency was affected in older versus newer member countries.

Maudos J. (2004) research investigates the interest margins in major European banking sectors, namely Germany, France, the UK, Italy, and Spain, from 1993 to 2000. Utilizing a substantial dataset of 15,888 observations, the study identifies key factors influencing these margins. Building on the foundational work of Ho and Saunders (1981), the study incorporates a novel approach by explicitly considering banks' operating costs. Additionally, it employs a direct measure of market competition, the Lerner index, which is not commonly used in similar literature. The findings reveal that the decrease in interest margins across the European banking system aligns with a reduction in competitive pressure, characterized by increased market power and concentration. However, this trend has been offset by the simultaneous reduction in interest rate risk, credit risk, and operating costs.

Sturm P. (2013) study investigates how the stock market responds to the announcement of operational losses in European financial institutions, emphasizing the impact of these losses on a company's reputation. The research analyses 136 operational losses reported by the Association of German Public Sector Banks (VÖB) involving European financial institutions with reported losses between January 2000 and December 2009. Consistent with existing studies, the findings indicate a significant negative impact on stock prices following the initial press release of operational losses. This trend continues by confirming the losses and disclosing the loss amounts. Despite considering the actual loss amounts, the negative cumulative abnormal returns post the initial announcement and settlement dates signal reputational damage to the firms experiencing operational losses. The study's multivariate regression analysis reveals that reputational damage is more closely tied to specific firm characteristics than to the particulars of the operational loss event. Notably, companies with a higher liabilities-to-total-assets ratio face more substantial reputational harm from operational losses than those with a greater equity base

2.126 European Banks After COVID-19

Institut Montaigne's 2021 report critically analyzes the current state and future direction of European banking in the aftermath of COVID-19. The report reveals that despite being financially more stable after the financial crises, European banks still face challenges in profitability and maintaining market value. These banks are unable to compete effectively with leading American banks and new tech-savvy competitors, mainly due to a lack of investor support. The report stresses that these issues are not just confined to the banking sector but also impact Europe's broader economic and political spheres.

The report highlights that, even though European banks are healthier post-2008 crisis regarding financial stability, they still fall behind their American counterparts in profitability, with a consistent 3-5% lower return on equity. This lag in performance is attributed to factors such as slow economic growth, negative interest rates, and limited market integration. European banks are facing a divided market with lesser financial agility than American banks and are also contending with rapidly evolving competitive landscapes marked by the rise of digital banks and financial technology firms. The strategic significance of the banking sector is emphasized in the context of Europe's economic stability and environmental goals and as a crucial medium for government assistance.

The report proposes significant reforms for banks and regulatory bodies to ensure the ongoing health and dynamism of Europe's financial systems. Banks are encouraged to overhaul their operational structures, emphasize customer-focused and high-value services, and form strategic alliances with fintech companies. A progressive strategy supporting stability, profitability, and global banking activities is advocated on the regulatory front. This includes revising the guidelines for handling banking crises, streamlining cross-border banking, and pushing for European adjustments to the Basel III reforms to enhance the competitive stance of European banks globally.

2.13 Machine Learning Impact on Banking

Emerson S. et al. (2019) studied Machine learning in quantitative finance. The study delves into how machine learning (ML), a subset of artificial intelligence (AI) employing statistical methods, has found diverse applications in the financial sector. It enhances operations like detecting fraud and streamlining payments. Specifically, the paper explores ML's role in investment processes such as predicting market returns, structuring investment portfolios, and gauging financial risks. AI's commercial journey began with "expert systems," which originated in the 1960s at Stanford and gained prominence in subsequent decades. These

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systems, created with programming languages like LISP and Prolog, were devised to tackle intricate problems in specialized domains. However, modern AI-driven solutions have largely overshadowed these rule-based programs.

The study of Emerson S. et al. (2019) also touches upon "cognitive computing," systems designed to emulate human cognition, including abilities like memory and learning. IBM's Watson is highlighted as a prominent example of such a system, initially known for its performance on the quiz show "Jeopardy!" Cognitive computing blends traditional computer science with statistical and ML methods to create solutions like Watson, which offer "augmented human intelligence. "Recently, there has been a surge in the adoption of ML techniques in financial applications. Examples include analysing market sentiment from news, identifying market trends, and optimizing investment portfolios. The paper aims to offer a comprehensive review, focusing on how ML can potentially benefit quantitative investments. It examines the technologies involved, their functionalities, and their capability to enhance investment results, offering valuable insights for scholars and industry professionals alike.

The study of Enerson S. et al. (2019) indicates that machine learning (ML) is revolutionizing the depth and complexity of financial analysis. Emerging literature confirms that investment analysts focusing on quantitative methods are keen to adopt these evolving tools. ML techniques like Multilayer Perceptron's (MLPs), Support Vector Machines (SVMs), and Long Short-Term Memory Networks (LSTMs) are prevalent for tasks such as predicting market returns, crafting investment portfolios, and assessing financial risks.

Furthermore, Emerson S. et al. (2019) also discuss advanced methods. These advanced methods are applied to traditional financial data and new forms of alternative information. As large datasets become increasingly available, ML proves to be highly effective in handling the complexity of this new data and detecting intricate patterns within it.

Recent trends also show a spike in hedge funds recruiting science, technology, engineering, and mathematics (STEM) graduates for portfolio management roles. These candidates bring the essential skills needed for in-depth analysis and computational modelling. Proficiency in ML, programming languages like Python and R, and familiarity with platforms such as TensorFlow are becoming valuable assets for anyone seeking a competitive advantage in quantitative investment.

Additionally, Matthew F.D. et al. (2019) discuss various ways machine learning can be used in finance. Machine learning (ML) advancement in the financial sector has been proportional to its theoretical and computational growth. While hedge funds like Bridgewater Associates and Renaissance Technologies have been early adopters of ML technologies,

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opinions vary on its effectiveness for quantitative trading. Bridgewater Associates, for example, invested in an artificial intelligence unit, pulling in expertise from IBM Watson's deep learning team. However, the industry remains cautious regarding the extent to which ML can revolutionize trading. Although still a developing field, ML's adoption in finance is one of the earliest and most vibrant industries. Finance offers all the ingredients that make ML effective: abundant data, computational power, and a highly competitive environment. However, the field is also facing increased scrutiny, especially regarding "black-box" approaches that are not easily explainable.

Furthermore, Matthew F.D. et al. (2019) talk about the impact of the 2007-08 crisis. Since the 2007-2008 financial crisis, there has been a move towards data-driven regulation, especially in stress-testing programs in banking in the U.S. and Europe. Moreover, "alternative data," such as social media metrics, are becoming increasingly important. Trading firms are hiring ML experts capable of applying Natural Language Processing (NLP) to financial news and reports, with data providers offering tailored sentiment data for trading models. ML models can analyze complicated, multi-dimensional data, continually adapt to new information, and help mitigate the risks of relying on a single predictive model. However, the adoption of ML in finance has its challenges, primarily due to human factors and the unique nature of the financial sector. While other disciplines may encourage open innovation, finance tends to be more secretive.

Matthew F.D. et al. (2019) analysis proposes an introductory look at ML's role in finance, pinpointing some of the reasoning flaws that have led to failures in ML applications. It will then propose a structured approach to experimental design to address these issues. It also breaks down ML in finance into three categories:

- Unsupervised ML focuses on data segmentation and dimension reduction, similar to principal component analysis. It has been used in portfolio selection via K-means clustering.
- Supervised ML is about understanding relationships between variables, generalizing from methods like ordinary least squares (OLS) regression. It's effective if the model's decisions don't affect the input data.
- Reinforcement Learning, a form of stochastic control, learns policies based on decisions that alter input states. Despite its high potential impact, its complexity makes it the least utilized in finance.

The paper argues that while the field is technologically advanced, human factors and sector-specific challenges often hinder the successful implementation of ML in finance.

Matthew F.D. et al. (2019) talk in detail about each type. Two primary types of machine learning are supervised and unsupervised learning. In supervised learning, algorithms are trained on labelled data and aim to make predictions based on this training. This approach is often "offline," meaning it doesn't adapt to new data once the model is trained. However, some advanced models like LSTM and GRU can dynamically adapt over time due to hidden state variables. In contrast, unsupervised learning works on unlabeled data to find patterns and relationships within the data set.

Reinforcement learning, another machine learning, stands apart from supervised and unsupervised learning. In reinforcement learning, an agent makes decisions based on specific inputs, but unlike supervised learning, no 'correct' answer is provided. Instead, agents receive rewards as feedback, encouraging specific behaviours without providing direct solutions. This answer is beneficial when decisions can affect future states and outcomes.

Matthew F.D. et al. (2019) explain that Supervised learning algorithms often extend or replace traditional statistical methods like ordinary least squares (OLS) and time-series regression. They excel in managing high-dimensional data and can generalize well to new, unseen data. On the other hand, reinforcement learning is most effective in situations that require optimizing a goal while considering that the decisions made will change the system's future state. In financial contexts, reinforcement learning can be applied to optimize trade execution algorithms, among other tasks.

Leo M. et al.(2019) study examines the increasing role of machine learning in business, particularly in bank risk management post-global financial crisis. The paper reviews existing literature to assess how machine learning techniques are being applied in managing banking risks like credit, market, operational, and liquidity risks. Despite considerable academic and industrial research in banking and risk management, the application of machine learning in these areas isn't as extensive as the current industry emphasis on risk management and machine learning would suggest. The review highlights a disparity between the potential applications of machine learning in banking risk management and its actual implementation. Many aspects of bank risk management could greatly benefit from more focused research on specific machine learning applications, suggesting a need for further exploration in this field.

Guerra P. et al.(2021) state that Machine learning (ML) significantly transforms data analysis, risk assessment and supervision in the banking sector. This comprehensive review examined

various ML applications in banking, drawing from multiple databases without restrictions on language, date, or journal. The final analysis included 41 papers and two book chapters, with over half from top-tier journals. The study focuses on popular ML techniques like k-nearest neighbours (KNN), support vector machines (SVM), tree-based models, ensemble methods, boosting techniques, and artificial neural networks (ANN). Key application areas include credit risk assessment, stress testing, and developing early warning systems for bankruptcy. However, the use of supervisory data in ML applications is limited, indicating a gap for future research. Despite this, the growing evidence suggests ML's potential to enhance decision-making and analysis in the banking industry.

Kaur J. (2020) states that the banking industry is grappling with the increasing issue of customer churning, also known as customer attrition, with around 1.5 million customers shifting banks annually. This trend is rising due to various factors, including superior financial services at competing banks, more convenient bank branch locations, and attractive interest rates. Banks employ predictive models to identify customers likely to churn to mitigate the challenge of retaining clients. Retaining long-term customers is more cost-effective than acquiring new ones, as loyal customers contribute to profits and generate new referrals. This paper focuses on utilizing various machine learning models, such as Logistic Regression (LR), Decision Tree (DT), K-Nearest Neighbor (KNN), and Random Forest (RF), to analyze banking datasets and predict customer churn probability. It also compares these models based on performance metrics like accuracy and recall.

- Deep Learning in Finance

Matthew F.D. et al. (2019) delve into the potential of deep learning in finance, a subset of machine learning involving complex neural networks, beneficial in areas like natural language processing. They caution against hastily adopting AI and deep learning in finance, suggesting these advanced methods are not always necessary and simpler models might suffice. The paper discusses specific architectures like convolutional neural networks for predicting financial time series data. However, they emphasize a balanced approach to integrating AI into financial modelling.

Ariwala P. (2023) discusses machine learning's expanding role in various financial institutions, beyond its initial hedge fund usage. ML now enhances processes across banks, fintech companies, regulatory bodies, and insurance agencies, aiding in risk assessment, portfolio management, and market research. Despite challenges in implementation, including data fragmentation and inflated cost estimates, ML's benefits in revenue enhancement, operational efficiency, and security are significant. Ariwala highlights ML's

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applications in cybersecurity, investment prediction, process automation, and transaction security, and anticipates future trends in financial services involving machine learning.

Joshi K (2022) explores machine learning's transformative impact on finance, handling tasks like asset management, risk evaluation, and fraud detection. He suggests partnering with experts for tailor-made algorithm development and highlights ML's advantages, including error reduction, speedier decisions, and cost-effectiveness. Machine learning is expected to automate financial processes fully by 2025, enhancing trading, customer service, and security. With the growing reliance on ML, job opportunities in this field are set to increase significantly

2.14 Big Data Impact on Banking

The surge of technology in recent times has made data an invaluable asset, especially in automated systems. This also holds true for the financial sector, where technological advancements have impacted everything from peer-to-peer lending to cryptocurrency. Big data, in particular, is transforming the industry in multiple ways, such as transparency, risk analysis, and customer satisfaction. Financial firms use vast data to make investment decisions, develop products, and analyze risks. While big data's role in finance is acknowledged, extensive research does not profoundly explore its influence across the financial industry. This study aims to fill that gap by examining the role of big data in areas like online banking, market operations, and financial management. It scrutinises existing theories and incorporates qualitative data to offer a more rounded view. It presents a new framework to understand how big data is reshaping the financial landscape, focusing on multiple aspects of the finance sector. This adds a fresh perspective to existing research, providing an integrated understanding of big data's role in finance, beneficial for both researchers and general readers.

Singh J. et al. (2022) state that in the evolving landscape of India's financial sector, where digital transactions are rapidly increasing, the challenge of bank fraud is also escalating. Banks are actively focusing on combating economic crimes, emphasising utilizing analytics and advanced technologies for effective fraud prevention. In this context, data has become more than just a technical asset; it's a critical component of the banking industry's digital evolution. Modern risk monitoring systems, grounded in data science and big data, enable effective surveillance and provide early warning signals for potential issues.

This study highlights the significant role of big data as a service and application in the Indian banking sector. It showcases how big data can aid in detecting security concerns and

fraudulent activities and preventing them early on. The research, conducted through a bibliometric analysis of Scopus and Web of Science databases and visualized using Vos Viewer software, identifies big data technology as a key strategy for the Indian banking system. The findings of this paper are aimed at enhancing the understanding of researchers in this field, focusing on the deployment of various big data technologies and techniques for managing financial risks and improving the operational workflow in banking.

Srivastava U. et al. (2015) studied big data analysis in the context of Indian banking. As per their study, the rise of big data in the 21st century has profoundly impacted the banking sector, especially given the extensive data banks have accumulated over decades. This data is now unlocking insights into monetary transactions, preventing significant incidents and thefts and deepening the understanding of consumer behaviour. Banks worldwide are increasingly leveraging this data to improve various aspects of their operations. These include analyzing customer sentiments, cross-selling products, managing regulatory compliance, addressing reputational risks, and combating financial crimes.

Indian banks are following global trends in utilizing big data but still have much room to grow. This paper examines how big data analytics is effectively employed in the banking sector, focusing on specific areas such as understanding customer spending patterns, tracking channel usage, segmenting and profiling customers, enhancing product cross-selling strategies, analyzing customer sentiments and feedback, and managing security and fraud. The research uses secondary data from a bank and conducts primary analysis, uncovering best practices used globally that Indian banks can adopt to improve their service offerings to customers.

Putra M.P's (2021) study focuses on incorporating elements of Industry 4.0 into the consumer loans banking sector, particularly in Europe and Germany. Industry 4.0 includes various advanced technologies, and the research investigates explicitly the application of big data analytics, the Internet of Things (IoT), and augmented reality in banking. The research relies on secondary data sourced from existing studies and academic literature.

Initially, the research outlines the necessity for integrating Industry 4.0 into the European consumer loans banking business, with a specific emphasis on Germany. It then delves into analysing how particular components of Industry 4.0 can be suitably incorporated into the consumer loans banking sector. The findings provide critical insights and recommendations for consumer loan banking stakeholders on effectively implementing Industry 4.0 technologies into their operations. This integration aims to enhance efficiency,

improve customer experiences, and stay competitive in the banking industry's rapidly evolving technological landscape.

Hung J.L. et al. (2019) studied and illustrated how a commercial bank in Asia effectively employed big data analytics to refine its business-to-business (B2B) operations, specifically enhancing supply chain finance and marketing strategies. The research involved a case study that examined two critical aspects of supply chain relationships: credit report analysis and e-wiring transactions among companies within the supply chain network.

The findings revealed that big data analytics significantly boosts the bank's marketing strategies and risk management capabilities. By utilizing these analytics, the bank was able to offer more tailored solutions to its B2B clients, maintain profitability, and create new business opportunities.

The case study is a valuable example for other B2B firms, demonstrating the potential benefits of integrating big data analytics into their business processes. This approach can help differentiate customer services and drive new value creation. The study also delves into both theoretical and practical implications, offering insights for businesses considering similar adaptations of big data analytics in their operations.

Pérez-Martín A. et al. (2018) studied Big Data techniques to measure credit banking risk in home equity loans. Their study highlights the necessity of Big Data techniques for handling and analysing massive financial datasets, particularly for risk group segmentation. The study incorporates Monte Carlo simulations with existing methods and algorithms to tackle the challenges of large datasets. A key innovation of the research is applying a linear mixed model (LMM), offering an incremental contribution to assessing credit risk for financial companies.

The research conducts computational experiments across various dataset sizes and types to ensure comprehensive coverage of different scenarios. Findings from these experiments underscore the importance of Big Data methods, which provide quicker and more accurate estimators, crucial for effective decision-making in the financial sector. These advanced techniques help minimize risks associated with credit assessments, potentially expanding access to credit loans. The study demonstrates that Big Data is essential for managing vast datasets and vital in enhancing financial companies' decision-making capabilities and risk management processes.

Hasan M.M. et al. (2020) conducted a comprehensive study to understand how big data interacts with the financial sector. Using databases like Scopus, Web of Science, and Google Scholar, they gathered 180 articles, eventually focusing on 86 for detailed review, with

34 directly relating to big data in finance. Their research underscores big data's crucial role in various financial aspects, such as market trends, banking risk assessment, online finance, and financial management. They discovered that financial institutions extensively use big data for customer insights, credit risk evaluation, and fraud detection while acknowledging challenges like data gaps and quality.

The study revealed that financial companies generate and analyze vast data daily from diverse sources like stock metrics and social media. This information is pivotal for market forecasting, risk analysis, and developing trading strategies. The researchers proposed a theoretical model to represent these applications.

- Key findings include:

- Big data significantly influences financial markets by shaping market behaviours, forecasting returns, assessing volatility, and enabling algorithmic trading. Social media data is particularly influential for sentiment analysis in markets.

- Larger firms gain notable benefits from big data due to their extensive data generation, which helps optimize corporate finance aspects, thus fostering growth.

- In Internet finance, big data is instrumental in risk assessment, credit risk prediction, and fraud detection, revolutionizing traditional financial services with more reliable and cost-effective solutions.

- This study highlights the transformative impact of big data across multiple dimensions of the financial sector.

- Big data is significantly transforming the financial services sector. It enhances operational efficiency in areas like risk management, financial analysis, and data management. However, managing the quality, speed, and sheer volume of data presents challenges.

- Key impacts include:

- Risk Management: Data analytics plays a crucial role in predicting and managing different types of risks, extending to fraud detection and regulatory compliance, which can be largely automated.

- Credit Risk Management: Big data is highly effective in assessing and managing credit risk. It allows banks to more accurately evaluate creditworthiness, expand loan access, and reduce default risks.

  According to Hasan M.M. et al. (2020), the Internet significantly influences investment markets and financial decisions. Online discussions and searches correlate with stock market movements and surges around corporate earnings announcements

Source – Systematic Framework of research structure by Hasan M, et al. (2020)
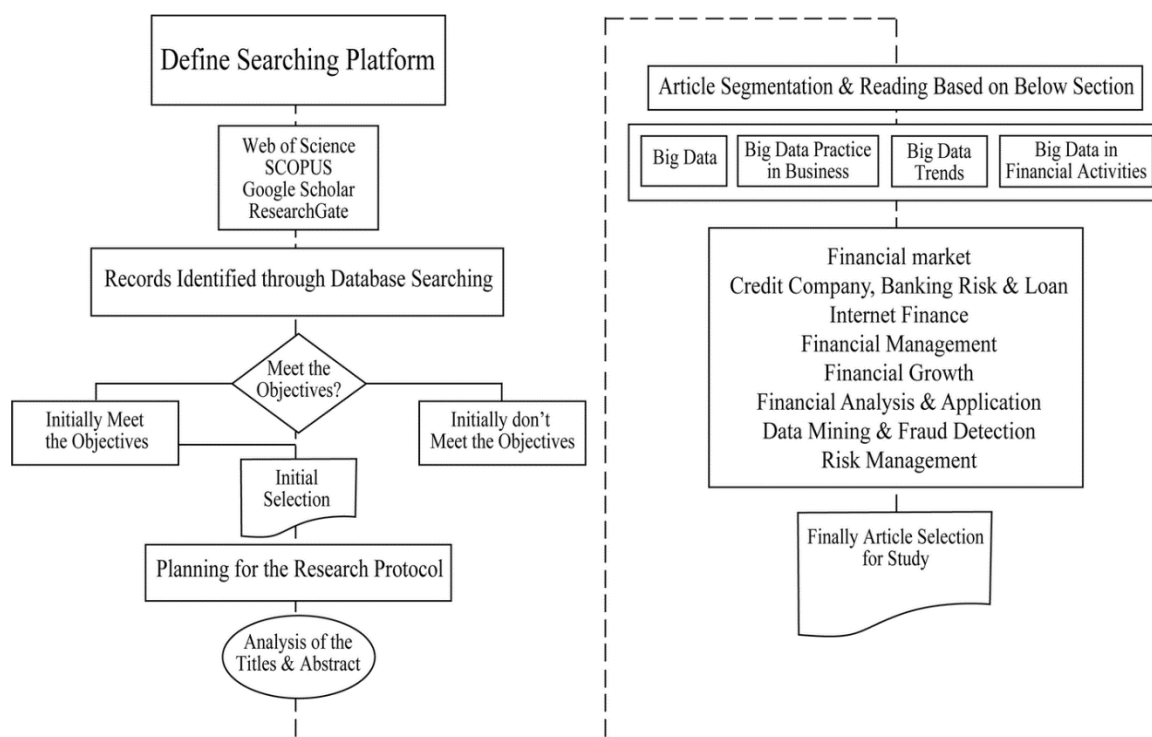
Figure 5 Big Data Framework

Source – Current Landscape and Influence of Big Data on Finance by Hasan M.M. Et al. (2020)

. Search query data can even predict market volatility, and microblogging sites impact stock activities.

Overall, advancements like big data, AI, and cloud computing are driving the finance sector towards a digital overhaul, improving market insights, fraud prevention, and risk analysis. This enhances revenue and customer satisfaction but raises concerns about data privacy, quality, and regulatory adherence. Future research in finance should address managing large data volumes, especially for smaller firms with limited data access, and explore big data's broader implications, including security aspects. Effective strategies for big data implementation in financial institutions also need exploration. As per Sun H. et.al. (2020), the rapid growth of big data technology is transforming various sectors, including finance. The study reveals that this technology is now essential for financial professionals, especially accountants, who need IT skills to navigate the modern business landscape.
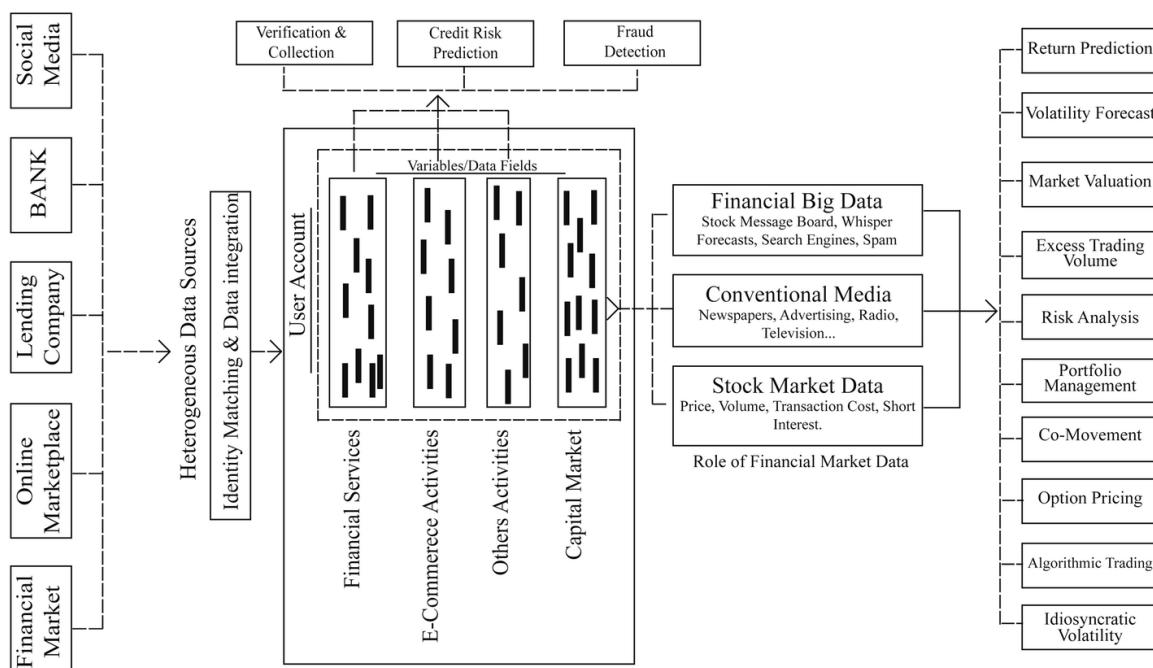
Figure 6 Big Data Impact on Finance

The research focuses on exploring the benefits and drawbacks of using big data in financial settings. The study uncovers how data analytics simplifies decision-making processes in finance. Daily financial transactions, counted in billions, generate massive data. This can be leveraged to analyze various financial products and services, offering valuable insights and posing risks, such as data security concerns.

Sun H. et al. (2020) highlight the diverse applications of big data in finance, such as fraud detection, assessing default rates, and evaluating credit ratings. The integration of data analytics with financial techniques enhances critical evaluations and fills research gaps in finance. The growth of information technology has broadened financial services, including online banking and investment, necessitating adherence to local regulations. Big data drives changes in traditional business practices, raising concerns about financial institutions' ability to adapt rapidly.

The research also points out that data from various sources, like social media, can be used to develop sophisticated risk management strategies. The growing reliance on electronic devices contributes to vast data generation, requiring effective management, particularly for sensitive information. Big data analytics plays a key role in guiding significant

business decisions and has increased public understanding of financial market operations, automated trading, risk analysis, and customer services in banking.

Sun H. et al. (2020) observe that while larger financial firms frequently use big data, smaller firms have been slower to adopt these technologies. The study, primarily qualitative, analyses literature and expert opinions to offer a comprehensive perspective on big data's impact on finance. Future research should explore this field more deeply, as current studies are limited and often focus only on certain aspects of financial services. The goal is to establish a foundational understanding of big data's role in finance, providing a basis for future academic and industry research.

2.15 Blockchain Impact on Finance

Verma J.R. (2019) explores how blockchain, a digital ledger technology, is becoming an increasingly viable alternative to traditional centralized financial systems. The 2007-2008 Global Financial Crisis and subsequent Eurozone Crisis, along with numerous cybersecurity incidents, have diminished trust in centralized financial entities like trade guarantors and global money transfer services. Blockchain's rise aligns with the growing appeal of decentralized frameworks due to their minimal trust requirements.

Cryptocurrencies like Bitcoin emerged as an alternative following the financial crisis. Despite their significant growth, broader financial sector applications are limited, primarily due to legal and commercial challenges rather than technological constraints. Blockchain has the potential to revolutionize various financial areas, but these issues must first be addressed. Mainstream financial institutions face the choice of regaining trust or risking obsolescence against blockchain-based systems.

Blockchain technology involves distributed ledger systems secured by cryptography. It groups transactions into 'blocks,' each cryptographically linked to its predecessor, ensuring that tampering with one block necessitates altering all subsequent blocks. Two main types of blockchain exist: 'permissionless' for public participation, like in cryptocurrencies, and 'permissioned' for known entities, more suitable for conventional finance. Notable blockchain platforms include Hyperledger Fabric and R3 Corda.

Blockchain's benefits include verifiable and shared transaction records, resilience to disruptions, robust defences against cyber threats, and the facilitation of smart contracts, potentially streamlining various stages of contractual agreements. Blockchain's decentralized nature contrasts with traditional systems' vulnerability to single points of failure, offering a solution for the future.

Dashkevich N. et al. (2020) studied the Blockchain Application for Central Banks: A Systematic Mapping Study. As per this study, Blockchain technology, increasingly of interest to central banks for its disruptive potential, is the subject of a research gap between industry practitioners and academics. This paper examines this gap by categorizing peer-reviewed research on blockchain use cases for central bank services and operations. It employs a systematic mapping study to analyze research maturity, focusing on blockchain adaptation for central bank use cases. The findings highlight the field's novelty, confirming industry leads in research depth and volume, outpacing academia. Key areas of focus include Central Bank Digital Currencies (CBDC), regulatory compliance, and Payment Clearing and Settlement Systems (PCS). However, less attention is given to asset transfer/ownership and audit trails. This study identifies critical areas for future research and collaboration between academics and practitioners.

2.12 Smart Contracts

Szabo N. (1997) introduced the concept of smart contracts over 20 years ago, during the internet's early days. These digital contracts function on public networks and go through various stages, like search and negotiation, to formalize secure agreements between parties. Although intelligent contracts can exist without blockchain technology, incorporating them into a blockchain enhances their trustworthiness. The blockchain serves as a jointly-owned virtual machine safeguarded by cryptography, where each participating computer verifies the actions of the others.

Traditionally, contracts were lengthy written documents using legal terminology. Nowadays, some financial agreements are so intricate that they're more effectively articulated through computer code. Regulatory agencies like the U.S. Securities and Exchange Commission have even proposed using code to clarify complex financial products for investors.

In today's financial world, many transactions, such as stock trading, are automated but still rely on a centralised authority for that automation. Smart contracts on blockchain can automate similar processes in markets where no central exchange exists, removing the need for a mediator and enhancing transactional efficiency.

Hillbom E. et al. (2016) thesis examines the integration of cryptocurrencies, like Bitcoin, with smart contracts, a concept proposed by Nick Szabo in 1997. Unlike traditional paper contracts, smart contracts are computer protocols that automate and enforce agreements between parties. Bitcoin, a decentralized cryptocurrency, functions on a blockchain without a central authority and includes a programming language that allows for more applications than just currency exchange.

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The thesis focuses on two types of contracts: the 'Double Deposit Escrow' (DDE) and 'smart property'. DDE facilitates secure transactions between untrusted parties by ensuring a double deposit escrow within the blockchain, minimizing financial risk. Smart property, on the other hand, enables physical property to be incorporated into contracts, allowing it to automatically engage in transactions.

The thesis uses current technology to develop a self-enforcing smart contract called the Smart-Property Ownership Exchange Protocol (SPOEP). Implemented in Python, it supports anonymous trading through Bitmessage and Near-Field Communication (NFC). The security and scalability of this protocol are analyzed and compared with similar projects like Ethereum and Colored Coins.

The study concludes that while there are various methods for creating smart contracts using cryptocurrencies, Bitcoin currently seems the most suitable for this purpose. However, the technology has flaws and requires further development for widespread application.

2.16 Legal and Commercial Challenges of Blockchain

Verma J.R. (2019) states that Potential applications of blockchain in finance are varied:

- Central banks issuing digital currencies: Proposals exist for banks to issue digital coins backed by central bank deposits, which would be redeemed daily to reduce risk.

- Private institutions issuing tokens: Challenges here include covering operational costs and generating revenue.

- Decentralized smart contracts: Systems like Dai Stablecoin use collateralized smart contracts to maintain value stability but face complexities with market evolution.

- Blockchain can also enhance micropayments, allowing tiny transactions with minimal fees. Through smart contracts, it may improve pre- and post-trade processes in securities trading, automate dividend distributions, and eliminate intermediaries. Additionally, blockchain allows for more customized investment strategies and efficient data management in financial systems, potentially addressing issues like data duplication and privacy concerns.

In trade finance, blockchain can unify data among various stakeholders, increasing efficiency and trust. It offers improved solutions for cross-border payments by reducing delays and fees. Though ICOs emerged as a fundraising method for blockchain projects, regulatory concerns have cast doubts on their sustainability.

Finally, Decentralized Autonomous Organizations (DAOs) represent a significant shift in governance, operating without centralized authority and relying on smart contracts, suggesting

a future of more decentralized business operations.

2.17 Impact of Fintech on the Banking Sector- FinTech Analysis of Banks –

Xavier Vives (2018) has described the most comprehensive impact. As per Xavier Wives, the influence or effect can be divided into four parts, as mentioned below.

Digital technology advancements, particularly in fintech, have significantly influenced the banking sector. Fintech solutions are increasingly adopted in less developed countries to reach underserved populations, improving financial inclusion and access. These technologies, free from legacy system constraints, enhance banking efficiency and are particularly effective in mobile platforms. For instance, in Africa, where bank account ownership is low but mobile phone usage is high, mobile fintech solutions are crucial for financial inclusion.

Peer-to-peer (P2P) lending platforms, which operate without traditional financial institutions, and robo-advisors, which utilize machine learning for tasks like wealth management, are other fintech innovations enhancing efficiency in repetitive tasks.

However, fintech also challenges traditional banking structures, as fintech firms and large tech companies like Amazon, Google, and Apple potentially disrupt the market. This competition could lead to an unbundling of financial services traditionally offered by banks.

Banking strategies are evolving in response to fintech innovations, with traditional banks needing to become more digitally adept to compete. Meanwhile, fintech companies' strategies largely depend on regulatory environments and available infrastructure.

Regulatory technology, or Regtech, aims to create an ethical, open marketplace for fintech players while posing challenges to traditional banks. However, banks adopting more digital solutions can better compete in the Reg-Tech space.

Research, including a study by Parminder Varma et al. (2022), which analyzed 93 articles, shows growing academic interest in blockchain and fintech. The study identifies 13 key themes, with blockchain and fintech emerging as significant focus areas, highlighting their impact, growth, and efficiency in the banking and financial sectors.

Elia G et al. (2022) studied the role of fintech in the banks. This study, offers a comprehensive analysis of fintech's impact on the banking industry, highlighting the rapid changes and challenges faced by business operators and regulatory authorities. It aims to update current knowledge on technological innovations in banking, pinpoint major trends, and suggest directions for future research.

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The study encompasses a review of 377 Scopus-indexed articles published between 2014 and 2021, focusing on fintech and banking. The methodology involves two primary steps: firstly, identifying "Fintech" and "bank" as the critical keywords for sourcing relevant articles, and secondly, employing tools like R and VOSviewer for a descriptive analysis of the dataset, examining keywords and their occurrences.

Key findings present a systemic view of fintech in the banking sector, emphasizing the emerging trend of digital banking. The study offers an overview of the research sample, including details about authors, keywords, and the most cited works. Additionally, it provides an in-depth analysis of the digital banking model, outlining six dimensions that encapsulate the key impacts of this model.

The study's originality lies in two aspects: it's one of the few comprehensive review studies on fintech within the banking sector, and it delves into multiple dimensions of fintech's impact, considering perspectives from customers, companies, banks, regulatory authorities, and society at large.

Acar O.et al. (2019) provide a step-by-step comprehensive framework for fintech integration in financial institutions, drawing from business practices at Kuveyt Türk Participation Bank in Turkey. The study presents a structured approach to fintech integration, dividing the process into seven distinct phases:

- Needs Assessment: Identifying internal department requirements.
- Fintech Scouting: Searching for suitable fintech solutions globally through databases and online platforms.
- Initial Presentation and Evaluation: Fintech companies present their business models, followed by an evaluation by bank staff to decide on proceeding to the next phase.
- Business Committee Review: Fintechs present to the bank's vice presidents of relevant departments.
- Collaboration with Key Departments: Discussions with IT, compliance, and legal departments to address and resolve potential issues.
- Proof of Concept (POC): Senior management initiates a POC process.
- Customer Integration: Final integration of the FinTech solution for customer use.
- This systematic approach reduces risks and promotes understanding and collaboration with fintechs across various bank departments. It emphasizes the importance of external collaboration and fosters departmental engagement with fintech innovations.

Murinde V. et al. (2022) examine the global FinTech revolution's impact on the banking industry by analysing high-quality bank data from 115 countries over 16 years. It focuses on the changing dynamics in the banking sector during the FinTech era, considering the opportunities and challenges it presents. Preliminary findings suggest that FinTech lenders are unlikely to replace traditional banks completely. This could be due to banks either developing their FinTech solutions or collaborating with FinTech startups. The paper also discusses how factors like regulation, global infrastructures, and geopolitical tensions will influence the future of banking. Furthermore, it highlights promising research directions in this domain and summarizes critical insights for policymakers and practitioners derived from existing research. Pandey K.d. et al. (2024) study analyzes 366 Scopus-indexed publications on FinTech using bibliometric and content analysis methods, mapping out the landscape of FinTech research in banking and finance. It identifies the most influential works and recurring themes, elucidating the intellectual framework of the field. The analysis underscores FinTech's pivotal role in transforming banking and financial systems, with significant research efforts directed towards understanding its relationship with crowdfunding, lending, credit sourcing, and stock market integration. The study highlights the need for more theoretical and contextual explorations, including methodological advancements in FinTech research. It identifies five key clusters representing the focus of current literature and outlines ten areas where future research is essential to advance understanding in the field.

2.18 Big Tech Impact on the Finance Sector

Big tech is the term used to describe big giant corporations. (Tett, 2018)

To understand the significant impact of technology on the finance sector, these are independent studies done by McKinsey, Capgemini, PWC, EY, and KPMG.

On November 19, 2020, McKinsey posted an article on Big Tech versus big banks: Battle for the Customer. The report says the summation of the market value of the 200 banks is almost little more than seven big-tech companies.

In 2020, it will be doubled by the 200 banks, and big tech has exceeded the $8 trillion value. Amazon, Facebook, Google, Microsoft, Alibaba, Apple, etc. are big techs that have started entering into financial services via direct or indirect routes. Moreover, the article also highlights the valuation gap between the bank's performance and BigTech. The same holds good for valuation. The bank is a high-volume -low-margin business, whereas Big Techs have better margins in their respective business areas.

IMF (International Monetary Fund) published an article on June 16, 2021; in the article, Tobias Adrian argued that it would be interesting to see a big MNC entry into financial services happen in a different way than an emerging Fintech. Fintech start-ups have used financial unbundling, like starting only card banks or lending banks. However, significant technology firms may reverse this trend.

Big tech can benefit from bundling the data, as it will help marketing across products, spending habits, and creditworthiness.

On August 31, 2022, BIS published an article about BigTech vs. banks. This paper studies the loaning process of big techs and compares it with traditional financial institutions and deposit collection at a lesser rate.

A tradelegder has carried out an article on big tech and threats to banking. In its report, Apple and Amazon have recently entered the credit card market, and Facebook started FacebookPay. It uses the data collected by Facebook to offer services relevant to the customer's needs. As banking is regulated, BigTech firms need banks as their partners and can create Banking as a -service.

2.19 Impact of IT Investment on Banks

This study by Kabiru I et al. (2012) explores the influence of investments in information technology on the return on assets (ROA) of specific banks in Nigeria during the period from 2000 to 2010. The independent variables, acting as proxies for Management Information Systems (MIS), include software, hardware investment, and the number of ATMs. The financial performance, represented by ROA, is used as the dependent variable. The data for this analysis were sourced from the annual reports and accounts of chosen banks listed on the Nigerian Stock Exchange (NSE). The study used multivariate regression analysis, utilizing the Statistical Package for Social Sciences (SPSS).

The analysis results indicate that the MIS surrogates, namely software, hardware investment, and the number of ATMs, significantly impacted the financial performance of Nigerian banks, as evidenced by the t-statistics results being statistically significant at the 1 per cent level. Based on these findings, the study suggests that banks should consider increasing their software, hardware, and ATM investments to enhance their Management Information Systems (MIS) and improve profitability.

Wilhelm W.J. (1999) analyses how technological advancements, particularly in information technology, are transforming the landscape of investment banking. It explores the historical context and economic implications of these changes, offering insights into the potential

evolution of this sector. The focus is on how technology might reduce the reliance on human capital and the importance of personal relationships in investment banking. This shift could have significant effects on the structure and operations of both individual banks and the industry as a whole, signalling a move towards more codified and standardized practices in investment banking.

The study by Gunawan H.(2018) investigates how technology investments impact the financial performance of banking companies listed on the Indonesia Stock Exchange. It utilizes audited financial statements as secondary data and applies simple regression analysis for data assessment. The findings indicate a positive relationship between investments in information technology and the financial performance of these banking companies. The results suggest that efficient and effective use of information technology can enhance a company's economic performance. This research highlights the importance of technology utilization in the banking sector. It suggests that future studies should broaden the scope to include other criteria, indicators, and different sectors beyond banking for a more comprehensive understanding of technology's impact on business.

The study by Tanna S (2009) investigates how foreign direct investment (FDI) impacts banks' productivity at an individual level. The research comprises two phases utilizing data from 566 publicly listed commercial banks in 75 countries between 2000 and 2004. Initially, it employs a Malmquist analysis to break down total factor productivity (TFP) bank changes into categories like efficiency, scale efficiency, and technological change. Following this, panel regressions are applied to determine FDI's impact on productivity while factoring in specific bank and country characteristics. The findings reveal that FDI has a short-term negative effect but a positive long-term impact on TFP change, aligning with instances of both technical regression and progress observed in banks. This paper stands out by being the first to examine the connection between FDI and bank-level total factor productivity, suggesting that FDI inflows contribute to productivity changes in the banking sector and the broader economic environment, supported by cross-country evidence.

Another interesting study was conducted by Takeda F. et al. (2021).

Over several decades, the economic environment facing regional banks in Japan has consistently declined, primarily due to the prolonged period of meagre interest rates. Furthermore, the study investigates how these regional banks' stock prices react to announcements related to investments in information technology (IT). Additionally, the study delve into the factors that influence the market's responses to such announcements, and our analysis yields three key findings.

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To begin with, the study observed that regional bank stock prices do not exhibit significant reactions to announcements regarding IT investments. Secondly, the study notes that the stock price reactions to these IT investment announcements are more positively aligned with the size of the regional banks and the ratio of individual shareholders. Finally, the study also observes that when there is news concerning equity investments in FinTech companies, the stock prices of regional banks tend to react more negatively.

The more focused study by Beccalli(2007) conducted a concentrated IT investment survey. This study aims to investigate the potential impact of investments in Information Technology (IT), encompassing hardware, software, and other IT services, on the overall performance of banks. To accomplish this, the study analyses data from a sample of 737 European banks from 1995 to 2000. Here, the analysis delves into whether IT investments are associated with improved performance using various metrics, including standard accounting ratios, cost efficiency measures, and alternative profit efficiency measures.

Despite the substantial investments made by banks in IT during this period, study findings reveal a limited correlation between the total IT investment and enhanced profitability or efficiency in banks. This suggests the presence of a profitability paradox in the banking sector. However, the influence of distinct types of IT investment (hardware, software, and services) on banks' performance exhibits heterogeneity. Notably, investments in IT services provided by external sources, such as consulting, implementation, training, and support services, seem to impact accounting profits and profit efficiency positively. In contrast, the acquisition of hardware and software appears to have a detrimental effect on the performance of banks.

2.20 Updated Problem Statement

Digital transformation has been extensively studied, particularly its influence on the banking industries in Europe and India. Prior research endeavours have shed light on several aspects of this transformation. For instance, Alexander Ruhi (2020) researched five critical factors from Buch's work (2018). These factors provided valuable insights into the evolving digital transformation landscape within the banking sector.

Nevertheless, recent academic research has uncovered various digital finance technologies, each carrying significant implications for the banking industry. This literature survey, which forms the basis for our study, revealed the following key technologies:

       a. Machine Learning (ML), as Matthew F.D. et al. (2019) examined.

       b. Big Data, as explored by Hasan M.M. et al. (2020).

       c. Blockchain, as investigated by Verma J.R. (2019).

d. Smart Contracts, as proposed by Szabo N. (2014).

e. Digitization, as conceptualized in the European context by Ruhi A(2020)

f Impact of IT investment by Beccalli (2007)

2.21 Identifying the Research Gap and Formulating the Research Question

While the existing body of research provides valuable insights into the impact of digital transformation on the banking industry, it is evident that several gaps remain unaddressed:

- Cross-Geographical Analysis: Most research has traditionally focused on one

Specific geography, be it Europe or India. However, there exists a significant gap in comprehensively studying and comparing the parameters of digital transformation across different geographical regions.

- Cost-to-Income Ratio and Profit Impact: The impact of emerging technologies on the banking sector, particularly regarding the cost-to-income ratio and overall profitability, has not received adequate attention in prior research.

- Objective and Subjective Analysis: The research landscape currently lacks a

holistic study that combines objective and subjective assessments of the impact of digital transformation across regions, such as Europe, India, or Asia.

- Fintech vs. Traditional Banks: While there is a wealth of documented research

There is a dearth of comparative studies on fintech and its disruptive potential that assess how fintech companies stack up against traditional banks across various attributes.

- Extensive Tech Customer Segmentation: Despite the substantial attention afforded to Big Tech companies, there is a notable scarcity of research that delves into

customer segmentation within the Big Tech sphere and its comparison to traditional banking customer analysis.

- Cross-Geographical Impact of Big Data and Emerging Technologies:

No comprehensive research has explored the impact of big data and emerging technologies while simultaneously comparing these impacts across different geographical regions. This research aims to bridge this critical gap by examining the influence of big data and emerging technologies within the financial domain and evaluating potential variations between areas.

In the subsequent sections of this paper, we will delve into each of these research gaps in detail, providing a comprehensive foundation for our study. Furthermore, we will formulate research questions that will guide our investigation into the impact of digital transformation technologies on the banking industry across diverse geographical contexts

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2.22 Revised Problem Statement

Given our understanding of the research gap, the problem statement for this study can be delineated as follows:

This research endeavours to investigate the profound impact of emerging technologies and IT investment on the banking sector within both the Indian and European regions over the course of the next decade. The principal parameters under scrutiny encompass examining revenue generation, total operating costs, and investments in Information Technology (IT) as pivotal indicators for an in-depth assessment of the banking sector's expenditure trends.

In essence, this study seeks to unveil the intricate interplay between technological advancements and the financial dynamics of the banking industry, with a particular focus on forecasting the implications of these innovations over the forthcoming decade. Through a meticulous analysis of revenue, operating costs, and IT investments, this research aims to provide valuable insights that can inform strategic decisions and operational planning within the banking sector.

2.23 Summary

- The literature review adopts a systematic and iterative approach, methodically unravelling one layer after another. Initially, it commences with an exploration of the various types of banks.

- Types of Banks: Explores different categories of banks, including those specific to the Indian banking system. This section delves into the various forms and structures of banks and their distinctive features.

- Banking Delivery Channels: Discusses the various methods and platforms through which banking services are delivered to customers, including digital and traditional channels.

- Retail Banking: Covers the aspects of retail banking, including performance measurement, payment types, and current trends influencing this sector.

- Corporate Banking: Focuses on corporate banking, addressing its key elements such as credit scoring frameworks, product offerings, treasury management functions, and risk management strategies.

- Wealth Banking: Examines wealth banking, its types, and the disruptive trends reshaping wealth management practices.

- Investment Banking: Provides a thorough investment banking analysis, including its divisions, a comparative view with commercial banking, current trends, outlook, and regulatory aspects.

- Indian Banking System: Offers a detailed insight into the Indian banking system, its types, services, high-level analogies, and challenges the industry faces.

- European Banking Overview: Reviews the European banking landscape, discussing competition, EU relationships, efficiency, ownership, the impact of monetary policies, and the sector's outlook post-COVID-19.

- Impact of Technology on Banking: Addresses the profound influence of technological advancements on banking, including machine learning, big data, blockchain, fintech, and the effects of big tech companies on the finance sector.

- The literature review establishes that the structural composition of Indian and European banks is notably similar, characterized by regulatory institutions at the core, surrounded by a mix of private and government-backed banking entities. A key observation from the literature is the tendency to analyses the impact of IT as a singular technological influence, without integrating multiple geographical perspectives. Although there have been a few studies exploring the relationship between IT impact and finance, these investigations often fall short in terms of inclusivity of various factors and lack a comprehensive multi-geographic scope.

- Furthermore, the literature review indicates that banking is frequently examined in isolation. There is a noticeable scarcity of research integrating banking with sectors like real estate or the automobile industry to assess interconnected impacts.

- This research aims to explore the influence of IT investment on future revenue, over the next decade, considering factors such as operating costs and profit. Additionally, the literature survey underscores a significant challenge in data availability for research purposes. It highlights the absence of transparency in data dissemination, particularly the lack of specific data like product revenue or margins, which are not typically disclosed in public datasets.

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CHAPTER III: RESEARCH METHODOLOGY

3.1 Introduction and Objective

Initial investigations indicate that a substantial body of research has been dedicated to examining emerging technologies and their influence on the banking sector. However, it is worth noting that much of this research has been constrained to a specific geographical context. Consequently, this research addresses this limitation by conducting comparative analyses across different geographical regions. The primary objective is to comprehensively understand emerging technologies' particular and nuanced effects on the Indian and European banking markets.

This study's overarching, long-term goal is to elucidate the pivotal role played by technology in fostering the growth and development of the banking industry in both the Indian and European sectors. By dissecting the impact of these technologies on these distinct markets, this research aims to provide valuable insights that can inform current strategies and pave the way for future advancements within the banking domain.

Data used will be Indian Bank's balance sheet data from 2017 till 2022 and European Bank's data received from the online Macrotrends Portal.

3.2 Overview of the research Problem

Understanding the identified gap in existing research, the problem statement of this study is articulated as follows. This research aims to explore the significant impact of emerging technologies and IT investment on the banking industry in both Indian and European contexts over the next ten years. Key areas of focus include the examination of revenue generation, total operating expenses, and Information Technology (IT) investments. These elements are crucial for a comprehensive evaluation of expenditure trends within the banking sector. Fundamentally, the objective of this study is to uncover the complex relationship between technological progress and the financial mechanisms within the banking industry, particularly in terms of projecting the effects of these developments over the next decade. By conducting an in-depth analysis of revenue streams, operating costs, and IT investments, this research intends to shed light on critical insights that could guide strategic decision-making and operational planning in the banking domain.

3.3 Operationalization of Theoretical Construct

- As mentioned in the abstract, the operationalization of theoretical constructs for investigating the impact of IT investment in the banking sectors of India and Europe is delineated as follows:

- Defining IT Investment: This research operationalises IT investment by distinctly defining its components within the banking sector, encompassing software, hardware, digital infrastructure, cybersecurity, and technological innovation expenditures. The study acquires direct IT investment values from various annual reports.

- Measuring Financial Attributes: The research identifies key measurable financial attributes to gauge the impact of IT investment. These include metrics like cost-to-income ratio, return on investment, profit margins, and revenue growth. It incorporates operating costs, revenue, and year as variables in developing a machine learning equation.

- Quantifying IT Investment Impact: The method to quantify the impact of IT investment on identified financial attributes involves leveraging indices or scores based on financial performance indicators. This study specifically considers the IT investment value without the need for further quantification.

- Comparative Analysis Tools: Criteria and tools have been established to compare IT investment impacts across Indian and European banking markets, utilizing statistical models or comparative financial analysis techniques. This research undertakes a comparative analysis based on various parameters.

- Time Frame Specification: The study is defined within the temporal context of 2022-2032, facilitating the understanding of trends and patterns across this period. The selected timeframe is crucial for the machine learning algorithm.

- Data Collection and Analysis Methodology: The methodology for data collection on IT investments and financial attributes includes sourcing data from financial reports, market analyses, and a designated website for data collection. Data analysis techniques comprise data-driven algorithms and statistical testing.

- Testing Hypotheses with Data-Driven Algorithms: The research specifies the algorithms or statistical methods employed for hypothesis testing, elucidating their suitability for analysing the relationship between IT investment and other factors.

- Validity and Reliability Considerations: Steps to ensure the validity and reliability of measurements and analyses include pilot testing, employing established financial

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metrics, and cross-validating results with secondary data. The research relies on real websites for data, ensuring reliability, although the outcomes of the machine learning algorithm require further validation.

- In summary, this research meticulously outlines the process for measuring and analysing IT investments in the banking sector, emphasizing the comparison of financial impacts between Indian and European markets.

3.4 Research Purpose and Questions

This study is designed to explore the influence of IT investment in the banking sectors of India and Europe, specifically focusing on the period from 2022 to 2032, and to analyse the cost-to-income ratio trends from 2017 to 2022. The research methodology incorporates four key variables: Revenue, IT investment, Operating cost, and Profit. Data for these variables are sourced from a reputable online portal. Currently, the subjective value of IT investment is not within the scope of this research. The primary objective is to ascertain the evolving value of IT investment over the forthcoming decade and to determine its effect on the total revenue of banks.

The research addresses several critical questions to gauge the efficacy and future impact of IT investment in the banking sector:

1. What is the current cost-to-income ratio observed in banks?
2. What proportion of their budget is allocated by banks towards IT investment?
3. How is IT investment projected to change in the upcoming ten years?
4. What impact will IT investment have on the revenue of banks in the next decade?

3.5 Research Design

- This research commences with a comprehensive literature survey, delving into the concept of banking and specifically examining the banking sectors in India and Europe. It then progresses to a detailed analysis of various IT initiatives, such as big data, AI/ML, and blockchain, and their impacts on banking. Additionally, the study investigates the role of IT in banking finance through scholarly papers.
- The methodology unfolds in several structured steps:
- Data Collection: The initial phase involves gathering banking data focusing on variables such as Revenue, IT investment, Operating cost, and the cost-to-income ratio.
- Data Acquisition: The subsequent step entails collecting data from the period 2017 to 2022 from a reputed website portal of macrotrends.

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- Data Analysis: Addressing any gaps in the data through linear regression to estimate missing values.

- Model Selection and Prediction: The study then examines various machine learning models suitable for forecasting values for the upcoming decade. The ARIMA model and the KPSS method are considered for their predictive capabilities.

- Parameter Estimation: A critical phase is the determination of the p, d, and q values, employing a methodical approach. The Akaike Information Criterion (AIC) method is identified as the most appropriate for this purpose.

- Model Application and Prediction: Using the selected model, the study predicts future IT investment and revenue.

- Statistical Testing: A key step involves understanding stationarity through KPSS values comparison. If the data series is found to be stationary, it is then used for further prediction of the upcoming decade's values.

- Hypothesis Evaluation: The study then systematically evaluates the predictions against each set hypothesis.

- Result Publication: Finally, the research culminates in the publication of the results, contributing to the existing body of knowledge in the field.

Overall, this research provides a thorough exploration of IT investment in banking, employing a methodical approach to forecast and understand its impact over the next decade.

3.6 Population and Sample

An exhaustive search was conducted across the web to gather banking data. This task proved to be challenging, as many websites provided only partial data. After extensive research, the website https://www.macrotrends.net/ was identified as a reliable data source. This platform facilitated the collection of data from selected Indian and European banks, spanning from 2017 to 2022. The endeavour involved gathering data for various banks from the Europe and India, and it became apparent that accessing comprehensive data posed a significant challenge. Consequently, it was resolved to utilize the data available on Macrotrends for this study.

Ultimately, the selection included 2 Indian banks and 6 European banks. The variables identified for the research were Revenue, Operating Cost, Year, Profit, and the Cost-to-Income Ratio. These were designated as the known variables for the study.

The variables slated for prediction are Revenue from 2022 to 2032 and IT Investment for the same period. For the purpose of forecasting these variables, the ARIMA model will be employed. Additionally, the KPSS and AIC methods will be utilized to assess the stationarity of the model, ensuring the reliability and accuracy of the predictions.

In conclusion, the research utilized a data sample spanning from 2017 to 2022 for eight banks. This dataset included variables such as year, revenue, operating cost, profit, and the cost-to-income ratio, which served as the foundational data for the study.

3.7 Participant Selection

Upon finalizing the research topic from the concept paper regarding the impact of IT investment estimation on Indian and European banks, the initial step involved selecting the Indian banks. This process commenced with a comprehensive search for a list of Indian nationalized banks. Subsequently, a deliberation occurred to determine the necessary variables for data collection, leading to the identification of the following four key variables:

1. Year: Indicates the year of the financial transaction.
2. Revenue: Represents the total revenue in USD.
3. Operating Cost: The total operating costs in USD.
4. Profit After Tax - Net Profit: The total profit.
5. Cost to Income Ratio: The yearly cost to income ratio of these banks.

The research focused on the timeframe from 2017 to 2022, as it began in 2022 and data availability extended back to 2017 for both Indian and European banks. Consequently, the variables and timeframe were solidified for this period.

During the data gathering phase, the website Macro Trends emerged as the primary source due to its extensive data availability in USD. While other websites offered fragmented data, Macrotrends provided comprehensive and reliable information. However, for the year 2022, Macrotrends only had data for two Indian banks, ICICI and HDFC, which were thus selected for the study.

In terms of selecting European banks, the initial step was to review a list of all European nationalized banks, ensuring a diverse regional representation. Banks like Credit Agricole and BNP were considered. Initially, Credit Suisse was included, but due to its acquisition by UBS and subsequent negative financial figures, it was excluded from the study. The same five variables used for the Indian banks were applied to the European banks. After extensive online research, Macro Trends was again chosen for its reputation for accuracy. The final selection of European banks included:

1. UBS
2. BNP
3. Credit Agricole (CA)
4. BS
5. Barclays
6. HSBC

This methodology outlines the process of bank selection and data acquisition for the research on IT investment impact in Indian and European banks.

3.8 Instrumentation

The instrumentation section of the study delineates the methods and software utilized for processing the results. It was determined that the prediction of investment and revenue for the next decade was essential. This raised critical questions regarding the choice of methodology and programming language. Given the enhanced accuracy and robustness of machine-learning algorithms, these were favoured for prediction models.

The exploration of various models led to the shortlisting of specific ones. Linear regression was chosen to estimate missing values in IT investment. For time series analysis, the Adfuller and KPSS methods were evaluated in conjunction with the ARIMA model. Preliminary calculations revealed that the Ad fuller test was less effective with limited data, while the KPSS method yielded better results. Consequently, KPSS was the chosen approach. The procedural steps were as follows:

- Python scripting was employed to develop the ARIMA model and implement the KPSS test.
- The Anaconda Enterprise platform, specifically the Jupyter Lab environment, was utilized for this task.
- Although the model provided the KPSS coefficient, the parameters p, d, and q were estimated using the Akaike Information Criterion (AIC) model.
- The AIC model identified 50 values that corresponded well with the observed data.
- The value with the lowest AIC was selected for making a 10-year forecast.
- To elucidate further, let's delve into the specifics of the ARIMA, KPSS, and AIC methodologies.

  Lets understand more about ARIMA model.

- ARIMA Model : The ARIMA model, which stands for Autoregressive Integrated Moving Average, is a popular statistical method used for forecasting time series data. It's particularly useful for data that show a clear trend or seasonal patterns. The ARIMA model is characterized by three key parameters: p, d, and q, each representing a specific aspect of the model:

1.Autoregressive (AR) term (p): This represents the number of lagged observations included in the model. It's based on the concept that current values of a series can be explained by its previous values. A high p value may indicate that the future value of the series is more dependent on its historical values.

2.Integrated (I) term (d): This signifies the number of times the data have been differenced to make it stationary. Stationarity is a crucial aspect of time series analysis, implying that the statistical properties of the series (like mean and variance) are constant over time. Differencing is a method of transforming a non-stationary series into a stationary one.

3.Moving Average (MA) term (q): This accounts for the number of lagged forecast errors in the prediction equation. It is based on the idea that the current value of the series can be explained by a linear combination of past forecast errors.

An ARIMA model is typically noted as ARIMA(p,d,q). The process of building an ARIMA model involves several steps:

• Identification: Where you determine the values of p, d, and q. This can be done by looking at autocorrelation and partial autocorrelation plots of the data.

• Estimation: Where the model coefficients are estimated using statistical methods like maximum likelihood estimation.

• Diagnostic Checking: In this step, you check whether the residuals (errors) of your model are white noise (i.e., they have no autocorrelation). If they are not, it might indicate that the model can be improved.

• Forecasting: The final model can be used to forecast future values.

ARIMA models are flexible and can be adapted to various types of time series data, making them a popular choice in fields like economics, finance, environmental science, and more. However, they do have limitations, especially when dealing with non-linear data or time series with changing variances (in which case, models like ARCH or GARCH might be more appropriate).

- The KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test is a statistical method used to test the stationarity of a time series. Unlike other tests like the Augmented Dickey-Fuller (ADF) test, which tests for unit roots (a sign of non-stationarity), the KPSS test checks for the presence of a trend or drift in a time series, assuming the null hypothesis that the series is stationary around a deterministic trend.

- The KPSS test can be used in two forms:

- Level Stationarity: Tests whether a series is stationary around a mean.

- Trend Stationarity: Tests whether a series is stationary around a trend.

- The key idea behind the KPSS test is that if a time series is stationary, it can be represented as a sum of the deterministic trend, a random walk, and a stationary error term. The test essentially decomposes the series into these components and tests for the presence of a unit root in the random walk component.

- The KPSS test statistic is computed based on the residuals (errors) obtained from the estimated trend equation. The test involves estimating the lagged autocorrelations of the residuals and then calculating the test statistic based on these autocorrelations.

- Steps involved in the KPSS test:

- Estimate the Trend: The first step is to estimate the deterministic trend (or mean) in the time series. This can be done using a linear regression model.

- Compute Residuals: Calculate the residuals from the estimated trend.

- Test Statistic: The KPSS test statistic is then calculated, which involves summing the squares of the cumulative sums of the residuals and normalizing this sum by an estimate of the long-run variance of the series.

- Critical Values: The test statistic is compared against critical values from the KPSS distribution. If the test statistic exceeds the critical value, the null hypothesis of stationarity is rejected, suggesting that the series has a unit root (i.e., it is non-stationary).

- Interpretation: If the KPSS statistic is greater than the critical value, the null hypothesis of stationarity is rejected, indicating that the series is non-stationary.

- If the KPSS statistic is less than the critical value, we fail to reject the null hypothesis, suggesting the series is stationary.

- The KPSS test is valuable in time series analysis as it provides a method to check for stationarity, which is a key assumption in many time series models. However, it's often used in conjunction with other tests like the ADF test because each test has its

own null hypothesis regarding stationarity, providing a more comprehensive understanding of the time series properties.

- The Akaike Information Criterion (AIC) is a statistical measure used to evaluate and compare the goodness of fit of statistical models. Developed by the statistician Hirotugu Akaike in 1973, the AIC is particularly useful in model selection, where the goal is to choose the best model from a set of candidates. It's widely used in various fields such as economics, sociology, environmental science, and machine learning, especially in the context of regression models, time series analysis, and other statistical modelling frameworks.

- Key Features of AIC:

- Balance Between Goodness of Fit and Complexity: AIC aims to balance the model's ability to fit the data well with the complexity of the model. It penalizes the inclusion of unnecessary variables that don't improve the model significantly.

- Relative Measure: AIC doesn't provide a test of a model in the sense of testing a null hypothesis; instead, it provides a way to compare models. A lower AIC score suggests a better model.

- Penalty for Complexity: AIC penalizes models with more parameters to avoid overfitting. Overfitting occurs when a model becomes too complex and starts capturing the noise rather than the underlying pattern in the data.

- Interpretation: Lower AIC Values: Indicate a better model. However, the absolute value of AIC is not interpretable by itself; it's only meaningful when comparing different models.

- Comparing Models: When comparing two or more models, the one with the lower AIC is generally preferred.

- Delta AIC: Often, the difference in AIC values (ΔAIC) between models is considered. A ΔAIC of more than about 2-6 can be considered evidence of a significantly better model.

- Limitations: Relative, Not Absolute: AIC tells you which model is better in a set, but it doesn't tell you if a model is good in an absolute sense.

- Sample Size Sensitivity: AIC can be sensitive to the sample size. For large samples, even small differences between the models can lead to large differences in AIC.

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- Assumption of Large Sample Size: The derivation of AIC assumes a large sample size. For small sample sizes, a correction to AIC, known as AICc, may be more appropriate.

- Usage: In practice, AIC is widely used in model selection procedures. For instance, in time series analysis with ARIMA models, AIC helps determine the most appropriate lag length. In regression analysis, it helps to select the most appropriate set of explanatory variables.

- AIC provides a practical and flexible approach to model selection, balancing model fit and complexity, which is crucial in many statistical modeling and data analysis application.

- Source - Self Analysis
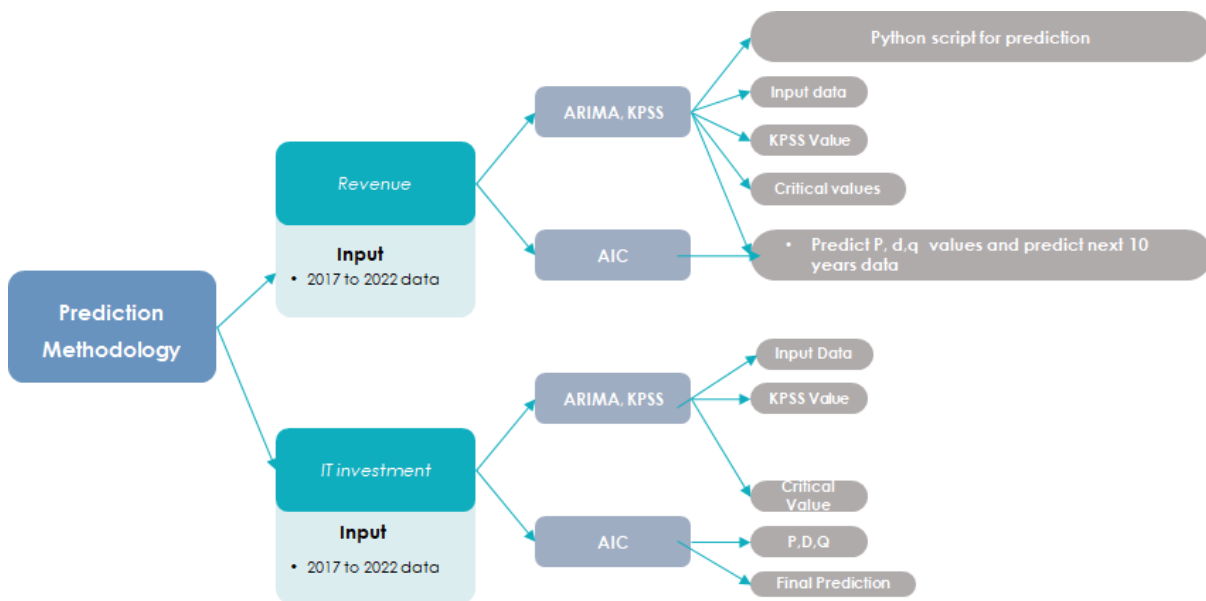
Figure 7 Theoretical Approach based on Instrumentation**.**

3.9 Data Collection Procedure India – Methodology

- To facilitate a comprehensive analysis of the Balance Sheets of the two foremost Indian banks, a meticulous data collection process was undertaken. The dataset for this analysis was sourced from the reputable platform Macrotrends. This dataset

encompasses a substantial temporal scope, spanning a period of five years, commencing from March 2017 and extending through to March 2022.

- The dataset extracted from Macrotrends comprises a set of pivotal variables, each of which holds significance in our analytical framework. The essential data points encompass the following elements:

- Bank: This variable delineates the specific banks under consideration.

- Year: This temporal dimension allows us to discern trends and fluctuations over the five years.

- Total Revenue: The financial metric provides insight into the banks' income generation during this timeframe.

- Profit After Tax or Net Income: Profit after tax is a fundamental indicator of the banks' profitability, factoring in the impact of taxation.

- Operating Costs: Operating costs encapsulate the expenses incurred in the day-to-day operations of these banks, offering insights into their operational efficiency.

- IT Investment: The IT investment component is crucial, as it underscores the technological investments made by these banks during the specified period. It was collected from various annual reports of the specific bank.

- By collating this rich and comprehensive dataset, we are well-equipped to embark on an in-depth examination of the financial performance and technological investments of the top two Indian banks, thus enabling a robust analysis that is both insightful and informative..

- A closer examination of the data reveals trends and patterns in the financial performance of HDFC and ICICI, including changes in total revenue, profitability, operating costs, and IT investments over the specified six-year period. Such insights are invaluable for assessing the banks' financial health, operational efficiency, and strategic priorities during this timeframe.

- **Source**

- HDFC - https://www.macrotrends.net/stocks/charts/HDB/hdfc-bank/financial-statements

- ICICI - https://www.macrotrends.net/stocks/charts/IBN/icici-bank/income-statement

Bank	Year	Total Revenue/Sales (USD)Billion	Net Income (USD)Billion	Operating Costs (USD)Billion
HDFC	2017	12.88	2.16	3.73
HDFC	2018	15.17	2.74	4.46
HDFC	2019	17.37	3.18	4.73
HDFC	2020	18.70	3.45	5.64
HDFC	2021	20.90	4.45	6.79
HDFC	2022	21.13	5.08	6.59
ICICI	2017	16.89	1.51	10.01
ICICI	2018	18.44	1.19	11.71
ICICI	2019	18.77	0.60	12.36
ICICI	2020	21.11	1.34	13.23
ICICI	2021	21.78	2.48	13.27
ICICI	2022	21.10	3.36	12.03

Table 2 HDFC and ICICI Data

3.10 Data Collection Procedure of European Banks - Methodology

Source: https://macrotrends.net

Bank	Year	Revenue (USD)Billion	Net Income (USD)Billion	Operating Costs (USD)Billion
UBS	2017	33.52	0.96	24.40
UBS	2018	35.38	4.51	24.34
UBS	2019	35.15	4.30	23.39
UBS	2020	36.03	6.55	24.92
UBS	2021	37.22	7.45	25.91
UBS	2022	39.72	7.63	24.95
BNP	2017	49.59	8.76	34.63
BNP	2018	50.95	8.88	36.98
BNP	2019	50.60	9.15	34.18

BNP	2020	51.05	8.07	37.05
BNP	2021	52.35	11.22	34.61
BNP	2022	50.92	10.74	34.30
BS	2017	79.23	7.03	29.08
BS	2018	80.78	8.56	29.56
BS	2019	79.21	6.63	28.79
BS	2020	66.28	-10.64	26.79
BS	2021	70.39	9.61	28.65
BS	2022	89.48	9.56	27.14
HSBC	2017	66.63	9.68	36.65
HSBC	2018	75.43	12.60	36.42
HSBC	2019	82.68	5.96	45.10
HSBC	2020	66.20	3.89	43.24
HSBC	2021	62.29	12.60	33.69
HSBC	2022	75.79	14.34	36.28
CA	2017	21.02	3.61	14.53
CA	2018	23.71	5.19	15.24
CA	2019	37.73	8.06	24.46
CA	2020	23.97	2.64	16.39
CA	2021	27.18	6.49	16.82
CA	2022	25.48	5.29	15.96
Barclays	2017	27.16	-2.47	22.84
Barclays	2018	28.21	1.86	23.64
Barclays	2019	27.62	4.18	22.14
Barclays	2020	27.94	1.95	24.04
Barclays	2021	30.16	8.76	18.95
Barclays	2022	30.86	6.21	22.19

Table 3 European Banking Data

The source in detail –

- UBS - https://www.macrotrends.net/stocks/charts/UBS/ubs-group-ag/financial-statements

- CS – https://www.macrotrends.net/stocks/charts/UBS/ubs-group-ag/financial-statements
- BNP - https://www.macrotrends.net/stocks/charts/BNPQY/bnp-paribas-sa/financial-statements
- BS - https://www.macrotrends.net/stocks/charts/SAN/banco-santander,-sa/financial-statements
- HSBC -https://www.macrotrends.net/stocks/charts/HSBC/hsbc/financial-statements
- CA - https://www.macrotrends.net/stocks/charts/CRARY/credit-agricole-sa/financial-statements
- BARCLAYS https://www.macrotrends.net/stocks/charts/BCS/barclays/financial-statements
- The data on IT investment was meticulously compiled from the annual reports of various banks..

3.11 Data Analysis

The above data lists several banks' annual Revenue, Net Income, and Operating Costs from 2017 to 2022. The banks included are UBS, Credit Suisse (CS), BNP Paribas (BNP), Banco Santander (BS), HSBC, Crédit Agricole (CA), and Barclays. Let's analyze and compare these banks based on their financial performance:

•   UBS:

UBS shows consistent growth in revenue from $33.52 billion in 2017 to $39.72 billion in 2022. Net income has increased significantly, especially from 2017 to 2021. Operating costs are relatively stable, with a slight increase over the years.

•   Credit Suisse (CS):

Credit Suisse has more fluctuating revenues, peaking in 2019 at $35.88 billion and then declining to $22.87 billion in 2022.

Net income shows volatility, with losses in 2017 and 2021 and a significant loss in 2022.

Operating costs decreased in 2022 compared to previous years.

•   BNP Paribas (BNP):

BNP's revenue is relatively stable, slightly fluctuating over the years. Net income shows an increasing trend, particularly in 2021. Operating costs are generally stable, with minor fluctuations.

•   Banco Santander (BS):

BS shows an overall increase in revenue, although there is a dip in 2020. Net income fluctuates significantly, with a notable loss in 2020. Operating costs decreased in 2020 and 2022.

- HSBC:

HSBC's revenue peaked in 2019, followed by a decline, but recovered in 2022. Net income shows significant variation, with a low in 2020 and a high in 2022. Operating costs have fluctuated, with an increase in 2019 and a decrease in 2021.

- Crédit Agricole (CA):

CA shows a mixed trend in revenue, with a peak in 2019. Net income generally increased, except for a dip in 2020. Operating costs show a gradual increase over the years.

- Barclays:

Barclays' revenue shows a gradual increase over the period. Net income fluctuated, with losses in 2017 and varying profits in other years. Operating costs fluctuated, with a significant decrease in 2021.

- Comparative Analysis:

Revenue Growth: BS and HSBC show the most significant growth in revenue over the period. CS, in contrast, has shown a decline in recent years.

Net Income Volatility: BS and HSBC demonstrate significant fluctuations in net income. CS had major losses in 2017, 2021, and 2022.

Stability: BNP and UBS appear to be more stable in terms of both revenue and net income.

Efficiency: Barclays showed a substantial decrease in operating costs in 2021, which may indicate increased efficiency or cost-cutting measures. In summary, each bank displays unique trends in financial performance, with some showing consistent growth and others experiencing more volatility in their financial metrics.

- India Data: The above-mentioned data encompasses financial information for two major banks, HDFC and ICICI, from 2017 to 2022. Let's break down the key financial figures for each bank over these six years:

- Total Revenue/Sales:

HDFC's revenue has consistently increased from 2017 to 2022, from $12.88 billion to $21.13 billion.

ICICI's revenue also increased, but not as consistently. It started at $16.89 billion in 2017, peaked at $21.78 billion in 2021, and then slightly decreased to $21.10 billion in 2022.

- Net Income:

HDFC's net income consistently increased from $2.16 billion in 2017 to $5.08 billion in 2022.

ICICI had fluctuating net income figures. It started at $1.51 billion in 2017, dropped to $0.60 billion in 2019, and significantly increased to $3.36 billion in 2022.

- Operating Costs:

HDFC's operating costs steadily increased from $3.73 billion in 2017 to $6.79 billion in 2021, then slightly decreased to $6.59 billion in 2022.

ICICI's operating costs were generally higher than HDFC's throughout the period. They increased from $10.01 billion in 2017 to a peak of $13.27 billion in 2021, then decreased to $12.03 billion in 2022.

- Comparison of HDFC to ICICI numbers

HDFC Bank has demonstrated a more stable and consistent revenue and net income growth than ICICI Bank.

HDFC's operating costs have increased over the years but at a slower rate than its revenues and net income increase.

While ICICI Bank has had higher total revenue in most years than HDFC, it has had more net income fluctuations and higher operating costs.

The net income trend for ICICI is more volatile than that of HDFC, which might suggest varying degrees of efficiency or different business strategies or challenges.

In conclusion, while ICICI generally had higher total revenues, HDFC showed more consistent growth and efficiency in net income and managing operating costs.

3.12 Research Objective

To comprehensively assess the influence of technology on the banking industries in both the Indian and European regions and to validate the proposed hypotheses, it is essential to conduct an in-depth analysis.

3.13 Proposed Hypothesis

Below are the proposed hypotheses. However, more can be written after analysing the actual analysis of data.

Note – These five hypotheses will be validated via the statical linear regression method and time series.

3.14 Hypothesis 1

- **Projected 30- 50% Increase of Bank's Revenue Due to IT Investment Over the Next Five Years:**

- Each financial institution is inclined toward automating their customer-facing operations, necessitating substantial IT investments. These investments are expected to yield profitability and return on investment (ROI) returns. According to our hypothesis, an IT investment ranging from 8 to 15 % of revenue today is anticipated to increase business and customer acquisition across Retail, Corporate, and Wealth banking segments. The central question revolves around the magnitude of this revenue increase.

- Many banks have already embraced digital customer onboarding, online banking, and various online processes, including services such as bereavement management. These digitalization efforts lead to cost savings and attract a more extensive customer base by adopting cutting-edge technology. In line with the hypothesis, as mentioned earlier, we will conduct an empirical analysis to ascertain the actual revenue impact over the next five-year period from 2022. This study aims to provide valuable insights into the financial implications of digitalization in the banking sector and the exact % increase in revenue in the next five years.

3.15 Hypothesis 2

- **A Singular IT Investment Yields Cumulative Returns an increase in revenue in coming ten years.**

- IT investments are pivotal in shaping a bank's operating costs, and the financial services industry relies heavily on technology to function efficiently. Digital transformation and IT infrastructure constitute the backbone of modern banking operations. It is widely recognized that banks' substantial IT investments can redefine their prospects, leading to the acquisition of significant customer segments or the emergence of new challenger banks leveraging digitization.

- Following our hypothesis, if a significant digital investment is made in 2022, it is anticipated that the subsequent 5-10 years will witness a noteworthy impact on revenue. This impact is expected to directly result from the concerted efforts directed towards IT transformation and modernization. This research examines and quantifies the effects of information technology transformation on revenue within the specified timeframe.

3.16 Hypothesis 3

- **Technological Adoption Positively Influences the Cost-to-Income Ratio**

- As per the literature review, it becomes evident that banks' profit depends on the use of technology in the digital world. However, how much has yet to be studied in detail?

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The current understanding is that the income ratio is on an upbeat track due to the use of technology. After our objective analysis, let's see whether a similar theory is sound.

- This study will empirically analyse the cost-to-income ratio from 2017 to 2022 concerning IT investment. The goal is to evaluate the impact of IT investment on the cost-to-income ratio over these five years and assess whether income experiences growth during this timeframe. We anticipate that the trend in the cost-to-income ratio will exhibit positive correlations with IT investment, with lower ratios indicating higher profitability.

3.17 Hypothesis 4

- **With the arrival of advanced technologies and Artificial Intelligence (AI) and Machine Learning (ML) capabilities, IT investments are projected to increase from 2027 to 2032.**

- IT expenditures typically range from 7% to a maximum of 33% of total revenue, with most data suggesting figures below 15%. There are differing perspectives on IT investment between 2027 and 2032.

- One perspective is that AI and machine learning (AIML) advancements will decrease investment as these technologies take over many processes, reducing costs.

- Another viewpoint suggests that it is premature to draw definitive conclusions, given that not all processes have been automated and digitized. Consequently, IT investment may continue at its current level even with the integration of AIML.

- The impact of IT investment on overall bank performance is minimal. The hypothesis above aligns with the second viewpoint, and we will assess this alignment using projected data from 2027 to 2032.

3.18 Hypothesis 5

- **The impact of IT Investment on overall banking investment is limited.**

- The aggregate IT investment accounts for approximately 7-15% of the overall revenue, except for a few values above 30%. Nevertheless, this assertion necessitates validation against forecasted data from 2022 to 2032. There is a perspective that posits IT investment yields multifaceted returns that extend beyond quantifiable metrics. Therefore, this hypothesis aims to determine IT investment's tangible, projected value rather than relying on subjective assessments. Presently, the return on investment (ROI) in IT projects is evident, yet it is essential to acknowledge that the finance industry's

overall operations rely heavily on IT infrastructure. This research will refrain from making assertions regarding operational productivity. However, it will provide an objective assessment based on quantitative data on the impact of IT.

3.19 Research design Limitation

- Limitation in Data Availability: A significant constraint lies in the unavailability of specific financial data from Indian and UK banks. Notably, information regarding IT expenditure is seldom disclosed as part of standard reporting practices. Further, detailed data on profit margins per product is rarely provided by many banks. The prevailing practice among these institutions is to publish only the data mandated by regulatory authorities, which, while beneficial from a competitive standpoint, severely restricts research possibilities due to the lack of comprehensive data.

- Scope Limitation in Indian Banking: This challenge is predominantly related to data constraints. Specifically, there is a dearth of information in USD, and obtaining data on net profits and IT expenditures is particularly challenging. The limited availability of such data hampers an in-depth analysis of the banking sector in India.

- Exclusion of Macro-Economic Factors: The study may not account for macro-economic factors such as inflation rates, economic growth, political stability, and global economic events, which can significantly influence bank performance.

- Lack of Comparative Analysis with Other Industries: By concentrating solely on the banking sector, the study might miss out on broader economic trends that could be identified through a comparative analysis with other sectors.

- Potential for Misinterpretation of Trends: Relying on a limited set of variables could lead to a misunderstanding of underlying trends. For instance, high revenue does not necessarily indicate a healthy bank if other factors like rising bad debts are not considered.

- Timeframe Constraints: If the study is restricted to a specific timeframe, it might not capture long-term trends or cyclical patterns in the banking industry.

- Cross-Country Comparison Challenges: Directly comparing Indian and UK banks may be challenging due to different regulatory environments, market maturity, customer behaviors, and economic contexts.

- Inter-variable Relationships: The study might not fully explore the interplay or causal relationships between the chosen variables and other factors affecting the banking sector.

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- Impact of Non-Financial Factors: The research might overlook the impact of non-financial factors such as customer service quality, brand reputation, digital banking capabilities, and corporate governance standards.

- Generalizability of Findings: The results derived from these variables might not be generalisable to all banks in the UK and India, especially if the sample size is limited or if the selected banks are not representative of the entire banking sector.

- Historical Performance vs. Future Predictions: The study's reliance on historical data for these variables might not accurately predict future performance, especially in a rapidly changing economic and regulatory environment.

- Influence of Internal Policies: Internal bank policies and management decisions, which can significantly impact these variables, are not accounted for in the study

- Absence of Subjective Value Analysis: While banks disclose final financial outcomes in their annual reports, there is a notable lack of detailed discussion regarding the impact of IT investments on value creation or enhancement. This omission of subjective value assessment hinders a deeper understanding of how IT spending contributes to overall bank performance.

- Insufficient Product-Level Information: Another limitation is the lack of detailed product-level data. Banks typically report outcomes at a broader sectoral level, which makes it challenging to base research on specific banking products. This constraint limits the ability to conduct a granular analysis of product-specific performance within the banking industry.

3.20 Concluding Summary for Research Methodology

1. Linear regression will be used to predict the missing values of IT investment.
2. Python scripting and the ARIMA model coupled with KPSS will be used to predict the next ten years' revenue and IT investment.
3. To get exact p,d,q, and the appropriate parameters, the AIC (Akaike Information Criterion) model will be used.

- Note - AR (Autoregressive): This part models the changing variable as a linear combination of its previous values. It's identified by the parameter 'p', which refers to the number of lag observations in the model.

- I (Integrated): This represents the differencing of raw observations to make the time series stationary (i.e., constant mean and variance over time). The parameter 'd' indicates the degree of differencing.

- MA (Moving Average): This aspect models the model's error as a linear combination of error terms from the past forecasted points. The parameter 'q' denotes the size of the moving average window.

CHAPTER IV: RESULTS

4.1 Introduction

This section comprehensively analyses the hypotheses by comparing them against empirical data. It is essential to acknowledge that, for certain banks, data regarding IT investments from 2017 to 2022 is currently unavailable. A linear regression approach is employed to estimate the IT investment figures for those years to address this data gap.

Furthermore, a sophisticated analytical approach is adopted when dealing with hypotheses concerning a forward-looking horizon spanning the next ten years. Specifically, advanced time series analysis techniques are utilised, incorporating the Autoregressive Integrated Moving Average (ARIMA) model and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) method. These advanced methodologies are well-suited for examining and forecasting trends over an extended timeframe, ensuring the analysis's robustness and accuracy.

4.2 Condition for Stationarity

The KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test is used to test for stationarity in a time series. Stationarity implies that the properties of the series, such as mean and variance, do not change over time. Here are the conditions for stationarity in the context of the KPSS test:

- Null Hypothesis (H0): The series is stationary (has a constant mean, variance, and autocovariance that do not depend on time).

- Alternate Hypothesis (H1): The series is not stationary (it has a unit root).

- When using the KPSS test, the focus is on the p-value to determine whether to reject the null hypothesis:

- If the p-value is less than a chosen significance level (usually 0.05), you reject the null hypothesis, suggesting that the series is not stationary.

- If the p-value exceeds the significance level, you fail to reject the null hypothesis, suggesting that the series is stationary.

- It's important to note that failing to reject the null hypothesis does not necessarily prove that the series is stationary; it merely indicates insufficient evidence against stationarity.

4.2 Hypothesis 1

- **Projected 30- 50% Increase of Bank's Revenue Due to IT Investment Over the Next Five Years:**

- Each financial institution is inclined toward automating its customer-facing operations, necessitating substantial IT investments. These investments are expected to yield

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profitability and return on investment (ROI) returns. According to our hypothesis, an IT investment ranging from 8 to 15 % of revenue today is anticipated to increase business and customer acquisition across Retail, Corporate, and Wealth banking segments. The central question revolves around the magnitude of this revenue increase. Many banks have already embraced digital customer onboarding, online banking, and various online processes, including services such as bereavement management. These digitalisation efforts lead to cost savings and attract a more extensive customer base by adopting cutting-edge technology. In line with the hypothesis, as mentioned earlier, we will conduct an empirical analysis to ascertain the actual revenue impact over the next five-year period from 2022. This study aims to provide valuable insights into the financial implications of digitalisation in the banking sector and the exact % increase in revenue in the next five years.

- **Input – Bank Data having revenue from 2017 to 2022**
- **Output – Revenue value of 2027 and % difference between 2022 to 2027**
- **Method -Time series Python scripting using ARIMA and KPSS model**
- **Research Methodology:**
- Utilisation of a time-series machine learning prediction model developed in Python.
- **Note**: 2022 revenue value is predicted via time series and not from the input.
- **Summary of Results:**

Bank Name	KPSS Value	P value	Stationary	% Rise in Revenue in 5 years	Hypothesis Accepted /Rejected
UBS	0.41	0.07	Yes	169.05 %	Accepted
BNP	0.39	0.08	Yes	96.65 %	Accepted
CA	0.20	0.1	Yes	88.06 %	Accepted
BS	0.11	0,1	Yes	277.21 %	Accepted
Barclays	0.36	0.09	Yes	44.68 %	Accepted
HSBC	0.10	0.1	Yes	-28.94%	Rejected
HDFC	0.40	0.07	Yes	11.75%	Rejected
ICICI	0.37	0.08	Yes	-6.20%	Rejected

Table 4 Summary Result of Hypothesis 1

Source – Analysis using Time-series Analysis

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UBS (2027 Projection):

- KPSS Statistic: 0.41

- P-value: 0.07

- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}

- Fail to reject the null hypothesis (series is stationary).

- Revenue at 2022 – $39.72 billion

- Revenue at 2027 – $106.87 billion

- % Rise – 169.05

- Let's break down each term and its significance in the context of the provided information about UBS's revenue projection for 2027:

- **KPSS Statistic**: The KPSS (Kwiatkowski-Phillips-Schmidt-Shin) statistic is used to determine whether a time series data set is stationary or non-stationary. Stationarity is a critical assumption in many time series analysis methods. In this context, a KPSS Statistic of 0.41

- **P-value**: Given that the p-value exceeds the selected significance threshold of 0.05 in the case of UBS, we conclude that the series exhibits stationarity.

- **Critical Values**: Critical values are thresholds compared to the KPSS Statistic to determine whether the time series is stationary. The essential values depend on the chosen significance level (e.g., 1%, 2.5%, 5%, or 10%). If the KPSS Statistic is less than the critical value, the null hypothesis is not rejected, indicating stationarity.

- **Fail to Reject the Null Hypothesis**: The statement "Fail to reject the null hypothesis (series is stationary)" indicates that, based on the KPSS test results, there isn't enough evidence to conclude that the time series is non-stationary. In other words, the data is considered to be stationary. The critical value is more than the KPSS value for 5%, 2.5%, and 1%. The series is stationary across these values.

- **Revenue in 2022** – $39.72 billion: This value represents UBS's revenue in the year 2022, which is $39.72 billion. It serves as the starting point for the revenue projection.

- **Revenue in 2027** – $106.87 billion: This value represents the projected revenue for UBS in 2027, which is $106.87 billion. It is based on the analysis or modelling conducted.

- **% Rise – 169.05%**: The percentage rise is the increase in revenue from 2022 to 2027, expressed as a percentage. In this case, it's 169.05%, which means that UBS is projected to experience a significant increase in revenue over these five years.
  Now, let's interpret the significance and meaning of these terms:

- In summary, the information mentioned earlier suggests that based on the KPSS test, UBS's revenue data is stationary, and the company anticipates a significant increase in revenue by 2027. Stationarity is essential for reliable time series analysis and forecasting, implying that the data follows a stable pattern over time.

BNP :

- KPSS Statistic: 0.39

- P-value: 0.08

- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}

- Fail to reject the null hypothesis (series is stationary).

- Revenue at 2022 – 55.04 USD billion

- Revenue at 2027 – 108.24 USD billion

- % Rise – 96.65%

- The above information includes the results of a KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test and a comparison of revenue percentages for 2022 and 2027. Let's break down the interpretation of each part:

- **KPSS Statistic (0.39)**: The KPSS statistic is a test statistic calculated from the time series data. In this case, the calculated KPSS statistic is 0.39. It measures how far the observed data deviates from the null hypothesis of stationarity. A value closer to zero suggests that the series is more likely to be stationary.

- **P-value (0.08):** Given that the p-value exceeds the selected significance threshold of 0.05 in the case of BNP, we conclude that the series exhibits stationarity.

- **Critical Values**: These thresholds can be compared against the KPSS statistic to determine whether to reject the null hypothesis. The critical values are selected based on the desired significance level (e.g., 1%, 2.5%, 5%, or 10%). By theory, science fails to reject the null hypothesis if the KPSS statistic is less than the critical value. The critical value is more than the KPSS value for 5%, 2.5%, and 1%. The series is stationary across these values.

- Therefore, based on the KPSS test results, theory fails to reject the null hypothesis, meaning the series is stationary. However, the p-value is relatively close to the

significance level, so there may be a suggestion of some mild departure from strict stationarity. Still, it's not significant enough to conclude that the series is non-stationary. Regarding the comparison of revenue percentages for the years 2022 and 2027:

- The revenue in 2022 is 55.04 USD billion.

- The revenue in 2027 is 108.24 USD billion.

- The following formula can calculate the revenue percentage change from 2022 to 2027.

- Percentage Change = ((New Value - Old Value) / Old Value) * 100

- **Percentage Change** = 96.65%

CA :

- KPSS Statistic: 0.20

- P-value: 0.1

- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}

- Fail to reject the null hypothesis (series is stationary)

- Revenue for 2022 - $25.48 Billion

- Revenue at 2027- $47.92 Billion

- %increase – 88.06 %

- The information provided includes the results of a KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test and a comparison of revenue percentages for 2022 and 2032. Let's break down the interpretation of each part:

- **KPSS Statistic** (0.20): The KPSS statistic is a test statistic calculated from the time series data. In this case, the calculated KPSS statistic is approximately 0.2032. It measures how far the observed data deviates from the null hypothesis of stationarity. A value closer to zero suggests that the series is more likely to be stationary.

- **P-value (0.1):** Given that the p-value exceeds the selected significance threshold of 0.05 in the case of CA, we conclude that the series exhibits stationarity.

- **Critical Values**: The vital values are thresholds that can be compared with the KPSS statistic to determine whether to reject the null hypothesis. The critical values are selected based on the desired significance level (e.g., 1%, 2.5%, 5%, or 10%). These significance values indicate that the theory fails to reject the null hypothesis if the KPSS statistic is less than the critical value.

- Now, let's interpret the results in the context of stationarity:

- Therefore, based on the KPSS test results, the theory fails to reject the null hypothesis, meaning the series is stationary. The p-value, although not extremely small, is still more significant than the significance level, indicating that the theory does not have enough evidence to conclude that the series is non-stationary.
- Regarding the comparison of revenue percentages for the years 2022 and 2032:
- The revenue in 2022 is $25.48 billion.
- The revenue in 2032 is $47.92 billion.
- The following formula can be used to calculate the percentage change from 2022 to 2032
- Percentage Change = ((New Value - Old Value) / Old Value) * 100
- Percentage Change = (($47.92 - $25.48) / $25.48) * 100 ≈ 88.06 %
- So, the revenue increased by approximately 88% from 2022 to 2032

BS :
- KPSS Statistic: 0.11
- P-value: 0.1
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary)
- Revenue for 2022 - $89.48 Billion
- Revenue at 2027: $337.53 Billion
- % change –277.21%
- Let's break down each number and term in the context of the provided information about revenue for a specific company (not specified) for the years 2022 and 2032:
- **KPSS Statistic (0.11):** The KPSS (Kwiatkowski-Phillips-Schmidt-Shin) Statistic is a test to determine whether a time series data set is stationary or non-stationary. In this case, the KPSS Statistic is 0.11.
- **P-value (0.1):** Given that the p-value exceeds the selected significance threshold of 0.05 in the case of BS, we conclude that the series exhibits stationarity.
- **Critical Values:** Critical values are thresholds compared to the KPSS Statistic to determine whether the time series is stationary. The essential values depend on the chosen significance level (e.g., 1%, 2.5%, 5%, or 10%). If the KPSS Statistic is less than the critical value, the null hypothesis is not rejected, indicating stationarity.

- **Fail to Reject the Null Hypothesis**: The statement "Fail to reject the null hypothesis (series is stationary)" indicates that, based on the KPSS test results, there isn't enough evidence to conclude that the time series is non-stationary. In other words, the data is considered to be stationary.

- **Revenue for 2022 - $89.48 Billion**: This value represents the company's revenue in 2022, which is $89.48 billion.

- **Revenue at 2027 - $337.53 Billion**: This value represents the company's projected revenue in 2032, which is $ 337.53 Billion.

- **% Increase**: This value represents the percentage increase in revenue from 2022 to 2032, which is 277.21%.

Barclays:
- KPSS Statistic: 0.36
- P-value: 0.09
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary)
- Revenue for 2022 -$30.86 Billion
- Revenue at 2027- $44.65 Billion
- %increase – 44.68%
- Let's examine each value and its significance in the context of the provided information about revenue for a specific company (not specified) for the years 2022 and 2032:

- **KPSS Statistic (0.36):** The KPSS (Kwiatkowski-Phillips-Schmidt-Shin) Statistic tests whether a time series data set is stationary or non-stationary. In this case, the KPSS Statistic is 0.36.

- **P-value (0.09):** Given that the p-value exceeds the selected significance threshold of 0.05 in the case of Barclays , we conclude that the series exhibits stationarity.

- **Critical Values**: Critical values are thresholds compared to the KPSS Statistic to determine whether the time series is stationary. The essential values depend on the chosen significance level (e.g., 1%, 2.5%, 5%, or 10%). If the KPSS Statistic is less than the critical value, the null hypothesis is not rejected, indicating stationarity.

- **Fail to Reject** the Null Hypothesis: The statement "Fail to reject the null hypothesis (series is stationary)" indicates that, based on the KPSS test results, there isn't enough

evidence to conclude that the time series is non-stationary. In other words, the data is considered to be stationary.

- **Revenue for 2022** - $30.86 Billion: This value represents the company's revenue in 2022, which is $30.86 billion.

- **Revenue at 2027** - $44.65 Billion: This value represents the company's projected revenue in 2027, which is a 44.68% increase.

- **Percentage Increase (44.68%):** This value represents the percentage increase in revenue from 2022 to 2027. This indicates that the company's revenue will increase by 44.68% over the next ten years.

- In summary, the provided information suggests that based on the KPSS test, the company's revenue data is stationary, and the company anticipates a substantial revenue increase by 2032. Stationarity is essential for reliable time series analysis, and the projected revenue increase represents a considerable growth opportunity for the company.

HSBC (2027 Projection):
- KPSS Statistic: 0.10
- P-value: 0.10
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary).
- Revenue at 2022 – $75.79 billion
- Revenue at 2027 – $53.85 billion
- % Decrease –28.94% decrease
- **KPSS Statistic (0.10):** The KPSS (Kwiatkowski-Phillips-Schmidt-Shin) statistic determines whether a time series data set is stationary or non-stationary. In this case, the KPSS statistic is 0.10.

- **P-value (0.10):** Given that the p-value exceeds the selected significance threshold of 0.05 in the case of HSBC, we conclude that the series exhibits stationarity.

- **Critical Values**: Critical values are thresholds used to compare with the KPSS statistic to determine whether the time series is stationary or non-stationary. The essential values depend on the chosen significance level (e.g., 1%, 2.5%, 5%, or 10%). In this case, the critical values are as follows:

- 10% Critical Value: 0.347

- 5% Critical Value: 0.463
- 2.5% Critical Value: 0.574
- 1% Critical Value: 0.739
- **Fail to reject the null hypothesis (series is stationary**): This statement indicates that based on the KPSS test results, there is insufficient evidence to reject the null hypothesis that the time series data is stationary. In other words, the data does not exhibit significant non-stationary characteristics.
  - **Revenue in 2022 – $75.79 billion**: This value represents the revenue generated by the entity in 2022, which is $75.79 billion.
  - **Revenue in 2027 – $53.85 billion:** This value represents the revenue projected for 2027, which is $53.85 billion.
  - **Percentage Decrease (28.94% decrease):** This value represents the revenue percentage decrease from 2022 to 2027. It indicates an expected revenue reduction of 28.9 % over these five years.

HDFC:
- KPSS Statistic: 0.40
- P-value: 0.07
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary)
- Revenue for 2022 -$ 21.13Billion
- Revenue at 2027 – $23.61Billion
- %increase – (11.75%)

The information provided includes the results of a KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test and a comparison of revenue percentages for 2022 and 2032. Let's break down the interpretation of each part:

- **KPSS Statistic (0.40):** The KPSS statistic is a test statistic calculated from the time series data. In this case, the calculated KPSS statistic is approximately 0.4005. It measures how far the observed data deviates from the null hypothesis of stationarity. A value closer to zero suggests that the series is more likely to be stationary.

- **P-value (0.07):** Given that the p-value exceeds the selected significance threshold of 0.05 in the case of HDFC, we conclude that the series exhibits stationarity..

- **Critical Values**: The essential values are thresholds that can be compared with the KPSS statistic to determine whether to reject the null hypothesis. The critical values are selected based on the desired significance level (e.g., 1%, 2.5%, 5%, or 10%). The theory fails to reject the null hypothesis if the KPSS statistic is less than the critical value.

- Therefore, based on the KPSS test results, the theory fails to reject the null hypothesis, meaning the series is stationary. The p-value, although not extremely small, is still more significant than the significance level, indicating that the theory does not have enough evidence to conclude that the series is non-stationary.

- Regarding the comparison of revenue percentages for the years 2022 and 2027:

- The revenue in 2022 is $21.13 billion.

- The revenue in 2027 is $ 23.61 billion.

- The formula can calculate the revenue percentage change from 2022 to 2032.

- Percentage Change = ((New Value - Old Value) / Old Value) * 100

- **Percentage Change** = 11.75%

ICICI:

- KPSS Statistic: 0.37

- P-value: 0.08

- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}

- Fail to reject the null hypothesis (series is stationary)

- Revenue for 2022 -$ 21.10 Billion

- Revenue at 2027- $19.79 Billion

- %decrease) – (-6.20%)

- The information provided includes the results of a KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test and a comparison of revenue percentages for 2022 and 2032. Let's break down the interpretation of each part:

- **KPSS Statistic (0.37):** The KPSS statistic is a test statistic calculated from the time series data. In this case, the calculated KPSS statistic is approximately 0.3758. It measures how far the observed data deviates from the null hypothesis of stationarity. A value closer to zero suggests that the series is more likely to be stationary.

- **P-value (0.08):** Given that the p-value exceeds the selected significance threshold of 0.05 in the case of ICICI, we conclude that the series exhibits stationarity.

- **Critical Values**: The vital values are thresholds that can be compared with the KPSS statistic to determine whether to reject the null hypothesis. The critical values are selected based on the desired significance level (e.g., 1%, 2.5%, 5%, or 10%). The theory fails to reject the null hypothesis if the KPSS statistic is less than the critical value.

- Therefore, based on the KPSS test results, theory fails to reject the null hypothesis, meaning the series is stationary. The p-value, although not extremely small, is still more significant than the significance level, indicating that theory does not have enough evidence to conclude that the series is non-stationary.

- Regarding the comparison of revenue percentages for the years 2022 and 2032:

- The revenue in 2022 is \$21.10 billion.

- The revenue in 2027 is 19.79 billion.

- The following formula can be used to calculate the percentage change from 2022 to 2032

- Percentage Change = ((New Value - Old Value) / Old Value) * 100

- Percentage Change = (\$19.79 - \$21.10) / \$21.10) * 100 ≈ -6.20%

4.3 Hypothesis 2

- **A Singular IT Investment Yields Cumulative Returns and an increase in revenue in the coming ten years.**

- IT investments are pivotal in shaping a bank's operating costs, and the financial services industry relies heavily on technology to function efficiently. Digital transformation and IT infrastructure constitute the backbone of modern banking operations. It is widely recognised that banks' substantial IT investments can redefine their prospects, leading to the acquisition of significant customer segments or the emergence of new challenger banks leveraging digitisation.

- Following our hypothesis, if a significant digital investment is made in 2022, it is anticipated that the subsequent 5-10 years will witness a noteworthy impact on revenue. This impact is expected to directly result from the concerted efforts directed towards IT transformation and modernisation. This research examines and quantifies the effects of information technology transformation on revenue within the specified timeframe.

- Result -

- **Research Methodology –Time series Machine Learning Python script using ARIMA and KPSS to predict revenue of 2032**

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- **Input -2017 to 2022 Available Revenue**
- **Output - Revenue of 2032 of each Bank**
- **Method -Time series Python scripting using ARIMA and KPSS model and AIC**
- Given that the p-value exceeds the selected significance threshold of 0.05 in all cases, we conclude that the series exhibits stationarity.

Source – KPSS and AIC model result

Bank Name	Revenue% increase in 10 years after IT investment @2032	2022 IT Revenue in Billions	2032 Revenue in Billions	P value	Hypothesis
UBS	798%	$39.72	$356.77	0.07	Accepted
BNP	403%	$55.04	$277.19	0.08	Accepted
CA	140%	$25.48	$61.37	0.1	Accepted
BS	627%	$89.48	$651.08	0.1	Accepted
Barclays	114%	$30.86	$66.19	0.09	Accepted
HSBC	-12%	$75.79	$66.39	0.1	Rejected
HDFC	-19%	$21.13	$17.06	0.07	Rejected
ICICI	-57%	$21.10	$9.09	0.08	Rejected

Table 5 Summary Result of Hypothesis 2**.**

- **UBS**: UBS experienced a substantial 798% increase in revenue from $39.72 billion in 2022 to $356.77 billion in 2032. The hypothesis for UBS is "Accepted," indicating that the revenue increase is significant and successful.
- **BNP:** BNP saw a 403% increase in revenue from $55.04 billion in 2022 to $277.19 billion in 2032. The hypothesis for BNP is "Accepted," suggesting that their revenue growth is significant and successful.
- **CA (Crédit Agricole):** Crédit Agricole's revenue increased by 140% from $23.97 billion in 2022 to $61.37 billion in 2032. The hypothesis for CA is "Accepted," implying that their revenue increase is deemed significant and successful.
- **BS (Banco Santander):** Banco Santander experienced a substantial 627% increase in revenue from $89.48 billion in 2022 to $651.08 billion in 2032. The hypothesis for BS is "Accepted," indicating that their revenue growth is significant and successful.

- **Barclays**: Barclays' revenue increased by 114% from $30.86 billion in 2022 to $66.19 billion in 2032. The hypothesis for Barclays is "Accepted," implying that their revenue increase is significant and successful.

- **HSBC**: HSBC's Revenue Increase (-12%): This value indicates the actual change in revenue for HSBC between 2022 and 2032. In this case, there was a decrease or negative change of 12%. Rejected: The term "Rejected" suggests that the actual outcome did not support the hypothesis made regarding the revenue increase after the IT investment. In this case, the assumption that HSBC's revenue would increase following the IT investment in 2032 was rejected because the revenue decreased by 12% during the specified period.

- **HDFC:** HDFC experienced a 19% decrease in revenue from $21.13 billion in 2022 to $17.06 billion in 2032. The hypothesis for HDFC is "Rejected," suggesting that their revenue decrease is not considered significant or successful.

- **ICICI:** ICICI experienced a substantial 57% decrease in revenue from $21.10 billion in 2022 to $9.09 billion in 2032. The hypothesis for ICICI is "Rejected," indicating that their revenue decrease is not considered significant or successful.

- The table explains how different banks' revenues changed ten years after making IT investments in 2032. Banks with "Accepted" hypotheses saw significant revenue increases, while banks with "Rejected" hypotheses experienced revenue decreases or changes that were not considered essential or successful. These numbers reflect the impact of IT investments on these banks' financial performance.

4.4 Hypothesis 3

- **Technological Adoption Positively Influences the Cost-to-Income Ratio for 2017 to 2022.**

- As per the literature review, it becomes evident that banks' profit depends on the use of technology in the digital world. However, how much has yet to be studied in detail? The current understanding is that the income ratio is on an upbeat track due to the use of technology. After our objective analysis, let's see whether a similar theory is sound.

- **Input data – 2017 to 2022 data with missing values for IT investment**

- **Output Data: 2017 to 2022 data with IT investment predicted by linear regression.**

- **Research Methodology: Available data with a literature survey and linear regression to predict data for unavailable values.**

- **R-squared Value (0.90):** The value typically ranges from 0 to 1. It measures the goodness of fit of the linear regression model. Specifically, an R-squared value of 1 indicates that the model perfectly fits the data, explaining 100% of the variance. An R-squared value of 0 indicates that the model does not present any variance, providing no predictive power. In this case, An R-squared value of approximately 0.9023 means that the linear regression model explains approximately 90.23% of the variance in IT investment using the chosen independent variables or features.

- This relatively high R-squared value indicates that the linear regression model fits the training data well and explains a significant portion of the variability in IT investment.

- It suggests that the features used in the model have a strong linear relationship with IT investment, and the model can make reasonably accurate predictions based on the training data.

- Each financial institution demonstrates the influence of IT expenditure on the cost-to-income ratio, validating the proposed hypothesis.

- Based on the below-mentioned results for the cost-to-income ratio, IT investment from 2017 to 2022, the impact, and the corresponding hypotheses, we can assess the contributions to both theory and management practice as follows:

Source – ARIMA KPSS and AIC model result

Bank Name	Cost-to-income ratio%	IT Investment in Billion 2017 to 2022	Impact	Hypothesis
UBS	81.50 to 72.10	$2.68 to $4	Positive	Accepted
BNP	69.4 to 67.30	$4.28 to $5.26	Positive	Accepted
CA	64 to 58.50	$2.53 to $3.28	Positive	Accepted
BS	47.40 to 45.80	$1.21 to $2.47	Positive	Accepted
Barclays	68 to 59.80	$2.71 to $3.25	Positive	Accepted
HSBC	60.30 to 64.40	$5.43 to $6.10	Negative	Rejected
HDFC	37.8 to 41.5	$2.41 to $3.47	Negative	Rejected
ICICI	42.60 to 40.60	$4.0 to $4.73	Positive	Accepted

Table 6 Summary Result of Hypothesis 3

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- **UBS:** UBS reduced its cost-to-income ratio from 81.50% to 72.5% and from $2.68 billion to $4 billion in IT investments. The impact of this investment was "Positive," indicating an improvement in efficiency. The hypothesis for UBS is "Accepted," suggesting that the improvement in the cost-to-income ratio is considered significant and successful.

- **Barclays**: Barclays reduced its cost-to-income ratio from 68% to 59.80% to $2.71 billion to $3.25 billion in IT investments. The impact of this investment was "Positive," indicating an improvement in efficiency. The hypothesis for Barclays is "Accepted," implying that the improvement in the cost-to-income ratio is considered significant and successful.

- **BNP**: BNP reduced its cost-to-income ratio from 69.4% to 67.30% and from $4.28 billion to $5.26 billion in IT investments. The impact of this investment was "Positive," indicating an improvement in efficiency. The hypothesis for BNP is "Accepted," suggesting that the improvement in the cost-to-income ratio is considered significant and successful.

- **CA**: Cost-to-Income Ratio% (64 to 58.50): This range represents the cost-to-income ratio percentage for CA, indicating that it falls within the specified range.

- IT Investment in Billion ($2.53 to $3.28): This range represents the IT investment in billions of dollars made by CA, showing that it falls within the specified range.

- Impact (Positive): The "Positive" impact suggests that the IT investments made by CA have positively affected the cost-to-income ratio.

- Hypothesis (Accepted): The hypothesis that IT investments positively impact the cost-to-income ratio has been accepted.

- **BS** (Banco Santander): Banco Santander reduced its cost-to-income ratio from 47.40% to 45.80% to $1.21 billion to $2.47 billion in IT investments. The impact of this investment was "Positive," indicating an improvement in efficiency. The hypothesis for BS is "Accepted," implying that the improvement in the cost-to-income ratio is considered significant and successful.

- **HSBC:**

- Cost-to-Income Ratio% (60.30 to 64.40): This range represents the cost-to-income ratio percentage for HSBC, indicating that it falls within the specified range.

- IT Investment in Billion ($5.43 to $6.10): This range represents the IT investment in billions of dollars made by HSBC, showing that it falls within the specified range.

- Impact (Negative): The "Negative" impact suggests that the IT investments made by HSBC have harmed the cost-to-income ratio.

- Hypothesis (Rejected): The hypothesis that IT investments positively impact the cost-to-income ratio has been rejected for HSBC due to the negative impact observed.

- **HDFC**: Cost-to-Income Ratio% (37.8 to 41.5): This range represents the cost-to-income ratio percentage for HDFC, indicating that it falls within the specified range.

- IT Investment in Billion ($2.41 to $3.47): This range represents the IT investment made by HDFC, indicating that it falls within the specified range.

- Impact (Negative): The "Negative" impact suggests that the IT investments made by HDFC have negatively affected the cost-to-income ratio, potentially leading to reduced operational efficiency.

- Hypothesis (Rejected): The hypothesis that IT investments positively impact the cost-to-income ratio has been rejected for HDFC, indicating evidence supporting a negative influence on efficiency.

- **ICICI**: ICICI reduced its cost-to-income ratio from 42.60% to 40.60%, from $4.0 billion to $4.73 billion in IT investments. The impact of this investment was "Positive," indicating an improvement in efficiency. The hypothesis for ICICI is "Accepted," suggesting that the improvement in the cost-to-income ratio is considered significant and successful.

- The table explains how different banks' cost-to-income ratios improved after making IT investments. Banks with "Positive" impacts and "Accepted" hypotheses achieved significant efficiency improvements, reflected in the reduction of their cost-to-income ratios. These numbers demonstrate the positive effects of IT investments on the operational efficiency of these banks.

4.5 Hypothesis 4

- **With the advent of advanced technologies, coupled with Artificial Intelligence (AI) and Machine Learning (ML) capabilities, it is projected that IT investments will increase over the period from 2027 to 2032**

- **Input – 2017 to 2022 IT investment in USD billion**

- **Output – IT investment in USD billion from 2022 to 2032 for each of the bank**

- **Research Methodology – Time series Machine learning Python using ARIMA and KPSS model**

- **Summary of Results:**

Bank Name	KPSS Value	P value	Stationary	% Rise in IT investment in 10 years	Hypothesis Accepted /Rejected
UBS	0.37	0.08	Yes	-8.0	Rejected
Barclays	0.45	0.05	Yes	-5.4	Rejected
BNP	0.51	0.03	No	-6.8	Rejected
BS	0.39	0.08	Yes	-2.5	Rejected
CA	0.16	0.10	Yes	-0.5	Rejected
HSBC	0.14	0.10	Yes	0.4	Accepted
HDFC	0.37	0.08	Yes	7.0	Accepted
ICICI	0.34	0.09	Yes	31.1	Accepted

Table 7 Summary Result of Hypothesis 4

UBS

- KPSS Statistic: 0.37
- P-value: 0.08, as it is greater than the significance level of 0.05, and the series is stationary.
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary).
- 2022 IT investment %- 10.1%
- 2032 IT Investment % - 2.1%%

The KPSS (Kwiatkowski-Phillips-Schmidt-Shin) statistic for the data is 0.37, and the associated p-value is 0.08. These statistical values are used to assess the stationarity of the dataset. Critical values are compared to evaluate stationarity. The essential values at different significance levels are as follows:

- 10% significance level: 0.34
- 5% significance level: 0.46
- 2.5% significance level: 0.57
- 1% significance level: 0.73

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- When analysing the IT investment percentages for 2022 and 2032, it is observed that the IT investment as a percentage of the total is 10% in 2022 and 15% in 2032.

- Based on the statistics mentioned above and IT investment data, the conclusion can be drawn as follows:

- Given that the p-value exceeds the selected significance threshold of 0.05 in the case of UBS, we conclude that the series exhibits stationarity. Additionally, the IT investment percentages for 2022 and 2032 reveal a change in investment strategy over the years, with a planned decrease in IT investment from 10% to 2.1% by 2032.

- It's important to note that while the data may exhibit stationarity, the change in IT investment strategy from 2022 to 2032 implies a deliberate effort to allocate a higher percentage of resources to IT, potentially indicating a shift in priorities or business strategy.

Barclays
- KPSS Statistic: 0.45
- P-value: 0.09 - Series is stationary as P is greater than threshold 0.05
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis - series is stationary at significance levels 5%, 2.5% and 1 %
- 2022 investment % - 10.5%
- 2032 investment % - 5.1%

BNP
- KPSS Statistic: 0.51
- P-value: 0.03 – Series is not stationary.
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}.
- 2022 investment % - 9.6%
- 2032 investment % - 2.8%

BS
- KPSS Statistic: 0.39
- P-value: 0.08 - Series is stationary as P is greater than threshold 0.05
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Series is stationary at 5%, 2.5% and 1% significance level.

- 2022 investment % - 2.8%
- 2032 investment % - 0.3%

CA

- KPSS Statistic: 0.16
- P-value: 0.1- Series is stationary as P is greater than threshold 0.05
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary at all significance levels.
- 2022 investment % - 12.9%
- 2032 investment % - 12.4%

HSBC

- KPSS Statistic: 0.14
- P-value: 0.1 - Series is stationary as P is greater than threshold 0.05
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary at all significance levels.)
- 2022 investment % - 8.0 %
- 2032 investment % - 8.4%

HDFC

- KPSS Statistic: 0.37
- P-value: 0.08 - Series is stationary as P is greater than threshold 0.05
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary at 5%.2.5%,1%)
- 2022 investment % - 16.4%
- 2032 investment % - 23.4%

ICICI

- KPSS Statistic: 0.34
- P-value: 0.09 - Series is stationary as P is greater than threshold 0.05
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary 5%, 2.5% and 1%)
- 2022 investment % - 22.4%
- 2032 investment % - 53.5% -- rise by 31.1%

4.6 Hypothesis 5

The impact of IT (Information Technology) investment on the overall bank performance is minimal.

Input –The year 2017 to 2022 IT investment

Output – Time series machine learning Python script for IT investment used in Hypothesis 4.

Source – Result of Hypothesis 1 to 4

Bank	Year	Revenue (USD)Billion	IT Investment (USD)Billion	%of Revenue
UBS	2017	33.52	2.68	8%
UBS	2018	35.38	2.37	7%
UBS	2019	35.15	2.30	7%
UBS	2020	36.03	3.44	10%
UBS	2021	37.22	3.90	10%
UBS	2022	39.72	4.00	10.1%
UBS	2023	44.53	5.07	11.4%
UBS	2024	52.65	4.70	8.9%
UBS	2025	65.08	5.36	8.2%
UBS	2026	82.82	5.69	6.9%
UBS	2027	106.87	6.37	6.0%
UBS	2028	138.23	5.99	4.3%
UBS	2029	177.9	7.05	4.0%
UBS	2030	226.88	7.16	3.2%
UBS	2031	286.17	7.56	2.6%
UBS	2032	356.77	7.55	2.1%
BNP	2017	49.59	4.28	9%
BNP	2018	50.95	4.62	9%
BNP	2019	50.6	4.50	9%
BNP	2020	51.05	4.83	9%
BNP	2021	52.35	4.82	9%
BNP	2022	55.04	5.26	9.6%
BNP	2023	59.66	5.29	8.9%
BNP	2024	66.75	5.74	8.6%
BNP	2025	76.85	5.77	7.5%
BNP	2026	90.5	6.21	6.9%
BNP	2027	108.24	6.25	5.8%
BNP	2028	130.61	6.69	5.1%
BNP	2029	158.15	6.72	4.2%
BNP	2030	191.4	7.17	3.7%
BNP	2031	230.9	7.20	3.1%
BNP	2032	277.19	7.65	2.8%

CA	2017	21.02	2.53	12%
CA	2018	23.71	2.87	12%
CA	2019	37.73	4.69	12%
CA	2020	23.97	3.18	13%
CA	2021	27.18	3.46	13%
CA	2022	23.97	3.28	13.7%
CA	2023	37.16	4.57	12.3%
CA	2024	39.85	4.91	12.3%
CA	2025	42.54	5.25	12.3%
CA	2026	45.23	5.59	12.4%
CA	2027	47.92	5.93	12.4%
CA	2028	50.61	6.27	12.4%
CA	2029	53.3	6.61	12.4%
CA	2030	55.99	6.95	12.4%
CA	2031	58.68	7.29	12.4%
CA	2032	61.37	7.63	12.4%
BS	2017	79.23	1.21	2%
BS	2018	80.78	1.55	2%
BS	2019	79.21	2.16	3%
BS	2020	66.28	2.11	3%
BS	2021	70.39	2.18	3%
BS	2022	89.48	2.47	2.8%
BS	2023	121.49	1.79	1.5%
BS	2024	164.36	0.99	0.6%
BS	2025	216.03	1.77	0.8%
BS	2026	274.44	2.99	1.1%
BS	2027	337.53	2.53	0.7%
BS	2028	403.24	1.35	0.3%
BS	2029	469.51	1.42	0.3%
BS	2030	534.28	2.09	0.4%
BS	2031	595.49	2.08	0.3%
BS	2032	651.08	2.09	0.3%
Barclays	2017	27.16	2.72	10%
Barclays	2018	28.21	2.90	10%
Barclays	2019	27.62	2.80	10%
Barclays	2020	27.94	3.06	11%
Barclays	2021	30.19	2.84	9%
Barclays	2022	30.86	3.25	10.5%
Barclays	2023	32.23	2.99	9.3%
Barclays	2024	35.67	3.33	9.3%
Barclays	2025	37.61	3.05	8.1%
Barclays	2026	40.04	3.35	8.4%
Barclays	2027	44.65	3.08	6.9%

Bank	Year			
Barclays	2028	47.86	3.36	7.0%
Barclays	2029	51.36	3.10	6.0%
Barclays	2030	57.13	3.35	5.9%
Barclays	2031	61.63	3.12	5.1%
Barclays	2032	66.19	3.35	5.1%
HSBC	2017	66.63	5.43	8%
HSBC	2018	75.43	5.76	8%
HSBC	2019	82.68	5.10	6%
HSBC	2020	66.2	5.10	8%
HSBC	2021	62.29	6.00	10%
HSBC	2022	75.79	6.10	8.0%
HSBC	2023	67.4	4.75	7.0%
HSBC	2024	58.6	5.41	9.2%
HSBC	2025	72.6	4.84	6.7%
HSBC	2026	69.0	6.34	9.2%
HSBC	2027	53.9	4.51	8.4%
HSBC	2028	63.7	5.60	8.8%
HSBC	2029	69.2	4.72	6.8%
HSBC	2030	52.4	6.44	12.3%
HSBC	2031	54.2	4.43	8.2%
HSBC	2032	66.4	5.63	8.4%

Indian Banks Data

Bank	Year	Revenue (USD)Billion	IT Investment (USD)Billion	%of Revenue
HDFC	2017	12.88	2.42	19%
HDFC	2018	15.17	2.70	18%
HDFC	2019	17.37	2.97	17%
HDFC	2020	18.7	3.20	17%
HDFC	2021	20.94	3.46	17%
HDFC	2022	21.13	3.47	16.4%
HDFC	2023	23.18	4.00	17%
HDFC	2024	22.50	4.00	18%
HDFC	2025	24.07	4.00	17%
HDFC	2026	22.82	4.00	18%
HDFC	2027	23.61	4.00	17%
HDFC	2028	22.05	4.00	18%
HDFC	2029	21.86	4.00	18%
HDFC	2030	20.15	4.00	20%
HDFC	2031	18.86	4.00	21%
HDFC	2032	17.06	4.00	23.4%

ICICI	2017	16.89	4.00	24%
ICICI	2018	18.44	4.38	24%
ICICI	2019	18.77	4.60	25%
ICICI	2020	21.11	4.87	23%
ICICI	2021	21.78	4.89	22%
ICICI	2022	21.10	4.73	22.4%
ICICI	2023	22.44	4.45	20%
ICICI	2024	22.23	4.13	19%
ICICI	2025	20.54	3.87	19%
ICICI	2026	20.88	3.76	18%
ICICI	2027	19.79	3.85	19%
ICICI	2028	17.10	4.09	24%
ICICI	2029	16.43	4.41	27%
ICICI	2030	14.46	4.70	33%
ICICI	2031	10.78	4.88	45%
ICICI	2032	9.10	4.87	53.5%

Table 8 Summary Result of Hypothesis 5

- **Observations: Increasing IT Investment with decreasing %:**
  All banks consistently increase IT investment in absolute dollar terms over the years.
  The percentage of revenue allocated to IT investment is generally decreasing over time
  for most banks.

- **Revenue Growth:**
  Most banks' revenue has grown over the 15-year period. Notably, UBS, BNP, CA, and
  BS show significant growth.
  HSBC, HDFC, and ICICI show a decrease in revenue towards the latter part of the
  timeline, which might warrant concern or further analysis.

- UBS: Over a decade, revenue has significantly increased, but the percentage of revenue
  allocated to IT investment has dropped, suggesting either more efficient IT spending or
  scaling benefits where IT investment growth doesn't match revenue growth.

- BNP: Shows an impressive revenue rise with a relative decrease in the IT investment
  percentage. The trend suggests that as revenue grows, the proportion dedicated to IT
  becomes smaller.

- CA: This bank's data indicates a stable proportion of revenue invested in IT, implying
  that IT spending scales proportionately with revenue growth.

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- BS: A dramatic increase in revenue is accompanied by a substantial decrease in the percentage of revenue for IT, suggesting that IT spending may not be a significant factor in the bank's revenue generation strategy or that other areas may have become more of a focus.

- Barclays: Experiences a doubling in revenue with a reduction by half in the percentage of revenue spent on IT, indicating gains in IT efficiency or changes in strategic spending.

- HSBC: Uniquely, there is a decrease in revenue over the decade, yet an increase in the percentage of revenue spent on IT, which could indicate investment in IT to stimulate future growth or a restructuring phase.

- HDFC: The bank shows a reduction in revenue but an increase in IT spending as a percentage of revenue, suggesting a strategic push towards technology despite revenue challenges.

- ICICI: There's a sharp decrease in revenue with an even sharper rise in the percentage of revenue dedicated to IT investment, which could imply a focus on digital transformation or tech investment to reverse the declining revenue trend

- **Return on IT Investment:**

  The return on IT investment appears to vary significantly between banks. Some banks seem to leverage IT investments more effectively to grow revenue than others.

- **Revenue Volatility:**

  Some banks show volatility in their year-over-year revenue percentages, which could indicate market conditions, strategic decisions, or operational changes impacting financial performance.

- **Strategic Implications:**

  Banks with decreasing revenue despite increased IT investment may need to reassess their IT strategy, ensure that investments align with overall business objectives, and drive innovation that leads to revenue generation.

  For banks with a high percentage of revenue attributed to IT investments, evaluating investments is driving sufficient innovation, and efficiency is essential to be essential.

- **Long-term Planning:**

  The data spans 15 years, suggesting long-term strategic planning in IT investment. Banks seem to be investing in IT with an expectation of long-term benefits, such as

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improved customer service, operational efficiency, and development of new digital products.

- **Impact of External Factors:**

The data does not account for external factors like economic downturns, regulatory changes, or competitive pressures, which can significantly affect both revenue and the effectiveness of IT investments.

It's important to note that these observations are based on the data provided, and a deeper analysis would require considering various factors, including the banks' business objectives, market conditions, and technology priorities. The IT investment strategy may also have different implications and outcomes for each bank's operations and competitiveness.

Because IT investment constitutes less than 20% of the overall financial portfolio, and considering that we lack the requisite data to compute the subjective value associated with a 20% investment, this analysis leads to the conclusion that the impact of the investment is constrained or limited.

4.7 Hypothesis Result Summary:

Source – Hypothesis 1 to 5 Result

Hypothesis	Brief	Result
Hypothesis 1	Projected 30-50% revenue increase in the next five years	Accepted for five banks out of Eight.
Hypothesis 2	IT investment increases revenue	Accepted for five banks out of Eight.
Hypothesis 3	IT investment impacts cost-to-income ratio	Accepted for Six banks out of Eight.
Hypothesis 4	IT investment will rise in the next ten years	Accepted for three banks out of Eight.
Hypothesis 5	IT investment impact is limited.	Accepted for all banks except BNP as the BNP P value is less than the chosen significance value of 0.05.

Table 9 Summary Result of Hypothesis 1 to 5

CHAPTER V: DISCUSSION

5.1 Introduction

This chapter will delve into the outcomes derived from testing the hypotheses. Our research encompasses five distinct hypotheses, each yielding its results. From a banking perspective, one of the hypotheses provides a definitive outcome. However, there are also insights to be gleaned from a statistical standpoint. For instance, while a hypothesis may be validated through KPSS methods, it could simultaneously be deemed inapplicable when evaluated from a banking perspective due to specific conditions of the hypothesis. Furthermore, this chapter will elaborate on this research's significant theoretical contributions and practical implications.

5.2 Hypothesis 1 Discussion

Projected 30- 50% Increase of Bank's Revenue Due to IT Investment Over the Next Five Years:

Let's discuss hypothesis one results

Source – KPSS Model and AIC model result

As the p-value exceeds the significance level in all cases, the theory fails to reject the null hypothesis, suggesting that the series is stationary

Bank Name	KPSS Value	P value	Stationary	% Rise in Revenue in 5 years	Hypothesis Accepted /Rejected
UBS	0.41	0.07	Yes	169.05 %	Accepted
BNP	0.39	0.08	Yes	96.65 %	Accepted
CA	0.20	0.1	Yes	88.06 %	Accepted
BS	0.11	0,1	Yes	277.21 %	Accepted
Barclays	0.36	0.09	Yes	44.68 %	Accepted
HSBC	0.10	0.1	Yes	-28.94%	Rejected
HDFC	0.40	0.07	Yes	11.75%	Rejected
ICICI	0.37	0.08	Yes	-6.20%	Rejected

Table 10 Summary of Hypothesis 1 Result

Based on the results mentioned above, here is the contribution to theory and contribution to management practice:

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- **Contribution to Theory**:
- **Stationarity Confirmation**: In theory, The critical values depend on the chosen significance level (e.g., 1%, 2.5%, 5%, or 10%). If the KPSS Statistic is less than the critical value, the null hypothesis is not rejected, indicating stationarity. The study confirms the stationarity of the time series data for the banks, as noted in the "Yes" in the Stationary column. This contributes to the time series analysis theory by providing empirical evidence of stationarity in financial data.
- **KPSS Value and P-value**: The KPSS values and p-values presented for each bank can be a reference for researchers and analysts working with financial time series data. These statistics are essential for assessing stationarity and conducting further analyses.
- **Hypothesis Testing**: The acceptance or rejection of hypotheses related to the percentage rise in revenue over five years contributes to hypothesis testing in financial research. The study provides empirical evidence to support or refute these hypotheses, which can guide future research.
- **Contribution to Management Practice**:
- **Performance Assessment**: The study evaluates each bank's percentage revenue rise over five years. This information can be valuable for bank executives and management teams to assess their respective banks' financial performance relative to peers.
- **Strategic Decision-Making**: Banks with accepted hypotheses indicating a significant revenue rise can use these findings to inform their strategic decision-making processes. They may seek to replicate successful strategies employed by banks that have demonstrated substantial revenue growth.
- **Risk Management**: Banks with rejected hypotheses, signifying a decline in revenue, can utilise this information to identify potential risks and implement risk mitigation strategies. Understanding the factors contributing to decreasing revenue is critical for effective risk management.
- **Benchmarking**: Banks in the industry can benchmark their revenue performance against the study's results to identify areas for improvement and consider adopting successful strategies from banks that have achieved significant revenue growth.
- In summary, this study contributes to the time series analysis theory by confirming stationarity and provides practical insights for both researchers and practitioners in the banking industry regarding revenue trends and their implications for management practice. It offers a basis for further research and informs decision-making within the banking sector. The individual bank results are described below.

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- This study includes UBS, Barclays, BNP, BS, CA, and ICICI. For each bank, the KPSS value, corresponding p-value, stationarity status, revenue percentage rise, and hypothesis acceptance or rejection were recorded. The theory postulates a positive correlation between IT investments and revenue growth.

The analysis yielded the following results:

- **Conclusions:**

- **UBS, BNP, CA, BS, Barclays**: All these banks show a significant percentage increase in revenue over five years and have KPSS values with corresponding p-values that suggest the series is stationary. The hypothesis for these banks is marked as "Accepted", which likely refers to a hypothesis related to the positive impact of specific strategies or operations, and it's linked to revenue growth and not merely the stationarity.

- **HSBC, HDFC, and ICICI**: These banks have different outcomes. HSBC and ICICI show a decline in revenue over five years, and HDFC shows a slight increase. Despite their revenue series being marked as stationary (like the other banks), the hypothesis for these banks is marked as "Rejected". The rejection of the theory is due to their negative or minimal revenue growth, but this conclusion is independent of their stationarity status.

- **Observations:**

- Upon examination, it is evident that all P values exceed the threshold significance level of 0.05, indicating that statistical parameters are within acceptable limits for proceeding with estimation. Nevertheless, subsequent estimation results do not satisfy the predefined hypothesis criteria.

- The table suggests that most banks are growing except for HSBC and ICICI, which have declining revenues, and HDFC, which shows only a slight increase in revenue. The hypothesis is accepted for banks with solid revenue growth and rejected for banks with declining or minimal growth.

- In summary, while the KPSS test indicates stationarity in the time series data for all banks, the acceptance or rejection of the hypothesis is based on the performance of the bank's revenue over five years, not on the stationarity of the series.

5.3 Hypothesis 2 Discussion
- **A Singular IT Investment Yields Cumulative Returns an increase in revenue in coming ten years. (decade).**

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Source – KPSS and AIC model result

As the p-value exceeds the significance level of 0.05, the theory fails to reject the null hypothesis, suggesting that the series is stationary.

Bank Name	Revenue% increase in 10 years after IT investment @2032	2022 IT Revenue in Billions	2032 Revenue in Billions	P value	Hypothesis
UBS	798%	$39.72	$356.77	0.07	Accepted
BNP	403%	$55.04	$277.19	0.08	Accepted
CA	140%	$25.48	$61.37	0.1	Accepted
BS	627%	$89.48	$651.08	0.1	Accepted
Barclays	114%	$30.86	$66.19	0.09	Accepted
HSBC	-12%	$75.79	$66.39	0.1	Rejected
HDFC	-19%	$21.13	$17.06	0.07	Rejected
ICICI	-57%	$21.10	$9.09	0.08	Rejected

Table 11Summary of Hypothesis 2 Result

Based on the results mentioned above for revenue increase in 10 years after IT investment, as well as the initial IT revenue in billions in 2022 and the projected revenue in 2032, we can assess the contributions to theory and management practice as follows:

- **Contribution to Theory:**
- **Validation of IT Investment Hypothesis**: The results support the hypothesis that significant IT investments in banks can lead to substantial revenue growth over ten years. This validates the theoretical understanding that technology plays a crucial role in the long-term financial success of banks.
- **Quantification of Impact:** The results quantify the impact of IT investment by expressing it in terms of percentage revenue increase. This contributes to theoretical discussions on the relationship between technology investments and financial outcomes.
- **Contribution to Management Practice:**

- **Strategic Decision-Making**: The findings offer bank management and decision-makers valuable insights. Banks can use this information to make informed decisions regarding allocating resources and investments in technology. It emphasises the importance of IT investment as a strategic move for future growth.

- **Risk Assessment**: The results also highlight the risk associated with inadequate or negative returns on IT investments. Banks that experience a decline in revenue after substantial IT investments need to reassess their strategies and address potential issues in their IT initiatives.

- **Benchmarking**: Banks can use the percentage revenue increase figures as benchmarks to evaluate the effectiveness of their IT investments. They can compare their projected revenue growth with industry peers to gauge their competitive position.

- **Long-Term Planning**: The findings underscore the significance of long-term planning regarding technology adoption in the banking sector. It encourages banks to consider the extended horizon and potential benefits of IT investments beyond the short term.

- In summary, these results contribute to both theoretical understanding and practical decision-making in the banking industry by providing empirical evidence of the impact of IT investments on revenue growth over ten years. They inform strategic choices, risk management, and long-term planning for banks considering or already engaged in significant IT initiatives. The individual bank results are described below.

- In conclusion, the hypothesis's acceptance or rejection hinges on the observed revenue increase rather than the KPSS value. From a statistical standpoint, all cases are deemed accepted.

5.4 Hypothesis 3 Discussion

- **Technological Adoption Positively Influences the Cost-to-Income Ratio**

- As per the literature review, it becomes evident that banks' profit depends on the use of technology in the digital world. However, how much has yet to be studied in detail? The current understanding is that the income ratio is on an upbeat track due to the use of technology. After our objective analysis, let's see whether a similar theory holds good or not

Source- 2017 to 2022 data analysis

Bank Name	Cost-to-income ratio%	IT Investment in	Impact	Hypothesis

		Billion 2017 to 2022		
UBS	81.50 to 72.10	$2.68 to $4	Positive	Accepted
BNP	69.4 to 67.30	$4.28 to $5.26	Positive	Accepted
CA	64 to 58.50	$2.53 to $3.28	Positive	Accepted
BS	47.40 to 45.80	$1.21 to $2.47	Positive	Accepted
Barclays	68 to 59.80	$2.71 to $3.25	Positive	Accepted
HSBC	60.30 to 64.40	$5.43 to $6.10	Negative	Rejected
HDFC	37.8 to 41.5	$2.41 to $3.47	Negative	Rejected
ICICI	42.60 to 40.60	$4.0 to $4.73	Positive	Accepted

Table 12 Summary of Hypothesis 3 Result

Contribution to Theory:

- **Validation of Hypotheses**: The results support the hypotheses that posit a relationship between the cost-to-income ratio and IT investment. This validates the theoretical understanding that IT investments can impact the cost-to-income ratio in banking.

- **Quantification of Impact:** The results quantify the impact by showing the range of cost-to-income ratio and IT investment values. This contributes to theoretical discussions on the role of IT investment in cost management and income generation in the banking sector.

- **Contribution to Management Practice:**

- **Strategic Decision-Making:** The findings offer practical insights for bank management. Banks can use this information to make strategic decisions regarding their IT investment plans. Positive impacts on the cost-to-income ratio indicate that well-planned IT investments can lead to more efficient cost management**.**

- **Risk Assessment:** Banks need to consider the potential negative impact of IT investments on the cost-to-income ratio. As the rejected hypotheses show, negative impacts suggest banks should carefully evaluate their IT initiatives to avoid adverse cost outcomes.

- **Budgeting and Planning:** These results can inform bank budgeting and planning processes. Management can use the range of cost-to-income ratios and IT investment figures as reference points for setting budgets and financial goals.

- **Performance Benchmarking**: Banks can benchmark their cost-to-income ratios and IT investments against the ranges observed in the study. This allows them to assess their competitiveness and efficiency compared to industry peers.

- **Long-Term Strategy:** The findings underscore the importance of considering the long-term impact of IT investments on cost management and income generation. Banks should align their IT strategies with their overall business objectives.

- In summary, these results contribute to theoretical understanding and practical decision-making in the banking industry by providing empirical evidence of the relationship between IT investments and the cost-to-income ratio. They inform strategic choices, risk management, budgeting, and performance benchmarking for banks, helping them optimise their IT investments for cost efficiency and income generation.

- In conclusion, whether the hypothesis is accepted or rejected hinges on the observed increase in the cost-to-income ratio rather than the KPSS value. From a statistical standpoint, all cases are deemed accepted.

5.5 Hypothesis 4 Discussion

With the advent of advanced technologies, coupled with Artificial Intelligence (AI) and Machine Learning (ML) capabilities, IT investments are projected to increase over the period.

Source – Results of ARIMA, KPSS and AIC model

As the p-value exceeds the significance level, the theory fails to reject the null hypothesis, suggesting that the series is stationary except for BNP.

Bank Name	KPSS Value	P value	Stationary	% Rise in IT investment in 10 years	Hypothesis Accepted /Rejected
UBS	0.37	0.08	Yes	-8.0	Rejected
Barclays	0.45	0.05	Yes	-5.4	Rejected
BNP	0.51	0.03	No	-6.8	Rejected
BS	0.39	0.08	Yes	-2.5	Rejected
CA	0.16	0.10	Yes	-0.5	Rejected
HSBC	0.14	0.10	Yes	0.8	Accepted
HDFC	0.37	0.08	Yes	7.0	Accepted
ICICI	0.34	0.09	Yes	31.1	Accepted

Table 13 Summary of Hypothesis 4 Result

Based on the results mentioned above for the KPSS value, P-value, stationarity, % rise in IT investment from 2027 to 2032, and the corresponding hypotheses, we can assess the contributions to both theory and management practice as follows:

- **Contribution to Theory:**
- **Validation of Hypotheses**: The results support the hypotheses that posit a relationship between stationarity and the % rise in IT investment. This validates the theoretical understanding that stationarity is crucial in predicting IT investment trends.
- **Quantification of Impact:** The results quantify the impact by showing the % rise in IT investment and its relationship with stationarity. This contributes to theoretical discussions on the factors affecting IT investment dynamics.
- **Contribution to Management Practice:**
- **Strategic Investment Planning:** The findings offer practical insights for banks and financial institutions in planning their IT investments. Banks can use this information to make informed decisions about the % increase in IT spending over the specified period.
- **Risk Assessment:** Banks can assess the risk associated with their IT investment plans. Understanding the relationship between stationarity and IT investment can help banks anticipate potential fluctuations in investment requirements.
- **Budgeting and Resource Allocation:** These results can inform banks' budgeting and resource allocation processes. Management can use the % rise in IT investment figures as reference points for setting IT budgets and allocating resources.
- **Long-Term Strategy:** The findings underscore the importance of considering data stationarity when planning IT investments. Banks should align their IT investment strategies with data stationarity to ensure stability and predictability in their technology spending.
- **Benchmarking:** Banks can benchmark their IT investment plans against the study's observed % rise in IT investment. This result allows them to assess their competitiveness and readiness for future technological challenges.
- **Mitigating Non-Stationarity:** For banks with rejected hypotheses (indicating non-stationarity), these results highlight the need to address data stationarity issues when planning IT investments. It suggests the importance of adopting strategies to mitigate non-stationarity effects.

- In summary, these results contribute to theoretical understanding and practical decision-making in the banking industry by providing empirical evidence of the relationship between data stationarity and the % rise in IT investment. They inform strategic investment planning, risk assessment, budgeting, resource allocation, and long-term IT strategy for banks, helping them make data-driven decisions and adapt to changing IT investment dynamics.

- Based on the analysis of the respective banks, there is a definitive trend indicating an augmentation in IT investments after 2027, even with the integration of AI and Machine Learning. While AI and ML offer significant benefits, tasks that defy automation remain. Additionally, the costs associated with updating and maintaining emerging technologies further contribute to this investment trajectory. These observations underscore that despite leveraging AI and ML, investments in technology remain indispensable. The individual bank results

- In conclusion, the determination of whether the hypothesis is accepted or rejected hinges on the observed increase in the IT investment rather than the KPSS value. From a statistical standpoint, all cases are deemed accepted.

- Here's a comparative analysis of the findings. All the banks in the dataset are stationary, meaning their time series data does not exhibit a significant trend or seasonality.

  - **KPSS Test and P-Values**:

  The KPSS test is used to check for stationarity in time series data. A lower KPSS value and a higher p-value generally indicate stronger stationarity. In this dataset, all banks have relatively low KPSS values and p-values greater than 0.05, which suggests that the data is stationary.

  - % Rise in IT Investment:

  The percentage rise in IT investment over ten years varies among the banks. ICICI (Bank) had the highest percentage rise (31%), while UBS had a negative percentage (8%). This indicates differences in the banks' IT investment strategies.

  - **Hypothesis Testing:**
  - In summary, the data for all banks is considered stationary based on the KPSS test and p-values. The percentage rise in IT investment varies, with some banks showing significant growth (e.g., ICICI) and others experiencing declines (e.g., UBS). The acceptance or rejection of hypotheses regarding stationarity depends on the specific statistical tests and thresholds used.

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5.6 Hypothesis 5 Discussion

IT investment impact on the overall bank performance is minimal.

Investment % data is as follows.

Source : Summary of Hypothesis 1 to 4 Result

Bank	Year	Revenue (USD)Billion	IT investment (USD)Billion	%of Revenue
UBS	2017	33.52	2.68	8%
UBS	2018	35.38	2.37	7%
UBS	2019	35.15	2.30	7%
UBS	2020	36.03	3.44	10%
UBS	2021	37.22	3.90	10%
UBS	2022	39.72	4.00	10.1%
UBS	2023	44.53	5.07	11.4%
UBS	2024	52.65	4.70	8.9%
UBS	2025	65.08	5.36	8.2%
UBS	2026	82.82	5.69	6.9%
UBS	2027	106.87	6.37	6.0%
UBS	2028	138.23	5.99	4.3%
UBS	2029	177.9	7.05	4.0%
UBS	2030	226.88	7.16	3.2%
UBS	2031	286.17	7.56	2.6%
UBS	2032	356.77	7.55	2.1%
BNP	2017	49.59	4.28	9%
BNP	2018	50.95	4.62	9%
BNP	2019	50.6	4.50	9%
BNP	2020	51.05	4.83	9%
BNP	2021	52.35	4.82	9%
BNP	2022	55.04	5.26	9.6%
BNP	2023	59.66	5.29	8.9%
BNP	2024	66.75	5.74	8.6%
BNP	2025	76.85	5.77	7.5%
BNP	2026	90.5	6.21	6.9%
BNP	2027	108.24	6.25	5.8%
BNP	2028	130.61	6.69	5.1%
BNP	2029	158.15	6.72	4.2%
BNP	2030	191.4	7.17	3.7%
BNP	2031	230.9	7.20	3.1%
BNP	2032	277.19	7.65	2.8%
CA	2017	21.02	2.53	12%

CA	2018	23.71	2.87	12%
CA	2019	37.73	4.69	12%
CA	2020	23.97	3.18	13%
CA	2021	27.18	3.46	13%
CA	2022	23.97	3.28	13.7%
CA	2023	37.16	4.57	12.3%
CA	2024	39.85	4.91	12.3%
CA	2025	42.54	5.25	12.3%
CA	2026	45.23	5.59	12.4%
CA	2027	47.92	5.93	12.4%
CA	2028	50.61	6.27	12.4%
CA	2029	53.3	6.61	12.4%
CA	2030	55.99	6.95	12.4%
CA	2031	58.68	7.29	12.4%
CA	2032	61.37	7.63	12.4%
BS	2017	79.23	1.21	2%
BS	2018	80.78	1.55	2%
BS	2019	79.21	2.16	3%
BS	2020	66.28	2.11	3%
BS	2021	70.39	2.18	3%
BS	2022	89.48	2.47	2.8%
BS	2023	121.49	1.79	1.5%
BS	2024	164.36	0.99	0.6%
BS	2025	216.03	1.77	0.8%
BS	2026	274.44	2.99	1.1%
BS	2027	337.53	2.53	0.7%
BS	2028	403.24	1.35	0.3%
BS	2029	469.51	1.42	0.3%
BS	2030	534.28	2.09	0.4%
BS	2031	595.49	2.08	0.3%
BS	2032	651.08	2.09	0.3%
Barclays	2017	27.16	2.72	10%
Barclays	2018	28.21	2.90	10%
Barclays	2019	27.62	2.80	10%
Barclays	2020	27.94	3.06	11%
Barclays	2021	30.19	2.84	9%
Barclays	2022	30.86	3.25	10.5%
Barclays	2023	32.23	2.99	9.3%
Barclays	2024	35.67	3.33	9.3%
Barclays	2025	37.61	3.05	8.1%
Barclays	2026	40.04	3.35	8.4%
Barclays	2027	44.65	3.08	6.9%
Barclays	2028	47.86	3.36	7.0%

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Barclays	2029	51.36	3.10	6.0%
Barclays	2030	57.13	3.35	5.9%
Barclays	2031	61.63	3.12	5.1%
Barclays	2032	66.19	3.35	5.1%
HSBC	2017	66.63	5.43	8%
HSBC	2018	75.43	5.76	8%
HSBC	2019	82.68	5.10	6%
HSBC	2020	66.2	5.10	8%
HSBC	2021	62.29	6.00	10%
HSBC	2022	75.79	6.10	8.0%
HSBC	2023	67.4	4.75	7.0%
HSBC	2024	58.6	5.41	9.2%
HSBC	2025	72.6	4.84	6.7%
HSBC	2026	69.0	6.34	9.2%
HSBC	2027	53.9	4.51	8.4%
HSBC	2028	63.7	5.60	8.8%
HSBC	2029	69.2	4.72	6.8%
HSBC	2030	52.4	6.44	12.3%
HSBC	2031	54.2	4.43	8.2%
HSBC	2032	66.4	5.63	8.4%

Table 14 Summary of Hypothesis 1 to 4 Result -Europe

Source – Results of Hypothesis 1 to 4

- **Indian Bank data**

Bank	**Year**	**Revenue (USD)Billion**	**IT investment (USD)Billion**	**%of Revenue**
HDFC	2017	12.88	2.42	19%
HDFC	2018	15.17	2.70	18%
HDFC	2019	17.37	2.97	17%
HDFC	2020	18.7	3.20	17%
HDFC	2021	20.94	3.46	17%
HDFC	2022	21.13	3.47	16.4%
HDFC	2023	23.18	4.00	17%
HDFC	2024	22.50	4.00	18%
HDFC	2025	24.07	4.00	17%
HDFC	2026	22.82	4.00	18%
HDFC	2027	23.61	4.00	17%

HDFC	2028	22.05	4.00	18%
HDFC	2029	21.86	4.00	18%
HDFC	2030	20.15	4.00	20%
HDFC	2031	18.86	4.00	21%
HDFC	2032	17.06	4.00	23.4%
ICICI	2017	16.89	4.00	24%
ICICI	2018	18.44	4.38	24%
ICICI	2019	18.77	4.60	25%
ICICI	2020	21.11	4.87	23%
ICICI	2021	21.78	4.89	22%
ICICI	2022	21.10	4.73	22.4%
ICICI	2023	22.44	4.45	20%
ICICI	2024	22.23	4.13	19%
ICICI	2025	20.54	3.87	19%
ICICI	2026	20.88	3.76	18%
ICICI	2027	19.79	3.85	19%
ICICI	2028	17.10	4.09	24%
ICICI	2029	16.43	4.41	27%
ICICI	2030	14.46	4.70	33%
ICICI	2031	10.78	4.88	45%
ICICI	2032	9.10	4.87	53.5%

Table 15 Summary of Hypothesis 1 to 4 Result -India

Based on the data mentioned above on IT investment as a percentage of total revenue for various banks over several years, we can assess the contributions to both theory and management practice as follows:

- **Contribution to Theory:**
- **IT Investment Trends:** The data provides insights into the trends in IT investment as a percentage of total revenue for different banks over ten years. This contributes to the theoretical understanding of how banks allocate their resources to IT infrastructure.
- **Comparative Analysis:** The data allows for a comparative analysis of IT investment strategies among different banks. Researchers can use this information to develop theories about the factors influencing IT investment decisions in the banking sector.
- **Long-Term IT Planning:** The data covers a substantial time frame, enabling the analysis of long-term IT planning and investment strategies. This contributes to theoretical discussions on the sustainability of IT investments in the banking industry.

Contribution to Management Practice:

- **Strategic Investment Planning:** Banks can use this data to benchmark their IT investment as a percentage of total revenue against industry peers. It aids in strategic investment planning and helps banks determine whether they invest an appropriate amount in IT infrastructure.

- **Resource Allocation:** Management can use this data to make informed decisions about resource allocation for IT projects. It assists in budgeting and ensures that IT investments align with the bank's revenue.

- **Risk Assessment:** Banks can assess the risk associated with their IT investment strategies. A bank with a significantly higher or lower IT investment percentage than its peers may need to evaluate its strategy for potential risks and opportunities.

- **Performance Evaluation:** Banks can use this data to evaluate the performance of their IT investments over time. This helps them assess whether IT investments are yielding the expected revenue growth returns.

- **Competitive Analysis:** Banks can compare their IT investment percentages with those of competitors to gain a competitive edge. It allows for adjustments in investment strategies to stay competitive in the market.

- **Regulatory Compliance:** Depending on the jurisdiction, regulatory bodies may have guidelines regarding IT investment as a percentage of total revenue. Banks can use this data to ensure compliance with such regulations.

- The above data contributes to theoretical understanding and practical decision-making in the banking industry. It offers insights into IT investment trends, facilitates comparative analysis, and aids in banks' strategic planning, resource allocation, risk assessment, and competitive analysis. These contributions enhance the industry's ability to make informed decisions regarding IT investments and align them with long-term business goals.

- The research under Hypothesis 5 examines the impact of IT investment on the overall performance of various banks, specifically how the percentage of IT investment relative to revenue affects bank performance over several years. This hypothesis posits that the impact of IT investment on overall bank performance is minimal. The analysis involves comparing data from UBS, BNP, HSBC, CA, BS, and Barclays over a period from 2017 to 2032. Here's a comparative analysis of the findings for each bank.

- **Correlation with Hypothesis:** The data suggest varying degrees of correlation with the hypothesis that IT investment has a limited impact on overall bank performance. For instance, UBS revenue increases, whereas IT investment % decreases over time. Across the banks, there's a general trend of increasing IT investment in nominal terms. Still, the percentage of revenue allocated to IT generally declines, possibly due to the overall growth in revenue outpacing the growth in IT spending. This indicates that while banks are investing more in IT, they're also becoming more revenue-rich, possibly because of the very technology investments they're making. Exceptions like HDFC and ICICI show that the relationship between IT spending and revenue isn't straightforward and may be influenced by numerous factors, including strategic priorities, market conditions, and operational efficiency gains.

  The IT investment percentage typically falls below 20%, indicating its comparatively restrained influence. A more detailed analysis incorporating factors such as decision-making processes, macroeconomic conditions, product-by-product evaluations, and customer journey assessments is required to assess its subjective value comprehensively. Based on this objective data, the impact can be considered circumscribed and limited.

- **The conclusion is that IT investment plays a Limited role in the bank's overall performance.**

5.7 Comparison of European and Indian Bank

Source – Results of Hypothesis 1 to 5

Topic	European Banks	Indian Banks
Revenue Ranges from 2017 to 2022	$21.08 to $89.48 Billion	$12.88 to $27.18 Billion
Operating Costs range from 2017 to 2022	$14.53 to $45.1 Billion	$3.73 to 12.03 billion
Net Income from 2017 to 2022	$-10.64 to $14.82 Billion	$0.81 to $5.09 Billion
IT Investment from 2017 to 2022	$1.21 to 6.1Billion	$2.42 and $4.89 Billion

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% IT investment ranges from 2022 to 2027	1% to 13.7% of total revenue	16% to 22.4% of total revenue
Revenue Ranges from 2022 to 2032	$23.97 Billion to $651.08 Billion	$9.09 to $24.06 Billion
IT Investment from 2022 to 2032	$0.99 to $7.65 billion per year	3.76 to 4. 88
% IT investment ranges from 2022 to 2032	0.3% to 13.7%	17% to 53.5 %
Cost to income ratio from 2017 to 2022	45.8% to 81.50%	37.84% to 48.98%

Table 16 Indian Vs European Banks

Note - Please note that the aforementioned table specifically addresses six European banks and two Indian banks within its scope and does not encompass the entire spectrum of European and Indian banking institutions.

This comparison is essential as it highlights the financial characteristics and trends of European and Indian banks, providing insights into their strategies, competitiveness, and growth prospects. It helps investors, policymakers, and industry analysts understand the dynamics of these banking sectors, make informed decisions, and identify potential opportunities and challenges in each region.

- **Revenue Growth**:

European Banks have demonstrated a substantial range in revenue growth, from $21.08 billion to $89.48 billion over the five years leading up to 2022. Looking ahead to the next decade, these banks project an even broader revenue range, potentially reaching $651.08 billion.

Indian Banks, while starting from a lower base, showed a narrower revenue range from $12.88 billion to $27.18 billion during the same initial five years. Their projected revenue growth up to 2032 tops out at $24.06 billion, indicating a steadier, albeit smaller, scale of development.

- **Operating Costs:**

European Banks reported operating costs ranging from $14.53 billion to $45.1 billion, which suggests substantial operational expenses when compared to their revenue.

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In contrast, Indian Banks incurred significantly lower operating costs, ranging from $3.73 billion to $12.03 billion, reflecting more conservative expenditure or potentially differing operational scales and cost structures.

- **Net Income:**

The net income of European Banks varied widely, with some banks experiencing losses (as indicated by the negative figure) and others achieving up to $14.82 billion in income, suggesting a volatile financial performance.

Indian Banks maintained a positive net income, ranging from $0.81 billion to $5.09 billion, which indicates consistent profitability, although smaller in magnitude.

- **IT Investment**:

European Banks' IT investments were between $1.21 billion and $6.1 billion, with a decreasing percentage of revenue dedicated to IT over time, from a high of 13.7% to a low of 0.3% by 2032.

Indian Banks allocated between $2.42 billion and $4.89 billion to IT, representing a significantly higher percentage of their revenue (16% to 22.4%), and this proportion is forecasted to rise dramatically, up to 53.5% by 2032, highlighting a strategic focus on technology.

- **Cost to Income Ratio:**

European banks displayed a cost-to-income ratio ranging from 45.8% to 81.50%, indicating varied efficiency, with some banks spending nearly as much, or more, as they earned.

Indian Banks showcased a more favourable cost to income ratio, from 37.84% to 48.98%, suggesting a tighter control over costs relative to income.

Conclusions:

Comparatively, European banks operate on a larger scale with wider revenue and operating cost ranges. However, their net income and cost to income ratios suggest that size does not necessarily equate to higher profitability or efficiency. Indian banks, with their smaller scale, show consistent profitability and a higher, more focused investment in IT as a percentage of revenue, which could be indicative of a strategic bet on technology-driven growth. The higher projected percentage of IT investment for Indian banks also suggests an anticipation of significant digital transformation and innovation in the banking sector in the region.

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CHAPTER VI: LIMITATIONS

6.1 Introduction

The comprehensive analysis conducted in this thesis reveals that the influence of IT investment on bank performance is somewhat limited. To gain a deeper and more constructive understanding, future research must expand its scope to include a broader range of factors. These should encompass various elements like Banking data of fifty years, customer segments, product costs, revenues from different banking products and services, and subjective value; a holistic examination of these factors, in conjunction with IT investment, will provide a more nuanced understanding of their collective impact on total revenue.

6.2 Limitations

- Limited Data Set of five years

Extending the data range from five to fifty years is imperative for a comprehensive understanding through predictive modelling. To achieve a robust model, having an extensive dataset spanning fifty years is crucial, ensuring a substantial training data portion and formulating realistic predictions. The limited historical data adversely affects the research, particularly in the context of predictive modelling. The scarcity of data points hinders the model's ability to identify seasonality and patterns, with only 3-4 values available. Moreover, the model's accuracy is heavily contingent on the availability of raw data, and a more significant number of data points allows for more effective model training. Each decade presents unique challenges, and the strategies employed by innovative minds in the banking sector to address these challenges form a compelling narrative. Attempting to capture the entire trend within five years is insufficient when predicting investment, revenue, and other factors for the next decade. A minimum of fifty years' worth of data is essential.

- Neglecting the consideration of banking products and their lifecycle can significantly impact the overall assessment of revenue figures:

Each banking product serves a distinct purpose, tailored to meet specific needs. For instance, utilizing a current account versus a credit card fulfils disparate objectives, addressing different customer requirements. While there has been a trend toward service consolidation through mobile platforms, it remains crucial to acknowledge that in banking analysis, customers and their associated products form one side of the equation, while value elements such as revenue and income reside on the other.

This research has thus far incorporated cost-to-income ratio data until 2022; however, it is evident that a more extensive dataset is required. Examining revenue on a customer product-wise basis is an essential aspect of comprehending the banking lifecycle. Revenue is generated when customers engage with specific products, making it a critical metric for evaluation. Moreover, various products hold prominence in different geographic regions. For instance, insured loans may be the most lucrative product in one area, while credit or mortgages could dominate in another. Identifying which product drives revenue and understanding the mechanisms behind this process poses a crucial question.

Failure to account for the diverse landscape of banking products represents one of the significant limitations of this research.

- Overlooks Customer segments:

This study overlooks the analysis of customer segments, including students, adults, married couples, and elderly citizens, four major customer categories within the banking sector. Understanding how each customer segment engages with various products holds valuable insights for marketing strategists aiming to expand their customer base. For instance, if the student segment demonstrates a higher inclination toward car loans in the UK, could strategic partnerships with universities be established to offer more appealing incentives to students? An effective customer acquisition strategy hinges on comprehending the customer journey and the factors influencing their purchasing decisions.

However, obtaining data on the triggers behind these decisions is equally challenging. Thus, this research faces a limitation regarding the lack of access to this crucial data.

- Ignores the impact of the subjective value of IT investment

This study primarily concentrates on the objective assessment of IT investment and its impact on revenue, encompassing all aspects documented in banks' annual reports. Nevertheless, the customer journey encompasses many factors, including pre-sales, post-sales, and cross-product journeys. Of significant importance is the customer support journey, where the IT infrastructure contributes value even when customers do not acquire new products. These values encompass convenience, trust, affordability, availability, stewardship, and ethical conduct.

Each bank adheres to a value framework; not all subjective values may possess a tangible, objective footprint. However, this research does not examine such subjective values offered by banks through their IT infrastructure or support staff as part of their service commitment.

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- Excludes the assessment of market value attributed to customer satisfaction and driven by IT investments:

This research does not consider the market capitalization that a bank may accrue due to implementing IT solutions. Furthermore, it does not calculate how IT investments contribute to a bank's overall performance and its subsequent increase in market capitalization. Consequently, this study falls short in conducting a comprehensive analysis of market capitalization.

Additionally, this study does not present a comprehensive model for evaluating bank performance. Focusing solely on metrics such as the cost-to-income ratio and revenue provides a limited perspective on a bank's performance. It is imperative to explore a more comprehensive model for assessing bank performance.

- Exclusion of Macro-Economic Factors:

  The study may not account for macro-economic factors such as inflation rates, economic growth, political stability, and global economic events, which can significantly influence bank performance.

- Lack of Comparative Analysis with Other Industries:

  By concentrating solely on the banking sector, the study might miss out on broader economic trends that could be identified through a comparative analysis with other sectors.

- Potential for Misinterpretation of Trends:

  Relying on a limited set of variables could lead to a misunderstanding of underlying trends. For instance, high revenue does not necessarily indicate a healthy bank if other factors like rising bad debts are not considered.

- Timeframe Constraints:

  If the study is restricted to a specific timeframe, it might not capture long-term trends or cyclical patterns in the banking industry.

- Cross-Country Comparison Challenges:

  Directly comparing Indian and UK banks may be challenging due to different regulatory environments, market maturity, customer behaviors, and economic contexts.

- Inter-variable Relationships:

  The study might not fully explore the interplay or causal relationships between the chosen variables and other factors affecting the banking sector.

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- Impact of Non-Financial Factors:

  The research might overlook the impact of non-financial factors such as customer service quality, brand reputation, digital banking capabilities, and corporate governance standards.

- Generalizability of Findings:

  The results derived from these variables might not be generalisable to all banks in the UK and India, especially if the sample size is limited or if the selected banks are not representative of the entire banking sector.

- Historical Performance vs. Future Predictions:

  The study's reliance on historical data for these variables might not accurately predict future performance, especially in a rapidly changing economic and regulatory environment.

- Influence of Internal Policies:

  Internal bank policies and management decisions, which can significantly impact these variables, are not accounted for in the study

6.3 Conclusion

In conclusion, future studies can provide more comprehensive insights by broadening the research parameters beyond IT investment to include a more diverse range of factors affecting bank performance, like fifty years of bank data, subjective value, customer segments and products. This, in turn, will equip banking institutions with the knowledge to make more informed strategic decisions, ultimately enhancing their performance and competitiveness in the rapidly evolving financial landscape.

CHAPTER VII: SUMMARY, IMPLICATIONS AND RECOMMENDATIONS AND FUTURE RESEARCH

7.0 Summary

Hypothesis	Brief	Result
Hypothesis 1	Projected 30-50% revenue increase in the next five years	Accepted for five banks out of Eight.
Hypothesis 2	IT investment increases revenue	Accepted for five banks out of Eight.
Hypothesis 3	IT investment impacts cost-to-income ratio	Accepted for Six banks out of Eight.
Hypothesis 4	IT investment will rise in the next ten years	Accepted for three banks out of Eight.
Hypothesis 5	IT investment impact is limited	Accepted for all banks.

- Explanation of Result:
- The table presents a summary of hypotheses and their results based on a study involving eight banks. It seems to focus on the impact of IT investment on various financial aspects of these banks. Here's a detailed description of the table:
- Hypothesis 1: Projected 30-50% Revenue Increase in the Next Five Years
- Brief: This hypothesis predicts that banks will experience a revenue increase of between 30% and 50% over the next five years.
- Result: The hypothesis was accepted for five out of the eight banks involved in the study, indicating that for these five banks, the data supported the prediction of a significant revenue increase.
- Hypothesis 2: IT Investment Increases Revenue
- Brief: This hypothesis suggests a direct correlation between IT investment and an increase in revenue.
- Result: Similar to Hypothesis 1, this was also accepted for five out of the eight banks, implying that for these banks, IT investment was linked to revenue growth.

- Hypothesis 3: IT Investment Impacts Cost-to-Income Ratio

- Brief: This hypothesis posits that IT investment has an effect on the cost-to-income ratio of the banks.

- Result: It was accepted for six out of eight banks, suggesting that for the majority of the banks, IT investment influenced their cost-to-income ratio.

- Hypothesis 4: IT Investment Will Rise in the Next Ten Years

- Brief: This hypothesis forecasts an increase in IT investment over the next decade.

- Result: It was accepted for only two out of the eight banks, indicating that for most of the banks, there wasn't sufficient evidence to support a predicted rise in IT investment over the next ten years.

- Hypothesis 5: IT Investment Impact is Limited

- Brief: This hypothesis asserts that the impact of IT investment is confined or restricted.

- Result: It was accepted for all eight banks, indicating a unanimous agreement across the sample that the impact of IT investment is indeed limited.

- The table provides a concise yet comprehensive overview of how each hypothesis fared in the context of the selected banks, offering insights into the varying impacts of IT investment in the banking sector.

7.1 Implications

- The results of this study indicate a significant emphasis by banks on IT investment. It challenges a commonly held belief, particularly in the context of Indian banks, suggesting their superior performance in IT compared to their counterparts in developed countries. This assertion finds some grounding in the IT investment figures observed in the study.

- Beyond theoretical considerations, an in-depth examination of the results reveals several implications:

- IT Investment and Subjective Value: Although this research does not explicitly focus on subjective values, the objective data underscores the increasing seriousness with which IT investment is regarded. Based on our findings, it appears probable that banks will allocate substantial resources to IT, both to gain a competitive advantage and to penetrate new markets. Banks with fully developed IT infrastructures might potentially dominate over others in the future.

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- IT Investment and Operating Costs: This research explores the correlation between operating costs and IT investment. However, the study's scope is limited to four variables: IT investment, year, operating cost, and profit. Its implications are restricted, given the necessity to consider bank data over a 50-year span, encompassing both subjective and objective factors. In more comprehensive scenarios, a clearer relationship between IT investment and operating costs might be discerned.

- IT Investment and Profit: In the future, IT investment will likely be closely scrutinized in relation to profits, especially as financial services become increasingly reliant on IT. Products like loans, including car and unsecured loans, are already predominantly IT-driven. It is foreseeable that IT investment will soon be directly linked to profit, with both subjective and objective values being assessed well in advance of the investment.

- Increased Awareness and Risk in IT Investment: The study indicates that while the impact of IT investment is limited, its value remains significant. Consequently, banks might lean towards further digitization while minimizing manual operations to enhance profits. This could lead to increased risk-taking and higher IT expenditures in pursuit of greater profitability.

- AI in Decision Making: Presently, human intervention is prevalent in decisions related to credit risk, loans, and trading. However, IT, particularly AI, has demonstrated its capability to lead and manage these domains effectively. As AI explainability becomes more prominent, it's conceivable that future financial decisions, like assessing credit risks or determining loan percentages, will be predominantly AI-driven.

- In summary, this research not only questions prevailing assumptions about IT competence in banking but also forecasts a future where IT investment, particularly in AI, becomes central to financial decision-making and operational strategies.

7.2 Recommendation and future Research

The comprehensive analysis conducted in this thesis reveals that the influence of IT investment on bank performance is somewhat limited. To gain a deeper and more constructive understanding, it is imperative that future research expands its scope to include a broader range of factors. These should encompass various elements like product costs, revenues from different banking products and services, the financial dynamics of fixed

deposits, and the revenue generated from mortgage services. A holistic examination of these factors, in conjunction with IT investment, will provide a more nuanced understanding of their collective impact on total revenue.

- Future Research Directions: To further enhance the body of knowledge in banking sector performance, future research could pivot in the following direction

- Banking Product Analysis: Delving into the detailed study of various banking products, understanding their market demand, profitability, and how they contribute to the overall revenue of a bank.

- Banking Services Analysis: Evaluating the range of services offered by banks, such as account management, loan processing, and customer service, and assessing their contribution to the bank's revenue.

- Revenue Modelling for Products and Services: Developing comprehensive models that accurately represent how different products and services contribute to the bank's revenue, factoring in variables such as customer preferences, market trends, and economic conditions. Operating Cost and Revenue Relationship: Investigating the relationship between operating costs and revenue, particularly in relation to the size and scale of the bank. This includes exploring how economies of scale might affect profitability and efficiency.

- Customer Base and Revenue Streams: Analysing the impact of the number of customers, the revenue from current accounts, and other areas such as savings accounts, investment services, and loan products.

- Impact of Digital Transformation: Assessing the direct cost savings brought about by digital transformation initiatives in the banking sector. This involves quantifying the financial benefits of adopting new technologies and digital processes

- Predictive Modelling: Building upon these research areas, researchers can develop sophisticated predictive models. These models, potentially based on dependency algorithms, can integrate the aforementioned factors to forecast future revenue streams with greater accuracy. Such models would not only be valuable for strategic planning and decision-making in banks but also provide insights into the evolving dynamics of the banking industry in the context of technological advancements and changing market conditions.

7.3 Conclusion

This research arrives at the conclusion that IT investment in banks ranges approximately from 0 to 20%, and its overall impact is somewhat constrained. However, it is important to note that this determination is made without factoring in the subjective value of the investment. The study utilizes four variables and a machine learning algorithm to project IT investment and revenue over the coming decade. For enhanced precision in the machine learning algorithm's outputs, data spanning 50 years would be advantageous. Additionally, a more comprehensive analysis should incorporate a range of factors, encompassing both objective measures and subjective values. This research the In conclusion, by broadening the research parameters beyond IT investment to include a more diverse range of factors affecting bank performance, future studies can provide more comprehensive insights. This, in turn, will equip banking institutions with the knowledge to make more informed strategic decisions, ultimately enhancing their performance and competitiveness in the rapidly evolving financial landscape.

APPENDIX A
Code to predict IT investment missing values

```python
#!/usr/bin/env python
# coding: utf-8

# In[1]:


# Import the libraries
import pandas as pd
import numpy as np

from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
from sklearn.metrics import mean_squared_error,mean_absolute_error


# In[2]:


# Read CSV
train_data = pd.read_csv('banktrain.csv')
test_data = pd.read_csv('banktest.csv')

print(train_data.shape, test_data.shape)


# In[3]:


train_data.head()


# #### Bank name is a string : use Label encoding
# #### Year number can be misleading : subtract it from current year
# #### Perform the same operations on Train and Test data

# In[4]:


le_BN = LabelEncoder()
train_data['Bank'] = le_BN.fit_transform(train_data['Bank'])
train_data['Year'] = 2023 - train_data['Year']
train_data.head()


# #### Transform the data with Standard Scaler ###
```

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In[5]:

```python
from sklearn.preprocessing import StandardScaler

train_data_new = train_data.values[:, :-1]
# define standard scaler
scaler = StandardScaler()

# transform data
scaled = scaler.fit_transform(train_data_new)
```

In[6]:

```python
test_data['Bank'] = le_BN.fit_transform(test_data['Bank'])
test_data['Year'] = 2023 - test_data['Year']
test_data.head()
```

Transform the data with Standard Scaler

In[7]:

```python
test_data_new = test_data.values[:, :-1]

# transform data
scaled_test = scaler.fit_transform(test_data_new)
```

In[8]:

```python
# Splitting the data into train and test

features = scaled
target = train_data[['IT investement (USD)Billion']]

X_train, X_test, y_train, y_test = train_test_split(features, target, train_size = 0.60, random_state = 5)

print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

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```python
# In[9]:


# Fitting the model
my_model = LinearRegression()
my_model.fit(X_train, y_train)


# ### Evaluation On Train Data

# In[10]:


my_linear_preds_train = my_model.predict(X_train)
print('MAE on Train Data :', mean_absolute_error(my_linear_preds_train,y_train))
print('MSE on Train Data :', mean_squared_error(my_linear_preds_train,y_train))
print('RMSE on Train Data :', np.sqrt(mean_squared_error(my_linear_preds_train,y_train)))
print('R-squared on Train Data :', my_model.score(X_train, y_train))


# ### Evaluation On Test Data

# In[11]:


my_linear_preds = my_model.predict(X_test)
print('MAE on Test Data :', mean_absolute_error(my_linear_preds,y_test))
print('MSE on Test Data :', mean_squared_error(my_linear_preds,y_test))
print('RMSE on Test Data :', np.sqrt(mean_squared_error(my_linear_preds,y_test)))
print('R-squared on Test Data :', my_model.score(X_test, y_test))


# ### Prediction Of IT Investments

# In[12]:


# drop the blank column 'IT investement (USD)Billion'

#test_data.drop(['IT investement (USD)Billion'], axis = 1, inplace = True)

IT_data = pd.DataFrame( my_model.predict(scaled_test), columns=['IT investement (USD)Billion'])
IT_data


# ### Reverse label encoding to get the output in original format

# In[13]:
```

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```python
test_data['Bank'] = le_BN.inverse_transform(test_data['Bank'])
test_data['Year'] = 2023 - test_data['Year']
test_data.head()
```

In[14]:

```python
pd.concat([test_data,pd.DataFrame(IT_data)], axis = 1).to_csv('predicted_IT_val.csv', index = False)
```

India data Prediction

In[15]:

```python
India_data = pd.read_csv('IndiaBankData.csv')
India_data.head(30)
India_data.shape
```

In[16]:

```python
India_data['Bank'] = le_BN.fit_transform(India_data['Bank'])
India_data['Year'] = 2023 - India_data['Year']
India_data.head()
```

Transform the data with Standard Scaler

In[17]:

```python
test_data_India = India_data.values[:, :-2]

# transform data
scaled_India = scaler.fit_transform(test_data_India)
dataset_India = pd.DataFrame(scaled_India)
```

In[18]:

```python
dataset_India.head()
```

In[19]:

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```
India_IT_pred = pd.DataFrame( my_model.predict(scaled_India), columns=['IT investement
(USD)Billion'])
India_IT_pred
```

In[20]:

```
India_data.drop(['IT investment ','Unnamed: 6'], axis = 1, inplace = True)
India_data['Bank'] = le_BN.inverse_transform(India_data['Bank'])
India_data['Year'] = 2023 - India_data['Year']
India_data.head()
```

In[21]:

```
pd.concat([India_data,pd.DataFrame(India_IT_pred)],                axis                =
1).to_csv('India_predicted_IT_val.csv', index = False)–
```

Input Given to the Program

Source – Various Websites listed in Reference

Bank	Year	IT investment (USD)Billion
UBS	2017	2.68
UBS	2018	2.37
UBS	2019	2.30
UBS	2020	3.44
UBS	2021	3.90
UBS	2022	4.00
HSBC	2019	5.10
HSBC	2020	5.10
HSBC	2021	6.00
HSBC	2022	6.10
BS	2017	1.21
BS	2018	1.55
BS	2019	2.16
BS	2020	2.11
BS	2021	2.18
BS	2022	2.47

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Table 17 Input to Linear Regression -

- R-squared on Train Data : 0.90

- R-squared on Test Data : 0.54

Test data :

Source – https://www.macrotrends.net/

Bank	Year	Revenue (USD)Billion	Net Income (USD)Billion	Operating Costs (USD)Billion
UBS	2017	33.52	0.96	24.4
UBS	2018	35.38	4.51	24.34
UBS	2019	35.15	4.3	23.39
UBS	2020	36.03	6.55	24.92
UBS	2021	37.22	7.45	25.91
UBS	2022	39.72	7.63	24.95
BNP	2017	49.59	8.76	34.63
BNP	2018	50.95	8.88	36.98
BNP	2019	50.60	9.15	34.18
BNP	2020	51.05	8.07	37.05
BNP	2021	52.35	11.22	34.61
BNP	2022	50.92	10.74	34.3
HSBC	2017	66.63	9.68	36.65
HSBC	2018	75.43	12.6	36.42
HSBC	2019	82.68	5.96	45.1
HSBC	2020	66.2	3.89	43.24
HSBC	2021	62.29	12.6	33.69
HSBC	2022	75.79	14.82	36.92
CA	2017	21.02	3.61	14.53
CA	2018	23.71	5.19	15.24
CA	2019	37.73	8.06	24.46
CA	2020	23.97	2.64	16.39
CA	2021	27.18	6.49	16.82
CA	2022	25.48	5.29	15.96
BS	2017	79.23	7.03	29.08
BS	2018	80.78	8.56	29.56
BS	2019	79.21	6.63	28.79
BS	2020	66.28	-10.64	26.79
BS	2021	70.39	9.61	28.65
BS	2022	89.48	9.56	27.14

Barclays	2017	27.16	-2.47	22.84
Barclays	2018	28.21	1.86	23.64
Barclays	2019	27.62	4.18	22.14
Barclays	2020	27.94	1.95	24.04
Barclays	2021	30.16	8.76	18.95
Barclays	2022	30.86	6.21	22.19
HDFC	2017	12.88	2.16	3.73
HDFC	2018	15.17	2.74	4.46
HDFC	2019	17.37	3.18	4.73
HDFC	2020	18.7	3.45	5.64
HDFC	2021	20.9	4.45	6.79
HDFC	2022	21.13	5.08	6.59
ICICI	2017	16.89	1.51	10.01
ICICI	2018	18.44	1.19	11.71
ICICI	2019	18.77	0.6	12.36
ICICI	2020	21.11	1.34	13.23
ICICI	2021	21.78	2.48	13.27
ICICI	2022	21.10	3.36	12.03

Table 18 Test Data for Linear regression

Source -Linear Regression Output

Bank	Year	IT investment (USD)Billion
Barclays	2017	2.72
Barclays	2018	2.90
Barclays	2019	2.80
Barclays	2020	3.06
Barclays	2021	2.84
Barclays	2022	3.25
CS	2017	5.16
CS	2018	5.05
CS	2019	5.27
CS	2020	5.17
CS	2021	5.29
CS	2022	4.69
BNP	2017	4.28
BNP	2018	4.62
BNP	2019	4.50
BNP	2020	4.83

BNP	2021	4.82
BNP	2022	5.26
CA	2017	2.53
CA	2018	2.87
CA	2019	4.69
CA	2020	3.18
CA	2021	3.46
CA	2022	3.28
HDFC	2017	2.42
HDFC	2018	2.70
HDFC	2019	2.97
HDFC	2020	3.20
HDFC	2021	3.46
HDFC	2022	3.47
ICICI	2017	4.00
ICICI	2018	4.38
ICICI	2019	4.60
ICICI	2020	4.87
ICICI	2021	4.89
ICICI	2022	4.73
UBS	2017	2.68
UBS	2018	2.37
UBS	2019	3.50
UBS	2020	3.50
UBS	2021	3.90
UBS	2022	4.00
HSBC	2017	5.43
HSBC	2018	5.78
HSBC	2019	5.10
HSBC	2020	5.10
HSBC	2021	5.10
HSBC	2022	6.10
BS	2017	1.21
BS	2018	1.55
BS	2019	2.16
BS	2020	2.07
BS	2021	2.18
BS	2022	2.47

Table 19 Output of Linear Regression

Note Sky blue colour indicates that are part of input.

APPENDIX B

Machine learning Python code to predict revenue of the next 10 years

- **Barclays Ten-year revenue prediction:**

- **Input to the program –**

Source-

https://www.macrotrends.net/stocks/charts/BCS/barclays/financial-statements

Year	Revenue $ billions
01-01-2017	27.16
01-01-2018	28.21
01-01-2019	27.62
01-01-2020	27.94
01-01-2021	30.16
01-01-2022	30.86

Table 20 Input of Barclays using ARIMA, KPSS, AIC for IT Investment

Code used to predict next 10 years of revenue from 2022 to 2032

```python
#!/usr/bin/env python
# coding: utf-8

# In[1]:
import pandas as pd
import numpy as np
ts = pd.read_csv("Barclays_timeseries.csv")
##ts["ds"] = pd.to_datetime(ts["Year"])
print(ts.shape)
ts.head(6)
# In[2]:
#convert year to datetime format.
ts["Year"] = pd.to_datetime(ts["Year"])
```

```
# In[3]:
import datetime
import math
from sklearn.metrics import mean_squared_error
from statsmodels.tsa.stattools import adfuller


x_train = ts[ts.Year < datetime.datetime(2021, 1, 1, 0, 0, 0)]
x_test = ts[ts.Year >= datetime.datetime(2021, 1, 1, 0, 0, 0)]
print(x_train.shape, x_test.shape)


# In[4]:
from statsmodels.tsa.arima.model import ARIMA
import warnings
warnings.filterwarnings('ignore')
x_train = ts.Revenue[:]
import itertools
p=d=q=range(0,5)
pdq = list(itertools.product(p,d,q))
for param in pdq:
    try:
        model_arima = ARIMA(x_train,order=param)
        model_arima_fit = model_arima.fit()
        print(param,model_arima_fit.aic)
    except:
        continue
    # The Akaike information criterion (AIC) is an estimator of in-sample prediction error and
thereby relative quality of
# statistical models for a given set of data
# It's like the mean squared error in Regression - The smaller the number, the better



# In[5]:
```

```python
# ARIMA Model
model = ARIMA(x_train, order=(2,3,0))
results_MA = model.fit()


#Code for checking Forecasting
pred = pd.DataFrame(results_MA.forecast(10))
pred.rename({0:'Revenue'}, inplace = True, axis = 1)
pred.columns = ["Revenue"]
pred.index = [6,7,8,9,10,11,12,13,14,15]


join_row = ts.iloc[5][1]
pred_new = pd.DataFrame([join_row],index=[5],columns=pred.columns)
pred = pd.concat([pred_new,pred])
pred = pred.sort_index(ascending=True)
print(pred)


# In[6]:


# Perform the KPSS test
from statsmodels.tsa.stattools import kpss
kpss_statistic, p_value, lags, critical_values = kpss(ts.Revenue, regression='c')


# Interpret the results
print(f"KPSS Statistic: {kpss_statistic}")
print(f"P-value: {p_value}")
print(f"Critical Values: {critical_values}")


# Compare the p-value to a chosen significance level (e.g., 0.05)
alpha = 0.05
if p_value < alpha:
    print("Reject the null hypothesis (series is not stationary).")
else:
    print("Fail to reject the null hypothesis (series is stationary).")
```

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- **The output calculated after AIC model values , p.d.q**

- **p.d.q = 2,3,0**

- **KPSS Statistic: 0.36**

- **P-value: 0.09**

- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**

- **Fail to reject the null hypothesis (series is stationary).**

- **Barclays -The next 10-year revenue is predicted as follows.**

  Source: ARIMA, KPSS, AIC model result for Barclays

Bank	Year	Revenue $ billions
Barclays	2022	30.86
Barclays	2023	32.233
Barclays	2024	35.67
Barclays	2025	37.608
Barclays	2026	40.039
Barclays	2027	44.651
Barclays	2028	47.864
Barclays	2029	51.358
Barclays	2030	57.133
Barclays	2031	61.626
Barclays	2032	66.191

Table 21 Output For Barclays using ARIMA, KPSS and AIC for Revenue

Note - Please note that the same code has been uniformly applied across all banks, with corresponding inputs being adjusted for each.

- **Input to the Program –UBS five-year data**.

  Source   -   https://www.macrotrends.net/stocks/charts/CRC/california-resources/financial-statements

Year	Revenue $ billions
01-01-2017	33.52

01-01-2018	35.38
01-01-2019	35.15
01-01-2020	36.03
01-01-2021	37.22
01-01-2022	39.72

Table 22 Input of UBS to ARIMA, KPSS and AIC for Revenue

- **Output of the program -**

AIC model gives 50 values and out of which the closest fitting value to the curve is chosen.

- **p.d.q = (0.4.0)**
- **KPSS Statistic: 0.41**
- **P-value: 0.07**
- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**
- **Fail to reject the null hypothesis (series is stationary).**
- **Revenue output –**
- Source – ARIMA, KPSS and AIC output for UBS Revenue

Bank	Year	Revenue $ billions
UBS	2022	39.72
UBS	2023	44.53
UBS	2024	52.65
UBS	2025	65.08
UBS	2026	82.82
UBS	2027	106.87
UBS	2028	138.23
UBS	2029	177.9
UBS	2030	226.88
UBS	2031	286.17
UBS	2032	356.77

Table 23 Output of UBS using ARMIA, KPSS and AIC for Revenue

- **BNP - Revenue prediction for next 10 years (2022 to 2032)**

  Program Input –BNP

  Source - https://www.macrotrends.net/stocks/charts/CRC/california-resources/financial-statements?q=BNP

Year	Revenue $ billions
01-01-2017	49.59
01-01-2018	50.95
01-01-2019	50.6
01-01-2020	51.05
01-01-2021	52.35
01-01-2022	55.04

Table 24 Input of BNP to ARIMA, KPSS and AIC for Revenue

AIC model has provided 50 values fitting to the curve. Selected the lowest distance possible match.

- **P,d,q = (0.4.0)**

- **Output is as follows.**

- **KPSS Statistic: 0.39**
- **P-value: 0.08**
- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**
- **Fail to reject the null hypothesis (series is stationary).**

- **Output of the Program.**

    Source – Output of ARIMA, KPSS and AIC for BNP

Bank	Year	Revenue $ billions
BNP	2022	55.04
BNP	2023	59.66
BNP	2024	66.75
BNP	2025	76.85
BNP	2026	90.5
BNP	2027	108.24
BNP	2028	130.61
BNP	2029	158.15
BNP	2030	191.4
BNP	2031	230.9
BNP	2032	277.19

Table 25 Output of BNP using ARIMA, KPSS and AIC for Revenue

CA – Credit Agricole - Revenue prediction for next Ten years (2022 to 2032)
- **Program Input –**

Year	Revenue$ billions
01-01-2017	21.02
01-01-2018	23.71
01-01-2019	37.73
01-01-2020	23.97
01-01-2021	27.18
01-01-2022	25.48

Table 26 Input of CA using ARIMA, KPSS, and AIC for Revenue

- AIC p,.d,q values = (2,2,0)

- KPSS Statistic: 0.20

- P-value: 0.1

- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}

- Fail to reject the null hypothesis (series is stationary).

Output of the Python code : Output of the program after applying AIC code closest match

Source – Credit Agricole Output via ARIMA, KPSS and AIC

Bank	Year	Revenue $ billions
CA	2022	25.48
CA	2023	37.16
CA	2024	39.85
CA	2025	42.54
CA	2026	45.23
CA	2027	47.92
CA	2028	50.61
CA	2029	53.3
CA	2030	55.99
CA	2031	58.68
CA	2032	61.37

Table 27 Output of CA using ARIMA, KPSS and AIC for Revenue

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- **BS (Banco Santander revenue prediction**
- **Input to the code –**

Source - https://www.macrotrends.net/stocks/charts/SAN/banco-santander,-sa/financial-statements

Year	Revenue $ billions
01-01-2017	79.23
01-01-2018	80.78
01-01-2019	79.21
01-01-2020	66.28
01-01-2021	70.39
01-01-2022	89.48

Table 28 Input of BS using ARIMA, KPSS, and AIC for Revenue

- **Output was received after applying the AIC code – Closest matched points.**

P,d,q = (0,4,0)

- **KPSS Statistic: 0.11**
- **P-value: 0.1**
- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**
- **Fail to reject the null hypothesis (series is stationary)**
- **Output – BS next ten years of revenue**
- **Source – ARIMA, KPSS and AIC model**

Bank	Year	Revenue $ billions
BS	2022	89.48
BS	2023	121.49
BS	2024	164.36
BS	2025	216.03
BS	2026	274.44
BS	2027	337.53
BS	2028	403.24
BS	2029	469.51
BS	2030	534.28
BS	2031	595.49
BS	2032	651.08

Table 29 Output of B using ARIMA, KPSS and AIC Model for Revenue

- **HSBC revenue prediction program**
- **Input – Given to the code as follows**

  Source - https://www.macrotrends.net/stocks/charts/HSBC/hsbc/financial-statements

Year	Revenue $ billions
01-01-2017	66.63
01-01-2018	75.43
01-01-2019	82.68
01-01-2020	66.2
01-01-2021	66.29
01-01-2022	75.79

Table 30 Input of HSBC using ARIMA, KPSS, AIC for Revenue

AIC values p, d,q =(2,2,0)

- KPSS Statistic: 0.10
- P-value: 0.1
- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}
- Fail to reject the null hypothesis (series is stationary).
- **Output for HSBC revenue from 2022 to 2032**

  Source – Output of ARIMA, KPSS and AIC

Bank	Year	Revenue$ billions
HSBC	2022	75.79
HSBC	2023	67.43
HSBC	2024	58.58
HSBC	2025	72.64
HSBC	2026	69.04
HSBC	2027	53.85
HSBC	2028	63.73
HSBC	2029	69.16
HSBC	2030	52.36
HSBC	2031	54.24
HSBC	2032	66.39

Table 31Output of HSBC using ARIMA, KPSS and AIC for Revenue

- **HDFC revenue prediction**
- **Input is given to the program**

  Source – https://www.macrotrends.net/stocks/charts/HSBC/hsbc/financial-statements?q=HDFC

Year	Revenue
01-01-2017	12.88
01-01-2018	15.17
01-01-2019	17.37
01-01-2020	18.7
01-01-2021	20.94
01-01-2022	21.13

Table 32 Input of HDFC using ARIMA, KPSS and AIC for Revenue

- Using AIC model the p.d.q values are (2,3,0)

- KPSS Statistic: 0.40

- P-value: 0.07

- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}

- Fail to reject the null hypothesis (series is stationary).

Output – the predicted revenue for the next ten years

Source – Output of ARIMA, KPSS and AIC models.

Bank	Year	Revenue $ billions
HDFC	2022	21.13
HDFC	2023	23.18
HDFC	2024	22.5
HDFC	2025	24.06
HDFC	2026	22.81
HDFC	2027	23.61
HDFC	2028	22.05
HDFC	2029	21.85
HDFC	2030	20.15
HDFC	2031	18.85

HDFC	2032	17.06

Table 33 Output of HDFC using ARIMA, KPSS, and AIC for Revenue

- **ICICI: Input given to the code**

Source   -   https://www.macrotrends.net/stocks/charts/HSBC/hsbc/financial-statements?q=ICICI

Year	Revenue
01-01-2017	16.89
01-01-2018	18.44
01-01-2019	18.77
01-01-2020	21.11
01-01-2021	21.78
01-01-2022	21.10

Table 34 Input of ICICI using ARIMA, KPSS, and AIC for Revenue

AIC model gives the p.d.q values as (2,3,0)

- KPSS Statistic: 0.37

- P-value: 0.08

- Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}

- Fail to reject the null hypothesis (series is stationary).

- **The output given by the code.---**

Bank	Year	Revenue $ billions
ICICI	2022	21.1
ICICI	2023	22.44
ICICI	2024	22.23
ICICI	2025	20.54
ICICI	2026	20.88
ICICI	2027	19.79
ICICI	2028	17.10
ICICI	2029	16.43
ICICI	2030	14.46
ICICI	2031	10.77
ICICI	2032	9.09

Table 35 Output of ICICI using ARIMA, KPSS and AIC for Revenue

APPENDIX C

Predicting the IT investment for 2022 to 2032 using the KPSS and AIC model.

- **HSBC : IT investment prediction for 2022 to 2032**

- **Input given to the code** –

- Source – Output of Linear Regression

- **Source – Hypothesis 1 Output**

Year	IT Investment
01-01-2017	5.43
01-01-2018	5.76
01-01-2019	5.1
01-01-2020	5.1
01-01-2021	6.0
01-01-2022	6.1

Table 36 Input of HSBC using ARIMA, KPSS, AIC for IT Investment

```
Code for Predicting IT investment
#!/usr/bin/env python
# coding: utf-8

# In[1]:

import pandas as pd
import numpy as np

ts = pd.read_csv("HSBC_IT_investment.csv")
##ts["ds"] = pd.to_datetime(ts["Year"])
print(ts.shape)
ts.head(6)

# In[2]:

#Convert year to datetime
ts["Year"] = pd.to_datetime(ts["Year"])

# In[3]:

import datetime
import math
from sklearn.metrics import mean_squared_error

x_train = ts[ts.Year < datetime.datetime(2021, 1, 1, 0, 0, 0)]
x_test = ts[ts.Year >= datetime.datetime(2021, 1, 1, 0, 0, 0)]
```

```
print(x_train.shape, x_test.shape)
```

In[4]:

```
import warnings
warnings.filterwarnings('ignore')
from statsmodels.tsa.arima.model import ARIMA
import warnings
warnings.filterwarnings('ignore')
from statsmodels.tsa.arima.model import ARIMA
x_train = ts.ITInvestment[:]
```

```
# The Akaike information criterion (AIC) is an estimator of in-sample prediction error and
thereby relative quality of
# statistical models for a given set of data
```

```
# It's like the mean squared error in Regression - The smaller the number, the better[:]
```

```
import itertools
p=d=q=range(0,5)
pdq = list(itertools.product(p,d,q))
```

```
for param in pdq:
    try:
        model_arima = ARIMA(x_train,order=param)
        model_arima_fit = model_arima.fit()
        print(param,model_arima_fit.aic)
    except:
        continue
```

```
# The Akaike information criterion (AIC) is an estimator of in-sample prediction error and
thereby relative quality of
# statistical models for a given set of data
```

```
# It's like the mean squared error in Regression - The smaller the number, the better
```

In[5]:

```
from statsmodels.tsa.arima.model import ARIMA
```

```
x_train = ts.ITInvestment[:]
```

```
# ARIMA Model
model = ARIMA(x_train, order=(4,0,0))
results_MA = model.fit()
```

```
#Code for checking Forecasting
pred = pd.DataFrame(results_MA.forecast(10))
```

```
pred.rename({0:'ITInvestment'}, inplace = True, axis = 1)
pred.columns = ["ITInvestment"]
pred.index = [6,7,8,9,10,11,12,13,14,15]

join_row = ts.iloc[5][1]
pred_new = pd.DataFrame([join_row],index=[5],columns=pred.columns)
pred = pd.concat([pred_new,pred])

print(pred)

# In[6]:


from statsmodels.tsa.stattools import kpss
# Perform the KPSS test
kpss_statistic, p_value, lags, critical_values = kpss(ts.ITInvestment, regression='c')

# Interpret the results
print(f"KPSS Statistic: {kpss_statistic}")
print(f"P-value: {p_value}")
print(f"Critical Values: {critical_values}")

# Compare the p-value to a chosen significance level (e.g., 0.05)
alpha = 0.05
if p_value < alpha:
    print("Reject the null hypothesis (series is not stationary).")
else:
    print("Fail to reject the null hypothesis (series is stationary).")
```

- **Using AIC model P,d,q = (4,0,0)**

- **KPSS Statistic: 0.14**

- **P-value: 0.1**

- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**

- **Fail to reject the null hypothesis (series is stationary).**

HSBC output – Next 10 years IT investment prediction

Source – Output of ARIMA, KPSS and AIC

Bank Name	Year	IT investment $ billions
HSBC	2022	6.10
HSBC	2023	4.75
HSBC	2024	5.41

HSBC	2025	4.84
HSBC	2026	6.34
HSBC	2027	4.51
HSBC	2028	5.60
HSBC	2029	4.72
HSBC	2030	6.44
HSBC	2031	4.43
HSBC	2032	5.63

Table 37 Output of HSBC using ARIMA, KPSS, AIC for IT Investment

HDFC – Next 10 year investment prediction using KPSS and AIC

   Source - HDFC Input for investment prediction

Year	Investment
01-01-2017	2.41
01-01-2018	2.70
01-01-2019	2.96
01-01-2020	3.20
01-01-2021	3.45
01-01-2022	3.47

Table 38 Input of HDFC for ARIMA, KPSS, AIC for IT Investment

- **Using AIC model p,d,q = (0,1,0)**
- **KPSS Statistic: 0.37**
- **P-value: 0.08**
- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**
- **Fail to reject the null hypothesis (series is stationary).**
- **HDFC prediction for next ten years**
- **Source – Output Via ARIMA, KPSS AND AIC for HDFC**

Bank Name	Year	IT investment
HDFC	2022	4.00
HDFC	2023	4.00
HDFC	2024	4.00
HDFC	2025	4.00
HDFC	2026	4.00
HDFC	2027	4.00
HDFC	2028	4.00
HDFC	2029	4.00

HDFC	2030	4.00
HDFC	2031	4.00
HDFC	2032	4.00

Table 39 Output of HDFC using ARIMA, KPSS, AIC for IT Investment

- **BNP input**
- **Source – Output of Hypothesis 1**

Year	IT Investment
01-01-2017	4.28
01-01-2018	4.61
01-01-2019	4.50
01-01-2020	4.82
01-01-2021	4.81
01-01-2022	5.26

Table 40 Input for BNP using ARIMA, KPSS and AIC for IT Investment

- **Using AIC model – p,d,q = 1,2,1**
- **KPSS Statistic: 0.51**
- **P-value: 0.03**
- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**
- **Reject the null hypothesis (series is not stationary).**

Source – Output via ARIMA, KPSS and AIC

Bank Name	Year	IT investment $ billions
BNP	2022	5.26
BNP	2023	5.29
BNP	2024	5.74
BNP	2025	5.77
BNP	2026	6.22
BNP	2027	6.25
BNP	2028	6.70
BNP	2029	6.73
BNP	2030	7.17
BNP	2031	7.21
BNP	2032	7.65

Table 41 Output of BNP using ARIMA, KPSS and AIC for IT Investment

- **CA input**

  Source – Output via Hypothesis 1

Year	IT Investment
01-01-2017	2.53
01-01-2018	2.86
01-01-2019	4.69
01-01-2020	3.18
01-01-2021	3.45
01-01-2022	3.28

Table 42 Input of CA using ARIMA, KPSS, AIC for IT Investment

- **Using AIC Model p,d,q = (2,2,0)**

- **KPSS Statistic: 0.16**

- **P-value: 0.1**

- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**

- **Fail to reject the null hypothesis (series is stationary**

- **Source - CA output via ARIMA, KPSS and AIC**

Bank Name	Year	IT investment $ billions
CA	2022	3.28
CA	2023	4.57
CA	2024	4.91
CA	2025	5.25
CA	2026	5.59
CA	2027	5.93
CA	2028	6.27
CA	2029	6.61
CA	2030	6.95
CA	2031	7.29
CA	2032	7.63

Table 43 Output of CA using ARIMA, KPSS and AIC for IT Investment

- **BS Input**

  Source – Output of Hypothesis one

Year	IT Investment $ billions
01-01-2017	1.21
01-01-2018	1.55
01-01-2019	2.16
01-01-2020	2.11
01-01-2021	2.18
01-01-2022	2.47

Table 44 Input for BS using ARIMA, KPSS, AIC for IT Investment

Using AIC Model p.d.q = (0,1,0)

- **KPSS Statistic: 0.39**

- **P-value: 0.08**

- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**

- **Fail to reject the null hypothesis (series is stationary)**

    Source - BS output – Investment prediction – for next 10 years

Bank Name	Year	IT investment
BS	2022	2.47
BS	2023	1.79
BS	2024	0.99
BS	2025	1.77
BS	2026	2.99
BS	2027	2.53
BS	2028	1.35
BS	2029	1.42
BS	2030	2.09
BS	2031	2.08
BS	2032	2.09

Table 45 Output of BS using ARIMA, KPSS and AIC for IT Investment

- **Barclays Input**

    Source – Output for Hypothesis one

Year	IT Investment $ billions

Date	Value
01-01-2017	2.71
01-01-2018	2.89
01-01-2019	2.80
01-01-2020	3.05
01-01-2021	2.84
01-01-2022	3.25

Table 46 Input for Barclays using ARIMA, KPSS and AIC for IT Investment

- **Using AIC model – p.d.q = (2,1,9)**

- **KPSS Statistic: 0.45**

- **P-value: 0.05**

- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**

- **Fail to reject the null hypothesis (series is stationary).**

- **Barclays Investment prediction till 2032**

- **Source - Output of ARIMA, KPSS and AIC**

Bank	Year	IT investment $ billions
Barclays	2022	3.25
Barclays	2023	2.99
Barclays	2024	3.33
Barclays	2025	3.05
Barclays	2026	3.35
Barclays	2027	3.08
Barclays	2028	3.36
Barclays	2029	3.10
Barclays	2030	3.35
Barclays	2031	3.12
Barclays	2032	3.35

Table 47 Output of Barclays using ARIMA, KPSS and ACI for IT Investment

UBS Input –

Year	IT Investment
01-01-2017	2.68
01-01-2018	2.37
01-01-2019	2.30
01-01-2020	3.44

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Year	IT Investment $ billions
01-01-2021	3.90
01-01-2022	4.00

Table 48 Input for UBS using ARIMA, KPSS and AIC for IT Investment

Using AIC model, derived the p,d,q = 3,2,0

- **KPSS Statistic: 0.37**

- **P-value: 0.08**

- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**

- **Fail to reject the null hypothesis (series is stationary).**

- **The output of the program is as follows**,

  Source: Output of UBS for investment via ARIMA, KPSS, AIC

Bank Name	Year	IT investment $ billions
UBS	2022	4.00
UBS	2023	5.07
UBS	2024	4.70
UBS	2025	5.36
UBS	2026	5.69
UBS	2027	6.37
UBS	2028	5.99
UBS	2029	7.05
UBS	2030	7.16
UBS	2031	7.56
UBS	2032	7.55

Table 49 Output of UBS using ARIMA, KPSS, AIC for IT Investment

- **ICICI Input –**

Source – Hypothesis 1 Result

Year	IT Investment $ billions
01-01-2017	4.00
01-01-2018	4.37
01-01-2019	4.59
01-01-2020	4.87
01-01-2021	4.88
01-01-2022	4.73

Table 50 Input of ICICI using ARIMA, KPSS, AIC for IT Investment

- **Using the AIC model p,d,q = (2,0,2))**
- **KPSS Statistic: 0.34**
- **P-value: 0.09**
- **Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}**
- **Fail to reject the null hypothesis (series is stationary).**
- **ICICI Output – Prediction of Next years of IT investment –**

Source – Output of ARIMA, KPSS, ACI

Bank Name	Year	IT investment
ICICI	2022	4.73
ICICI	2023	4.45
ICICI	2024	4.13
ICICI	2025	3.87
ICICI	2026	3.76
ICICI	2027	3.85
ICICI	2028	4.09
ICICI	2029	4.41
ICICI	2030	4.70
ICICI	2031	4.88
ICICI	2032	4.87

Table 51 Output of ICICI using ARIMA, KPSS, AIC for IT Investment

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