

**INTELLECTUAL CAPITAL AND ITS IMPACT ON FINANCIAL PERFORMANCE
OF INDIAN BANKING SECTOR**

A Thesis

Submitted in Fulfilment of the Requirements for the Degree of

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DECLARATION

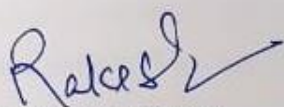
I, Monika Barak hereby declare that the thesis entitled: **“Intellectual Capital and its Impact on Financial Performance of Indian Banking Sector”** submitted to Thapar Institute of Engineering & Technology (Deemed to be University), Patiala, in fulfilment of the requirements for the award of the degree of **DOCTOR OF PHILOSOPHY in FINANCE**, is a record of the original research work carried out by me under the supervision of **Dr. Rakesh Kumar Sharma**, Associate Professor, School of Humanities & Social Sciences, Thapar Institute of Engineering & Technology. The matter embodied in this thesis has not been submitted in part or full to any other institute for the award of any degree.


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CERTIFICATE

This is to certify that the thesis entitled “**Intellectual Capital and its Impact on Financial Performance of Indian Banking Sector**” which is being submitted by Ms. Monika Barak, in fulfilment of the requirements for the award of the degree of DOCTOR OF PHILOSOPHY in FINANCE, is a record of the candidate’s original research work carried out under supervision and guidance. The matter embodied in this thesis has not been submitted in part or full to any other institute for the award of any degree.



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ABSTRACT

In the present era of the digital and knowledge-based economy, there has been a significant shift in the primary factor that drives organizational efficiency, performance, and value creation. In the past, physical assets were largely recognized as the primary determinant. With the emergence of knowledge-based economies and this digital era where production and value creation more depend on intangible assets (intellectual capital). Without a doubt, in the 21st century, the most effective method for nations to overcome the problems of globalization is by embracing Knowledge-Based assets preferably intellectual capital. Service enterprises, including banks, are classified as knowledge-intensive organizations, where the collection and growth of intellectual capital assets are essential aspects of bank administration. Intellectual capital, known as knowledge, has emerged as the primary driver of banks' wealth and the major force behind output.

The stability of a country's financial sector is essential to its sustainable growth and expansion. As a result of globalization and COVID-19, banks are confronted with new challenges because of the escalating complexity of emerging technologies, the advancement of communication and information techniques, and the rise in consumer expectations, as well as regulatory constraints. The dynamic transformations in the banking industry and the competitive landscape have compelled financial institutions to function as a sector that heavily relies on knowledge. This further led financial institutions to prioritize the assessment of the I.C to achieve their long-term goals.

This study investigates the impact of the I.C on the financial performance (F.P) of 12 public and 17 private sector scheduled commercial banks in India. The Modified Value-added Intellectual coefficient (MVAIC) technique has been utilized to measure intellectual capital efficiency. The independent variables used to measure intellectual capital efficiency include human capital (H.C), structural capital (S.C), capital employed, and relational capital. The financial performance, namely profitability, has been assessed by utilizing return on assets (ROA), return on equity (ROE), return on capital employed (ROCE), and return on sales (ROS) as dependent variables. Two control variables, Leverage and Size, have also been considered. The sample for this study consists of 12 public and 17 private scheduled commercial banks, covering the period from 2010 to 2022. The study's data has been obtained from the financial annual reports of banks and the prowessIQ database of the Centre for Monitoring Indian Economy (CMIE).

Once the relevant data from various variables has been collected and organized into panel data format then data is analyzed using suitable regression techniques i.e. fixed effect and cross-section random effect model and generalized method of moments (GMM). Based on the findings of this study, it was determined that banks in India generate significant value by investing in I.C resources. When considering the efficiencies resulting from I.C and its various components, it was found that human capital efficiency (HCE) was the most crucial resource compared to relational capital efficiencies (RCE), structural capital efficiencies (SCE), and capital employed efficiencies (CEE). This is logical because India is the most populous country in the world and has the youngest population. From an investment and business perspective, India offers great potential for growth, entrepreneurship, and innovation in several sectors. Thus, the outcome underscores the significance of making substantial investments in human resources, a concept supported by many business theories such as Resource-based theory (RB theory) and Human capital theory (HC theory).

The study offers conclusions and suggests future research directions based on its findings. The findings will aid executives, government officials, and policymakers in measuring efficiency and understanding the crucial intellectual components that improve their efficacy. These discoveries will assist in formulating measures to promote and augment their intellectual capacity. Moreover, the extent of investments in the I.C has a direct impact on the growth efficiency and eventual profitability of both public and private scheduled commercial banks in India. This indicates that policymakers and regulators should focus on raising investments, strengthening management practices, and enhancing the monitoring of intellectual capital resources to achieve a robust, efficient, and profitable banking institution.

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LIST OF ABBREVIATIONS

KBE	Knowledge-based economies
KE	Knowledge economy
RB	Resource-based Theory
OL	Organizational Learning
ICM	Intellectual capital management
I.C	Intellectual Capital
NBFCs	Non-Banking Financial Companies
FinTech	Financial Technology
RRB	Regional rural banks
BCBS	Basel Committee on Banking Supervision
GCC	Gulf cooperation council
IBs	Islamic Banks
H.C	Human Capital
S.C	Structural Capital
C.E	Capital Employed
R.C	Relational Capital
R&D	Research and Development
MB	Market value
ATO	Assets Turnover Ratio
EP	Earning price ratio
ROA	Return on Assets
ROE	Return on Equity
ROCE	Return on Capital Employed
ROS	Return on Sales
LEV	Leverage
EBIT	Earnings before Interest and Tax
VA	Value Added
VAIC	Value-added Intellectual Coefficient
MVAIVC	Modified Value-added Intellectual Coefficient
HCE	Human Capital Efficiency
CEE	Capital Employed Efficiency
SCE	Structural Capital Efficiency

RCE	Relational Capital Efficiency
GMM	Generalized method of moments
FE	Fixed effect model
CSRE	Cross-section Random Effect
DW	Durbin-Watson
HT	Hausman Test

CHAPTER – 1

INTRODUCTION

1.1 Background

In the 21st century, it is indisputable that countries can only effectively navigate the problems of globalization by embracing Knowledge-Based Economies (KBE) (Asongu & Nwachukwu, 2016; Xu et al., 2023). The reason for this is that we are currently in a period where the generation of value and the production of products and services rely on intangible assets, such as knowledge assets. This is in contrast to the era of industrial capitalism, where businesses completely relied on tangible assets. The acquisition and utilization of knowledge have become essential for competing in the 21st century. This period is characterized by the emergence of a KBE and has been highlighted as a crucial aspect in a policy report by the World Bank throughout the last decade (Amavilah et al., 2017). North America and Europe have successfully understood and become proficient in the intricacies of a Knowledge-Based Economy (KBE) with this mindset. They are inevitably documenting the trajectory of advancement on the global stage. Similarly, Latin America and Asia are increasingly recognizing the significance of the Knowledge-Based Economy (KBE) in their efforts to gain regional and national advantages (Dahlman, 2007). The substantial economic growth in these countries is attributed to their extensive investment and dependence on cutting-edge technology, which plays a pivotal role in the creation of a KBE. It is hardly surprising that these nations are seeing a notable transition from industrialized capitalism to a knowledge-based economy (KBE). Hence, the global economy focuses primarily on the geographical dimensions of economic expansion. The direction of economic growth has switched towards resource input rather than output in the previous mode of production. Nowadays, production is predominantly knowledge-based (Martins Rodriguez & María Viedma Martí, 2006).

In the current economic landscape, intellectual capital (I.C) is widely acknowledged as the most crucial intangible resource for company success. It is considered the important driver of a firm's competitive advantage, ensuring its sustainability and ability to stay ahead of the competition (Kwaku Mensah Mawutor et al., 2023; Kweh et al., 2022; Malchev et al., 2024; Marsintauli et al., 2023; Tiwari et al., 2023). Therefore, it is believed that the presence of I.C assets is crucial for establishing a competitive edge in the modern economy (Kiong et al., 2011; Stewart, 1997; Zheng et al., 2022). To gain a competitive advantage, companies must utilize a collection of important intellectual resources that are readily accessible to them (Penrose,

2009). Therefore, by integrating all important intangible resources, specifically I.C, that are accessible to a company, numerous advantages can be obtained (Ozkan et al., 2017; Serpeninova et al., 2022). To gain the advantages mentioned above in terms of intellectual assets, (Wang, 2011) argued that good knowledge management is crucial. This entails the integration of individuals, procedures, and technology to enhance performance and achieve a sustainable advantage. This assures that businesses can gradually grow and use their knowledge assets, or I.C, to obtain the desired competitive advantage (Boonchukham et al., 2023; Kweh et al., 2022; Rajesh et al., 2011; Skhvediani et al., 2023). Hence, the implementation of efficient knowledge management strategies by companies will enable the utilization and enhancement of I.C to generate and enhance value, as well as guarantee a lasting competitive edge for the companies. Therefore, having an adequate amount of I.C resources and effective management will allow a company to generate innovations (Chistov et al., 2021; Goh, 2003). The importance of I.C for a firm's performance is highlighted by (Ghosh & Wu, 2007), they argue that investing in I.C can yield twice the value compared to investing in physical assets, as stated (Zambon et al., 2003). Every organization needs a certain level of I.C to thrive in the competitive information economy. This is especially true for knowledge-intensive enterprises, which rely heavily on I.C to sustain their presence in the knowledge economy.

Service organizations, like banks, are classified as knowledge-intensive firms. This means that acquiring and growing I.C assets are essential for managing banks effectively (Castelo Branco et al., 2011; Khalique et al., 2019; Mondal & Ghosh, 2012; Tiwari & Vidyarthi, 2018). According to the World Bank (1999), knowledge, also known as intellectual capital, is currently the primary driver of wealth for banks and the most influential factor in production. It is not surprising that the global banking industry is increasingly driven by intellectual resources as a means of creating wealth, as opposed to other resources (Bontis, 1998). Banks rely on innovation to provide cutting-edge goods and creative services to gain a competitive advantage. According to Chen Goh (2005), banks can achieve increased productivity and economic value by focusing on their intangible asset, specifically their I.C. Effectively managing the knowledge resources that banks have is crucial to providing the necessary products and services that will facilitate the movement of cash towards the economic growth of countries. A nation cannot function effectively without the presence of well-organized financial institutions such as banks, as the functioning of banks is crucial for the overall economic well-being. Banks play a crucial role in the advancement of nations by generating value through the supply of goods and services that enhance the well-being of citizens and foster economic growth (Barak & Sharma, 2024). Banks are strongly advised to cultivate and

oversee their intellectual capital to effectively contribute to economic development by creating value. Effective management of I.C is now essential for banks to remain competitive in this dynamic and highly competitive industry (Aslam et al., 2024; Rehman et al., 2022).

It is evident from the above that for nations to achieve economic development, the success of their financial institutions, such as banks, relies on the effective investment and management of I.C assets. Furthermore, banks play a crucial role as financial intermediaries, offering essential services to enhance and promote economic growth. Therefore, banks require intellectual assets for their operations, as highlighted by Goh (2005), which in turn contributes to the overall increase in the gross domestic product of the economies. Given the significance of the banking sector and its impact on the overall economy, it is essential to conduct research on its development and analyze its performance. This study specifically examines the complete impact of I.C assets on the economic growth of the Indian economy. This study aims to quantify and assess the efficiency of I.C, as well as its effects on the performance of both commercial sector banks (public and private sector) in India, to their economic growth.

1.2 Overview of Intellectual Capital

The core concept of an intangible asset was initially documented by Lawrence R. Dick in 1896 (Kristandl & Bontis, 2007). Since then, the knowledge economy (KE) has consistently examined the impact of intangibles on a firm's market value. Penrose's (1959) vision of corporations highlights the role of productive and non-physical resources in determining the performance of a company (Martí, 2007). The productive resources referred to here are a company's internal capabilities that contribute to its profitability and value, as described by Penrose (1980). The focus on intangibles has received attention due to the rise of KBE, which necessitates advanced skills as crucial factors for the growth of governments and companies. The World Bank and OECD have emphasized the importance of understanding and effectively utilizing KBE in their policy studies (Amavilah et al., 2017).

The KBE relies on the utilization of strategic assets, such as knowledge and information, as identified by the OECD in 1996. The effective application of these assets determines a country's progress and accounts for the disparities in growth observed among nations. The optimism over the KBE is grounded in actual evidence that demonstrates the significant significance of knowledge generation and utilization in wealth creation. There is a global recognition that the KBE offers new avenues for growth due to the widespread use of information and communication technologies, which are all centered around the generation, distribution, and application of knowledge (World Bank, 2004). According to KBE principles, innovation,

technology, and knowledge are prioritized as crucial elements of development (Singh, 2008). This highlights the significance of intangible assets in comparison to physical assets. This supports the idea that intangible assets are important for creating wealth (Mokyr, 2005; Serpeninova et al., 2022). However, the absence of understanding regarding intangible assets and their significance to organizations was a significant drawback in the corporate accounting records. Currently, organizations are seeing an increasing number of difficult issues because their important assets are no longer tangible, but rather intangible. In the past, tangible assets accounted for 75% of an organization's value. However, in today's highly competitive business landscape, intangible assets, such as the intellectual skills and knowledge of employees, make up 50% of a company's value. Soft assets currently have a smaller place in the company's balance sheet, which is a difficult fact to acknowledge. Given the aforementioned and the accumulation of value from intangible assets, it is necessary to include this in the financial statement.

According to research conducted by Boeckstein, (2009), businesses must increase their competencies and innovations in addition to other nonphysical resources like knowledge because they have limited physical resources. This will help them develop better products and services faster and more profitably. Lipunga, (2014) stated that in the 21st century, the KBE is becoming increasingly dominant. Many companies are moving away from relying on physical assets and instead focusing on utilizing intangible resources to maximize their resource efficiency. The intangible resources that encompass knowledge-based assets are referred to as I.C, which has the potential to be converted into value and financial gain.

The concept of "intellectual capital" was first proposed by John Kenneth Galbraith in 1969 (Bontis, 1998; Edvinsson & Malone, 1997a; Hsiao et al., 2010). I.C was defined as more than just pure intellect, ideally integrated into intellectual action. Since then, the research on I.C has gained significant attention, mostly driven by the advancements in the Knowledge-Based Economy (KBE) that are influenced by knowledge and information (Petty & Guthrie, 2000). Various researchers have provided numerous explanations for the idea of I.C, leading to the absence of a clear and definitive definition and components for I.C (Hsiao et al., 2010). Stewart (1997) argued that I.C resources encompass intellectual material such as information, experience, intellectual property, and knowledge, which in turn contribute to the creation of wealth. I.C refers to the intrinsic worth of a company's knowledge and skills, which is integrated into its corporate structures, organizational strategies, processes, and systems (Edvinsson & Malone, 1997a). Regarding the composition of constituents of I.C, while

different scholars have provided varying components, they all share a basic understanding. For example:

- Scandia (1996) defines Intellectual Capital (I.C) as comprising Structural Capital (S.C), Human Capital (H.C), and other intangible assets and intellectual property owned by the firm.
- Edvinsson & Malone (1997) describe I.C as consisting of H.C and S.C, with S.C further divided into Organizational Capital and Customer Capital, which are grouped into Process Capital and Innovation Capital.
- Euroforum (1998), based on the model used by Spanish companies, categorizes I.C into Human, Structural, and Relational components.
- Sveiby (1997) categorized I.C into three distinct components: human capital, structural capital, and customer capital.
- Jardon & Martinez-Cobas (2021) summarized I.C consists of both tangible and intangible assets that contain knowledge and knowledge assets that serve as the foundation for a firm competency. It is a collection of knowledge assets that an organization owns, manages, and that significantly adds value to the business.
- Ahmed et al. (2022) Relational, structural, and human capital are all components of I.C.
- Abredu et al. (2023) An extension of conventional capital, intellectual capital consists of immaterial assets with potential for value creation.
- Ali et al. (2023) defined a replacement for an organization's physical capital, intellectual capital as the skill, relationship, and knowledge of its soft assets.

The aforementioned elements of I.C are the variables that a corporation can combine and utilize to create economic prosperity. To optimize the utilization of the elements of I.C, effective management is necessary. This concept is known as Intellectual Capital Management (ICM), which involves the creation and administration of I.C from a strategic standpoint.

1.3 Indian Banking System and Its Evolution

The Indian banking system plays a crucial role in the economic structure of the country, as it is vital in fostering financial stability, facilitating resource allocation, and driving economic advancement (Sharma, 2022). In India, the banking industry possesses a rich and extensive historical background, rooted in the early 18th century (Gupta et al., 2023). Throughout the years, this industry has exhibited a noteworthy ability to adapt to the evolving economic landscape and adopt advancements in technology (Tiwari & Vidyarthi, 2018).

The principal regulatory authority in charge of monitoring the operations of financial institutions across the country is the Reserve Bank of India (RBI), which was established in 1935. The central bank is primarily tasked with the formulation and implementation of monetary policy, along with the issuing and supervision of currency. Moreover, it assumes the onus of overseeing the operations within the banking sector, aiming to guarantee the preservation of stability, sufficiency of capital, and fiscal integrity.

The classification of the Indian banking system encompasses two primary categories, namely Non-Scheduled and Scheduled banks. Scheduled Banks are a category of financial institutions that have been officially listed in the II Schedule of the RBI Act, of 1934. These banks are legally required to adhere to specific criteria, which comprise the preservation of a minimum amount of paid-up capital and network. Scheduled banks are an essential component of a nation's economic framework. In contrast, Non-Scheduled banks, while also holding significance, operate on a relatively lesser scale and do not possess the same rights as their Scheduled bank counterparts.

The Indian banking system is defined by a dual-control structure, which is distinguished by the coexistence of both commercial public and private sector banks. Public sector banks are financial institutions in which a substantial proportion of the ownership is held by the government. This characteristic enables them to assume a crucial role in driving the socio-economic progress of the country. In contrast, private sector banks are controlled and run by private persons or corporations, hence fostering competition, and promoting innovation within the banking industry.

The Indian financial system has seen significant and diverse development over two centuries, thus shaping its historical trajectory. Provided herein is a brief description of the historical context of the subject matter.

1. Pre-Independence Period (Pre-1947)

- The Bank of Hindustan, founded in 1770, is widely regarded as the first banking institution in India. It was formed in Calcutta, presently known as Kolkata.
- The General Bank of India was established in Bombay (now Mumbai) in the year 1786.
- The Bank of Bombay (1840), Bank of Madras (1843), and Bank of Bengal (1806) were the three Presidency Banks, serving as the foremost banking establishments in British India during that time.

- Three banks culminated in the establishment of a singular banking institution in 1921, known as the "Imperial Bank of India." This bank underwent nationalization in 1955 and was subsequently renamed The State Bank of India, presently recognized as the largest Indian public sector bank.

2. Post-Independence Period (1947-1969)

- The establishment of the Imperial Bank of India in 1921 was a direct consequence of the amalgamation of the Presidency Banks. Before attaining independence, this financial organization played a substantial role in the Indian economy.
- The RBI was established in 1935 to serve as the major central financial institution in India.
- The year 1949 signified a notable landmark in the historical trajectory of the RBI as it underwent a process of nationalization. The occurrence of this revolutionary event led to an increased level of involvement by the RBI in the domain of regulation and supervision within the banking sector.

3. Nationalization (1969)

- The process of nationalizing major banks took place in 1969 under the leadership of Prime Minister Indira Gandhi. This initiative resulted in the transfer of ownership of 14 significant commercial banks to the state. This category included well-established financial institutions such as Punjab National Bank, Bank of India, and Canara Bank. To improve banking accessibility and reduce the concentration of economic power, the government has acquired a majority stake.

4. Banking Reforms (1980s and 1990s)

- During the second phase of nationalization in 1980, there was a notable expansion in the number of nationalized banks, with an increase of six, so reaching a cumulative count of 20 nationalized banks.
- The nationalization of these banks occurred as a result of the implementation of the Banking Regulation Act in 1949.

5. Liberalization and Modernization (1990s-Present)

- A balance of payments crisis, the Indian government undertook economic reforms in 1991, often known as liberalization. The initiative involved the liberalization of the banking sector, allowing for the participation of private and

international businesses. This resulted in heightened competition and the creation of an environment that promotes innovation.

- The inception of a discrete categorization of financial institutions referred to as new private banks developed in 1993. The financial institutions comprise Axis, ICICI, and HDFC Bank.
- In 1994, the Indian government implemented a policy that authorized international banks to create wholly-owned subsidiaries within the country.
- RRBs (Regional Rural Banks) were established in 1975 following the introduction of Local Area Banks (LABs) in 1996. Regulatory Changes

6. Regulatory Changes

- The legislative framework required for the regulation and supervision of banks was established by the Banking Regulation Act of 1949.
- The Narasimham Committee, in both 1991 and 1998, proposed a set of significant recommendations to strengthen the resilience of the banking sector. The recommendations covered a variety of initiatives aimed at improving the quality of assets, ensuring sufficient capital, and fostering transparency within the sector.

7. Recent Developments (2010s onwards)

- In tandem with this noteworthy advancement, the Central Bank of India (Reserve Bank of India) adopted two innovative banking models, namely universal banks, and differentiated banks, in the fiscal year 2015-16.
- Payments banks are classified under a differentiated bank license, whereas small finance banks are classified under universal bank licenses owing to their limited capacity to offer the complete array of services provided by commercial banks. There are a total of 11 small financing banks and 6 payment banks in India, per the statistics recorded in December 2021. The formation of these banking institutions was driven by the aim of addressing the specific needs of various geographical regions and promoting the ideals of financial inclusiveness.
- The banking business is currently experiencing a continuous phase of evolution, with daily advancements observed in the sector aimed at enhancing the economic progress of the nation. To enhance the resilience and self-sufficiency of the banking sector, the Government of India undertook the consolidation of government-owned banks, reducing their number to 12 in the year 2019. This

strategic move aimed to enable these banks to effectively compete with their worldwide counterparts.

- In recent years, India has placed significant emphasis on expanding the accessibility of its banking industry, employing different initiatives such as the Pradhan Mantri Jan Dhan Yojana and Post payment banks. Initiatives such as these, in conjunction with substantial reforms in the banking sector including digital payments, the emergence of neo-banking, the growth of Indian non-banking financial companies (NBFCs), and the advancement of financial technology (fintech), have notably augmented India's financial inclusivity and contributed to the stimulation of the credit cycle inside the nation.

Currently, the Indian banking system comprises 12 public sector banks, 22 private sector banks, 46 foreign banks, 56 RRBs, 1485 urban cooperative banks, 96,000 rural cooperative banks, and cooperative credit institutions (Barak & Sharma, 2024). There has been a substantial increase in bank assets from the year 2020. During the fiscal year 2022-23, the combined assets of the public and private banking sectors amounted to US dollars 1,553.57 billion and US dollars 901.3 billion, respectively. During the fiscal year 2022-23, the assets belonging to public sector banks were 59.24% of the overall banking assets, encompassing public, private sector, and foreign banks.

1.4 Statement of the problem

The world is gradually transitioning from an era of industrial capitalism, which prioritizes tangible physical assets, to a new era of knowledge economy, which prioritizes intangible assets as the main source of value creation. Therefore, intangible assets serve as the primary production instrument that is effectively contributing to the success of enterprises. However, in the financial statements of firms, there is often little or no consideration given to intangible assets, with the focus being on physical and financial assets. It is hardly surprising that traditional financial reports are losing credibility due to their provision of partial accounting (Guthrie et al., 2009; Melloni, 2015). These reports are based on traditional accounting standards and are not appropriate for the current knowledge economy (Firer & Mitchell Williams, 2003). The report has served as the main foundation for decision-making and has the potential to misguide investors, managers, and other stakeholders when it comes to making informed decisions. The decision may be deemed incorrect due to the absence of intangible assets in the financial statements (Lev, 2000).

Furthermore, it is often acknowledged that investors in the capital market frequently encounter heightened instability when assessing the value of intangible resources in a corporation compared to tangible assets (Zahn et al., 2007). This question pertains to the company's annual reports and the roles of auditors and accountants as preparers and examiners. Therefore, a considerable portion of intangible assets extends well beyond the limits of the traditional financial accounting framework. The growing instances of misappropriations in a company's financial statement necessitate study to investigate the significance of intangible assets and demonstrate their value in the financial statements of firms.

The advent of the new economy known as the KBE is also responsible for a change in the perception that knowledge is now recognized as a key source of profit for businesses and as a separate factor of production. The current economy is closely linked to the growing acknowledgment of strong rivalry and the need for nations and organizations to possess high levels of capabilities (Seleim et al., 2007). Technology combined with the increasing rate of globalization has resulted in instability, variability, unpredictability, and imbalance that define the KE according to (Suciu, 2004). The implementation of a KBE was a result of recent technical progress and the globalization of the global economy. This necessitates that countries and enterprises excel and assimilate into the global economy, recognizing the growing significance of specialized knowledge as a means of adapting to the emerging phenomenon of globalization. Being receptive is a characteristic of nations and organizations that flourish as top competitors. North America and Europe have successfully mastered the dynamics of KBE with a strong sense of determination and enthusiasm. They are inevitably documenting the trajectory of advancement on the international stage. Furthermore, countries in Latin America and Asia are increasingly recognizing the significance of the KE in their efforts to gain regional and national benefits (Dahlman, 2007). These nations have experienced a significant transition from product-based economies during the industrialization era to knowledge-based economies, which rely on tacit knowledge for economic development.

India has indeed utilized knowledge economy techniques in conjunction with the implementation of reforms like globalization and deregulation. This has resulted in both obstacles and possibilities for banks to adapt and effectively compete in rising markets (Weqar & Haque, 2020). Despite the efforts to disrupt, reform, and privatize state-controlled banks as part of the structural adjustment policies of the World Bank and the IMF, additional measures have been implemented to alleviate the limitations on entering and exiting the banking sector. The entry of private and international banks into these economies led to increased competition

and subsequent changes in the banking system. This rivalry has resulted in a decrease in the difference between interest rates and a reduction in the revenues of banks (Hsiao et al., 2010). Therefore, to establish, uphold, and preserve an edge, banks must efficiently oversee their I.C, considering their increasing reliance on intangible assets for superior performance. Hence, the contention is that in the face of intense rivalry in the banking industry, the only way to maintain a competitive edge is by effectively managing intellectual capital to secure a leading position in the knowledge-based economy (KBE) (Wiklund & Shepherd, 2003).

Furthermore, research conducted by Mohiuddin et al. (2006); El-Bannany (2012); Mondal and Ghosh (2012); Soriya and Narwhal (2015); Onyekwelu et al. (2021); and Oppong and Pattanayak (2019); Tiwari et al. (2023); Tiwari & Vidyarthi, (2018); Weqar & Haque, (2020) have examined the association between I.C and banks' performance. These studies have indicated that I.C is vital in determining firms' productivity, profitability, and efficiency. Thus, it is crucial to examine I.C in the banking industry, as this sector falls into the category of knowledge-intensive enterprises (Mavridis, 2004).

Many research studies conducted worldwide have examined the significant impact of the I.C on the bank's performance. These studies have gone beyond individual studies to include cross-country studies, particularly focusing on Europe, Asia, and Middle East countries. Examples of relevant studies include Gigante's (2013) research on banks in ten European countries, Nawaz and Hamiffa's (2016) research on the I.C performance of banks in Asia, Europe, and the Middle East, Al-Musali and Ismaili's (2016) assessment of I.C performance in banks in GCC countries, Setianto and Sukmana's (2016) investigation into the I.C efficiency of Islamic banks in Malaysia and Indonesia, and Hamdan's (2018) examination of I.C performance in banks in GCC countries.

In developing countries like India, not much research has been done on the connection between an I.C. bank's performance and its success. It must be acknowledged, nonetheless, that some research has been done on Indian banks (Mohapatra et al., 2019; Tiwari et al., 2023; Tiwari & Vidyarthi, 2018; Weqar & Haque, 2020, 2022). These researches concentrated on straightforward methods for analyzing the noteworthy correlation that exists between I.C and bank performance. Our goal in this work was to use a suitable econometric technique for longitudinal data analysis, with a particular emphasis on the years 2010–2022, taking into account the effects of COVID-19 and demonetization. On the other hand, we have used more sophisticated statistical techniques such as fixed and cross-section random effect models, as well as the Generalized method of moments (GMM). This makes our research unique. In

addition, this study also identifies the disparities in methods used to measure the impact of I.C. on financial performance. We have replaced the contentious VAIC model with an alternative measure of I.C called MVAIC to solve the inadequacies of earlier research. As a developing country, India needs to grow its I.C to transform its economy. The motivation behind the study is to resolve the discrepancies found in earlier research on the connection between I.C and F.P.

1.5 Research questions of the study

R1: What is the relationship among human capital, relational capital, structural capital, and capital employed of the Indian banking sector?

R2: How does intellectual capital impact the financial performance of Indian banks?

R3: How does the impact of intellectual capital on financial performance differ in public and private sector banks in India?

1.6 Objectives of the study

Q1: To examine the relationship among human capital, relational capital, structural capital, and capital employed of the Indian banking sector.

Q2: To analyze the impact of intellectual capital on the financial performance of Indian banks.

Q3: To compare the impact of intellectual capital on the financial performance of Indian public and private sector banks.

1.7 Significance and contribution of the research

Several stakeholders, including customers, suppliers, management, owners, regulators, policymakers, and banking authorities, are interested in learning more about the impact of the I.C on the financial performance of public and private sector banks in India. As a result, by using the data from Indian banks, multiple impacts can be made, including theoretical, methodological, and practical contributions.

1.7.1 Theoretical contribution

Even though intangible assets are rarely or never considered in traditional accounting models, such reports have historically served as the main foundation for decision-making regarding a company's financial and material assets. Because businesses invest a large portion of their capital in intangible assets, this can deceive investors, administrators, and other stakeholders. Because of this, the study's findings will inform managers about the importance of including

intangible assets and I.C in the firm's financial statements, which will help eliminate decision-making discrepancies that many managers, investors, and other stakeholders believe to be misleading. Once again, it is commonly argued that those involved in the financial market experience greater uncertainty when evaluating the intangible assets of a company as opposed to its tangible assets Zahn et al., (2007). The results of this study will partially demonstrate the methods and approaches used to assess the value of intangible assets in companies, organizations, and institutions. This will aid in the eradication of the increased level of uncertainties experienced by executives, business owners, experts, and national-level bodies.

1.7.2 Methodological contribution

This study is one of the limited empirical studies examining and exploring the influence of I.C on the financial performance (F.P) of the Indian banking sector. This research enhances comprehension of how improved I.C in banking firms can provide more advantages for the many stakeholders. The current study also aims to recognize the discrepancy in the techniques employed to quantify the influence of I.C on financial performance. To address the shortcomings of previous studies, we have employed an alternative measure of I.C known as MVAIC, instead of the disputed VAIC model. In addition, we have addressed a significant research gap in the existing studies conducted in India. These studies have used simple regression techniques to establish the relationship between I.C and F.P. However, we have employed more advanced statistical methods such as the Generalized method of moments (GMM), and Fixed and cross-section Random effect models. This study will be distinctive in examining the role of I.C doing a comparative analysis between two distinct groups of institutions and considering the two major events demonetization and the COVID-19 period.

1.7.3 Practical contribution

From a practical standpoint, in the current digital and knowledge-driven economy, administrators must be fully aware of the critical role that I.C plays in enhancing financial performance. Financial institutions are vital for nations as no economy can operate effectively without a crucial banking system. An examination that focuses on the investment of I.C and performance analysis in banking development is highly significant for the overall health of the economy. This study is both thrilling and advantageous for customers, owners, management, nations, and regulators. The analysis of this empirical research will reveal the true worth of intellectual investments in banks, providing insight into how nations and the continent as a whole view the I.C as a means to achieve financial progress. Indian stakeholders will

immediately profit from this area as well. This has the potential to eventually enhance the growth of Indian banking and other financial organizations.

According to this study, Indian financial institutions need to ensure that they properly manage the efficiency of each component of their I.C, which includes their capital employed, human capital, structural capital, and relational capital. It has been shown that in the banking sector, I.C. is essential to achieving both financial success and a long-term competitive edge. To improve economic growth and performance, Indian banks ought to promote I.C. investment. Policymakers can thus utilize this research as a guide when developing I.C. development policies for the banking industry in the future.

1.8 Organization of the Thesis

The thesis embodies six chapters: Introduction; Review of Literature; Research Design and Methodology; Data Analysis and Results; Discussion and Impact of Intellectual Capital, and Summary, conclusion and Limitations and Future Research.

Chapter 1: Introduction

This chapter provides a brief overview of the context for this research project. It emphasizes the research problem and demonstrates the need for doing the research. The chapter provides insight into the current state of I.C in India. It also sheds light on the significant advancement of I.C in India. The chapter briefly outlines the study's objectives, requirements, and motivation.

Chapter 2: Review of Literature

This chapter reviews pertinent literature from various sources to comprehend multiple concepts of I.C in India and other countries of the world. The review of the literature assists in providing a direction to the research based on the theoretical framework of various studies covered for comparison and deeper learning. The study presents the research gaps.

Chapter 3: Research design and methods

This chapter examines the study techniques and procedures used to accomplish the objectives. The study objectives have been clearly outlined in this chapter. The primary emphasis is on the research design, sampling design, sources of data collection, reliability, and validity testing. It also outlines the research methods employed to substantiate the study objectives. The report provides a comprehensive account of the research conducted using secondary data. This chapter also includes the conceptual model of the study.

Chapter 4: Data analysis and results

This chapter focuses on the results obtained from the analysis of the data. The chapter addresses the analysis of the findings, commencing with descriptive statistics, correlation matrix, assessment of data stationarity, panel least square results utilizing fixed and cross-section random effects models, Hausman test, and ultimately the generalized method of moment estimation. This study employs these methodologies to determine the specific components of intellectual capital that have the greatest impact on generating value for both sector banks in India.

Chapter 5: Discussion and Impact of Intellectual Capital

This chapter also examines the comprehensive analysis of the findings, followed by the study implications for policies and practices presented in this section.

Chapter 6: Summary, conclusion, limitations, and future research

The final section of the study presents a summary of the research and outlines the implications for various stakeholders including practitioners, scholars, and policymakers. The constraints of the study and possibilities for future research form an essential component of this chapter.

CHAPTER – 2

REVIEW OF LITERATURE

2.1 Introduction

The concept of I.C has gained popularity among academics due to its appeal as a prominent area of study in the academic realm. The focus and intense curiosity in studying I.C have been prompted by the emergence of knowledge workers and information and knowledge technology (Subramaniam & Youndt, 2005) to maintain an edge over competitors (Cabrita & Bontis, 2008). This part of the study provides a comprehensive overview of the existing literature on I.C. The review encompasses the historical advancements in the field of I.C as well as the current state of I.C studies. It also includes an examination of the many elements of I.C, the process of measuring it, and the models used to classify it. The chapter presents a current and comprehensive analysis of the empirical research on I.C, specifically focusing on the relationship between profitability measures and financial success.

2.2 Evolution of Intellectual Capital and Its Growth

The concept of capital can be attributed to the writings of Marx and Brewer (1933, 1995, 1984). From a capitalist standpoint, capital is regarded as a constituent of the dominant social class that participates in investment and accrues surplus value. Marx argued that organizations allocate value to the fixed capital they invest in. In the early 1990s, Marx's thesis gained attention from academic researchers and economists. This concept proposed a shift in company strategy, moving from a focus on competitive dynamics to a more ambitious approach centered around resource-based efficiency, specifically capital. This novel approach emphasizes the role of policy in the utilization of capital assets specific to enterprises. In his 1969 article, John Kenneth Galbraith coined the phrase "intellectual capital" to describe the assets of certain firms. This notion suggests that intellectual capital is a more effective strategy than static capital. It means that intellectual action is a resilient approach, as opposed to a mere type of capital (Edvinsson, 1997). In addition, Itami & Roehl, (1991) published pioneering research that highlighted the significance of intangible assets as valuable capital for organizations. Nevertheless, the concept of recognizing the worth of intangible assets was not readily embraced by individuals involved in intellectual assets. As a result, there was limited acknowledgment of its substantial impact in that particular industry. One major obstacle that prevented Itami's idea from gaining further traction was the lack of knowledge about non-physical resources and their importance to enterprises.

Subsequently, other organizations were enticed to assess the worth of their intangible assets due to the concept of capital for value creation proposed by Itami (1991) and Sveiby (1986). Edvinsson (1991), the Director of I.C at Skandia, discussed the concept of hidden values and subsequently created a model for effectively managing the I.C of companies in his initial implementation. He made a valuable contribution by developing a management model to measure intangible assets. This model led Skandia to include six additional intellectual supplements in their annual reports. These supplements highlighted the firm's I.C and elucidated how this concealed value may be advantageous to both shareholders and customers. Martin-de-Castro et al. (2011) define the evolution of I.C as being determined by the concepts of Emergence and Academic focus.

- **Emergence:** It is widely agreed that the final ten years of the 20th century were crucial in introducing the concept of I.C to the field of business administration. The concept of I.C as a valuable intangible resource for a company originated from the diverse activities of numerous enterprises and consulting firms. This prompted researchers in the 1990s to concentrate on identifying a company's I.C and quantifying its capacity to generate value.
- **Academic focus:** The evaluation of I.C among academics has recently gained prominence due to its high appeal in the realm of academia. The increased focus and strong zeal for studying I.C can be attributed to the influence of I.C and the rise of knowledge workers as a means of achieving a long-lasting competitive edge (Cabrita & Bontis, 2008; Subramaniam & Youndt, 2005). Today, scientists and academicians are advocating for a greater focus on I.C resources, which have surpassed the conventional reliance on physical assets.

2.3 Definitions of Intellectual Capital

I.C is commonly understood to be synonymous with intangible assets, which are vague, subjective, invisible, and difficult to define. In addition, the majority of researchers have formulated concepts on the definition of I.C. However, there exists a divergence in their perspectives and interpretations of the I.C definition (Edvinsson, 1997; Roos et al., 1997). Intellectual capital has been characterized by numerous institutional bodies, groups, scholars, and professionals in the following manner:

- As stated by the Society of Management Accountants of Canada (1998), I.C refers to the collection of knowledge-based assets possessed by a corporation that contributes to significant profitability and growth.
- The OECD has also defined I.C in terms of its economic value, which is mostly derived from the intangible assets of a corporation, such as its structural or human capital.
- Intangible assets, according to Itami (1991), are also invisible assets that comprise a company's culture, technological advances, goodwill, managerial abilities, and customer trust.
- According to Brooking, (1997), I.C refers to the amalgamation of several assets, including market, human, infrastructure, and intellectual property resources. These assets generate value for companies when they are combined with the company's other productive assets.
- I.C is a relationship issue and a debt problem that is gathered from employees, clients, and other stakeholders, and a combination of these items, according to Edvinsson, (1997) makes the business more effective.
- According to Lev, (2000), I.C is composed of intangible assets like invention, human capital knowledge, and organizational capital. These assets do not have physical existence.
- According to Dean and Kretschmer (2007), I.C refers to an organization's capacity to generate value, effectively compete, and achieve high performance by utilizing its intangible assets.
- Ordóñez de Pablos (2004) defined I.C as resources derived from knowledge that provide a corporation with a competitive edge.
- According to Sullivan (2000) I.C refers to intangible assets that are not recorded on a company's balance sheet.

2.4 Components of Intellectual Capital

Sveiby, (1997) argued that there has been difficulty in defining I.C and its components. While some have attempted to describe it, only a few have truly comprehended the phrase, and it has not been widely valued practically. Sveiby was the first to suggest a classification for I.C, in which I.C was expanded into three overarching categories. The entities mentioned above encompassed the customer, human, and structural capital. These categories were based on company-wise categorization. Nick Bontis' early studies, published in 1991, highlighted the significance of Sveiby's classification. Consequently, this provided an opportunity for Bontis

to revise the components of Sveiby's (1998) I.C framework by replacing relational capital with customer capital (Asare et al., 2014; Curado & Bontis, 2007). The dwindling interest in categorizing I.C elements was observed in IFAC's (1998) study, which made a little adjustment by including infrastructure assets as part of the intellectual elements. This was simply a continuation of the diligent efforts made by Sveiby and Bontis. Khalique et al., (2013) asserted that the components of I.C might be expanded to encompass six primary sections. I.C is a significant catalyst and valuable resource for enterprises. The introduction of spirit and technological capital resulted in the depletion of customer capital from social capital, making a significant impact. The elements consist of spiritual, human, structural, technological, customer, and social. The researchers utilized certain terminology from the aforementioned study to describe intangible or I.C.

However, the majority of scholars have acknowledged the existence of four categories of I.C, namely human and structural capital, capital employed, and customer/relationship capital. After conducting a comprehensive analysis of the intellectual components, in this section, I.C indicators will be categorized among the components provided by different researchers (Asare et al., 2014; Bontis, 1998; Buallay et al., 2020; Chen Goh, 2005; Khalique et al., 2013; Kweh et al., 2022; Nawaz & Haniffa, 2017; Nazari & Herremans, 2007; Ozkan et al., 2017; Pulic, 1998; K. E. Sveiby, 1997).

2.4.1 Human Capital

According to Yang & Lin, (2009), the main resource of a business is its human capital (H.C), a term originally coined by Gary Becker (2009) to refer to the combined worth of the knowledge and skills possessed by the workforce in the United States (Smart, 1999). H.C refers to the collective attitudes, experiences, knowledge, intuitions, and abilities possessed by the workforce. Improving I.C can be achieved by enhancing the productivity of individual workers through improving their capacity. Human capital (H.C) is crucial because it catalyzes strategy rejuvenation and innovation, as stated by Bontis in 1996. Firms' personnel are responsible for generating information, generating new ideas, developing new goods, and forming relationships that optimize the organization's processes.

Therefore, enterprises must enhance their investment in intangible assets, with a particular focus on H.C (Kharal et al., 2014). This investment will yield intangible benefits, such as knowledge, skills, or other values, that are inherently linked to the C.E participating in these activities. It is well known that investing in human capital can improve the quality of work, increase national wealth, and spur economic progress.

2.4.2 Structural Capital

This includes a broad spectrum of ideas, frameworks, intellectual property, machines, protocols, and organizational frameworks. The personnel are responsible for constructing structures; yet, these structures are ultimately under the ownership and authority of the organization. Investment and development decisions about structural resources can be made with a high level of confidence and, in rare situations, outsourced. Structural capital (S.C) means the ability of an entity to meet the requirements of its organization's operations. It often encompasses the frameworks and operational procedures that facilitate the endeavors of staff members to attain an ideal level of cognitive and total effectiveness. A business that lacks strong structures, such as systems and procedures, may hinder individuals with high intellectual capabilities from reaching their maximum potential (Bontis, 1998). The firm's S.C may include four aspects, as proposed by Plott (Plott & Humphrey, 1996).

- System: Systems encompass several organizational operations, such as decision-making, information management, communication, and the production of products/services and financial transactions.
- Structure: Organizational structure refers to how duties and responsibilities are assigned, explaining the role of the group and how its personnel interact with one another.
- Strategy: Strategy refers to the set of objectives and methods that an organization plans to use to achieve its goals.
- Culture: Culture refers to the collective sum of an organization's individual opinions, customs, beliefs, and general behaviors.

S.C is the problem-solving approach and procedure that creates value within a business (Chu et al., 2006). According to (Chen, 2009), structural capital, which is based on organizations, provides the necessary framework for human resources. Therefore, a company that possesses sufficient and strong S.C can assist in maximizing the potential of its people resources and therefore enhance customer satisfaction. It can be further classified into many components, including organizational learning, culture, firm structure, procedure, and knowledge system (Ramezan, 2011). S.C supports people, enabling them to enhance their job performance and achieve better overall outcomes (Liu, 2017). Therefore, S.C is an essential element of a company's knowledge resource that can successfully support the functioning of other knowledge resources.

2.4.3 Relational Capital

At first, relational capital (R.C) was classified as part of the S.C in the original work by Edvinsson and Malone (1997b). Nevertheless, Tunc Bozbura (2004) argued that it is crucial to distinguish between R.C and S.C, as emphasized by Chen (2009). R.C, or customer capital, is a term used in certain studies (Chen, 2009; Kim et al., 2011; Ramezan, 2011) to refer to the value that customers bring to a business. Customer capital, as defined by Chen et al. (2004), is the main component that determines the transformation of I.C into a significant market value. It acts as a bridge and catalyst for I.C operations. According to Bontis (1998), the influence of customer capital on profitability and corporate success is greater than that of human and organizational capital. This capital encompasses the interactions between consumers, shareholders, suppliers, rivals, the economy, government agencies, and society as a whole (Lee, 2010).

According to (Meritum, 2002), a company's brand value, client loyalty, strong network, and royalties should all be considered when determining R.C. External parties who are interested have a quantifiable impact on the assessment of R.C. This type of capital is also associated with the valuation of a business that encompasses all external relationships. This pertains to the maintenance of strong relationships between the company and its clientele (Brooking, 1997). R.C assists companies in establishing and sustaining relationships with their customers. The efficacy of the relationship and its capacity to acquire prospective customers are crucial aspects of the sustainability of a business. The contacts maintained with other organizations, such as vendors and the company's partnerships, are also an essential source of knowledge. R.C encompasses both the current value and the future value of client connections.

2.4.4 Capital Employed

Capital employed represents the amalgamation of physical and financial assets owned by a bank (Chen Goh, 2005; Kweh et al., 2022; Nawaz & Haniffa, 2017; Ozkan et al., 2017; Pulic, 1998; Smriti & Das, 2018). Capital employed efficiency is a key metric that contextualizes the value produced by a firm to its capital investments. This measure quantifies the value generated per dollar invested in physical or financial capital (Martens, 2023a). Optimizing the utilization of capital is essential for businesses, as it directly reflects the book value of their assets. According to (Chowdhury et al., 2019), organizations can enhance their performance by cultivating positive relationships with employees, consumers, suppliers, creditors, and the government, both internally and outside. Total net tangible assets are used to calculate C.E (Barak & Sharma, 2023).

2.5 Theoretical Foundation

Five fundamental components form the basis of the theoretical framework: knowledge-based theory, intellectual capital theory, human capital theory, resource-based theory, and organizational learning theory. These theories offer an alternative to Porter's competitive advantage or product-based perspective, which mostly focuses on research conducted in the latter decades of the twentieth century (Grant, 1996; Von Krogh & Roos, 1995). The global economy is currently transitioning into a knowledge-based economy (KBE), which aligns with Penrose's idea that enterprises serve as stores of experience and knowledge, with competency being the key determinant of their development (Penrose, 2009). In recent times, there has been a growing agreement among professionals and scholars that I.C is crucial for a company's ability to compete effectively (Bontis, 1998; Stewart, 1997). Consequently, this has sparked significant curiosity in the topic (Edvinsson & Malone, 1997b; Stewart, 1997; Sveiby, 1997) originating from many perspectives, which will be further on in the following sections.

2.5.1 Resource-Based Theory

The resource-based theory (RB theory) is primarily based on Penrose's (1959) concept that a company's resources are comprised of productive resources that offer numerous benefits to the organization. The company possesses vital resources that enable it to justify its profitability and value (Penrose, 2009). The RB hypothesis is based on the reasoning, that highlights the resources of different enterprises as the explanation for performance differences within a company, market, sector, or country (Barney, 1991). The concepts of this are based on two primary factors: the presence of capabilities and the heterogeneity of resources. Regarding this objective, it frequently recognizes a corporation as a distinct entity with exclusive assets Barney, (1991), setting them apart from others. Maintaining and updating organizational knowledge resources is essential for businesses to prosper in the information economy that is driving the new millennium (Cabrilo et al., 2009). As a result, the RB theory is among the most effective methods for understanding the nuances of intangibles, such as I.C, and the knowledge-driven new era.

I.C is conceptualized as the combination of all the knowledge resources that have the potential to create a lasting competitive advantage for an organization (Stewart, 1997). Furthermore, organizations can examine the competitive advantages gained by their involvement in this combination (Carayannis et al., 2014). The firm's performance is improved by the combined impact of both systematic and planned managerial operations, as well as the resources of

intellectual capital (Inkinen, 2015). In summary, the RB theory posits that the combined knowledge resources can be categorized as either intangible (organizational or human) or tangible (physical). According to Amit & Schoemaker, (1993), these resources are believed to contribute to a firm's competitive advantage and generate financial returns. However, while the physical resources of a business might generate returns that are higher than average, it is the intangible resources that establish and maintain a sustained competitive edge.

The Resource-Based theory of the company largely emphasizes the internal aspects of the organization, such as capacities and resources, in explaining its profitability and value (Barney, 1991; Grant, 1996; Makhija, 2003; Peteraf, 1993; Wernerfelt, 1984). The idea explains the variations in performance levels among companies operating within the same industry (Hoopes et al., 2003). According to the theory, performance differences occur when a company has access to valuable resources that its rivals do not, allowing it to collect rent in a quasi-monopolistic manner (Wernerfelt, 1984). The idea posits that diverse resources and competencies within a group of enterprises are crucial in explaining variations between companies. This text elucidates the rivalry, predicated on the premise that intimate competitors differ in their resources and capabilities in a significant and enduring approach (Helfat & Peteraf, 2003).

The RB theory, which examines the origins of competitive advantage, is based on two assumptions firstly, companies or organizations within a specific sector may differ in terms of the strategic resources they possess; secondly, these resources do not have to be easily transferable between companies, and as a result, the differences in resources can persist for a long time. The company's resource framework analyzes the consequences of both assumptions when evaluating the sources that help it sustain an edge in the market. The diversity across enterprises is determined by the variability in the available resources. Stated differently, corporations possess diverse resources, but they do not allocate them equitably. Consequently, the performance outcomes of these companies vary. Barney (1991) categorizes the firm's resources into three main groups:

- Human resources encompass the collective expertise, intellectual capacity, decision-making, and perceptual abilities of a company's staff and executives.
- Material resources pertain to the physical assets of a company, such as its machinery and equipment, as well as the availability of raw materials and the technological tools employed by the company.

- Organizational resources encompass both formal and informal elements of planning, organization, control, reporting, and intergroup relationships within and outside a corporation. As a result, organizational resources are seen to be diverse, enabling businesses to plan and execute strategies that will improve their efficiency and productivity (Grant, 1996).

Barney (1991) states that for a resource to provide an edge over competitors, it must possess the qualities of value, rarity, imitability, and non-substitutability. Madhani, (2010) outlined the attributes of valuable resources as described by Barney (1991) in the following manner:

- **Valuable:** Valuable tools are defined as those that can provide strategic value to an organization. Resources have inherent worth, as they enable enterprises to exploit commercial opportunities and mitigate market risks. Owning a resource has no benefit unless it raises the value of the company.
- **Rare:** It is challenging for a company to achieve a significant competitive edge if it possesses the same resources as multiple competing businesses in the market. Due to numerous businesses operating in the same industry, it is impossible to develop and implement a new company strategy. Barney (1991) argues that a firm's resources must be sufficiently difficult to obtain to provide both a distinct advantage over existing companies and prospective rivals. Therefore, these resources must be scarce to provide firms with the necessary competitive edge.
- **Imperfect imitability:** Imperfect imitability refers to the inability to construct a replica or imitate the capital. When firms have unique resources that cannot be easily copied by other enterprises in the same industry or market, they can gain a significant advantage. This occurs because the resources of the firm acquire distinctiveness and divergence from those possessed by other firms. Resources can serve as the foundation for a lasting competitive edge when other companies are unable to replicate or imitate what a company possesses.
- **Non-substitutability:** Non-substitutability refers to the situation when a valued resource cannot be replaced by any other resources. This suggests that such resources cannot be replaced by another equivalent resource. When competitors are unable to replace a valued resource, it indicates that they will be unable to match the firm's performance levels.

To summarize the previous discussion of the RB theory, the main objective is for a company to thrive by acquiring valuable and efficient resources that may generate returns higher than

the average. This references the concept introduced by Lin, (2014), who argued that I.C possesses the same valuable characteristics as described by Barney (1991). Specifically, I.C is valuable, rare, and unique, making it difficult to replicate. Additionally, I.C can be shared with others, and its components are comprehensive and identifiable (Radjenović & Krstić, 2017). Effective management of a firm's I.C resources guarantees improved performance and increased wealth.

2.5.2 Intellectual Capital Theory

The notion of I.C theory is relatively new and is based on the idea that intangible resources that are not disclosed to the public in the balance sheet are crucial to a company's ability to create value in the information age (Kolaković, 2003). The idea has been developed as a response to the gaps or oversights within a company (Harris, 2000). The reason for this is that intangibles have emerged as the dominant and highly potent weapons of competition in the modern era. The emphasis on intangible assets pertains to the significance of I.C in increasing the performance and efficiency of enterprises considering the opportunities and challenges in the work environment (Asutay & Ubaidillah, 2023; Barak & Sharma, 2024; Faruq et al., 2023; Kasoga, 2020; Kweh et al., 2022; Ky & Lim, 2024; Mohapatra et al., 2019; Weqar & Haque, 2020, 2022). Therefore, the presence of intangible resources is the foundation for establishing a competitive edge (Stewart, 1997). The concept of this theory is based on the premise that intangible assets hold greater worth than physical assets. The theory suggests that the prosperity of a corporation is contingent upon its structural capital, consumer capital, and human capital. According to Njuguna, (2014), value is generated when people resources (human capital) are used to develop new company procedures (structural capital), offer customers better services, and subsequently increase their loyalty (consumer capital).

In his 1969 article, John Kenneth Galbraith coined the phrase "Intellectual capital" to refer to the assets of certain firms that are intellectual. This concept suggests that I.C is intended to be a more effective and dynamic strategy, rather than just a static form of capital (Edvinsson & Malone, 1997b). The 1911 book "The Principles of Scientific Management," written by Taylor, is credited with giving rise to the concepts of intellectual capital in the 20th century. This book discusses the importance of employee knowledge, skills, and experience. Subsequently, the concept of I.C was also identified in the research conducted by (Robinson, 1969). They emphasized that a firm's performance is heavily reliant on its capabilities, trademarks, brands, patents, and technical know-how. Schumpeter (1934) made significant contributions to

economic theory by recognizing that a crucial prerequisite for the emergence of a new inventive product is the combining of knowledge (Radjenović & Krstić, 2017).

The previous advancement of the I.C theory laid the foundation for Penrose's investigation into "The theory of the growth of the firm" in 1959. This research emphasized the significance of intangible assets and a firm's capabilities as crucial factors for firm performance. In addition, Penrose (1959) highlighted the need for management to effectively utilize readily available internal resources, such as the skills and expertise of people, to transform resources into products that fulfill consumers' demands. This, in turn, facilitates the identification and pursuit of business possibilities. The term I.C is mostly associated with Machlup, (1962), who provides a concept that emphasizes the importance of I.C for the development and expansion of a corporation (Radjenović & Krstić, 2017). In the realm of I.C theory development, (Polanyi, 1967) made a distinction between implicit and explicit knowledge, highlighting the importance of integrating these two types of information for a corporation to achieve success. Romer, (1993) and other notable authors have made significant contributions to the field of endogenous growth theory, particularly to intangible resources and the concept of I.C.(Kolaković, (2003) identified three prominent schools that have made significant contributions to the development of I.C theory, as outlined below:

- The Japanese school, under the leadership of Itami in the 1980s, has played a significant role in advancing the development of I.C theory. The Japanese school conducted a study on the effect of intangible assets on Japanese firms and emphasized the significance of intangible resources for emerging companies. Their research has stimulated and made a valuable contribution to the meticulous examination of intangible assets globally. Within this educational institution, it is important to recognize that Nonaka and Takeuchi initially examined the concept of knowledge management by elucidating how Japanese companies revolutionize their operations through the distribution and application of both implicit and explicit knowledge (Nonaka, 2009). Additionally, they emphasized that companies are unable to generate knowledge, as it is alone the persons employed within them that possess this capability.
- The concept of H.C originated in 1776 with Adam Smith's renowned work "The Wealth of Nations" and concluded in the 1960s when a significant portion of H.C became the empirical and theoretical foundation of intellectual capital (Sweetland, 1996). Smith extensively examines the significance of employees' knowledge and skills for the production system, emphasizing that investing in employees is manifested through

learning and education (Nerdrum & Erikson, 2001). In 1890, Marshall recently contended that a significant amount of capital needed to be spent on humans, although he did not explicitly use the term "human capital." Becker, (1962); Mincer, (1962); Schultz, (1961) contributed significantly to the development of the theory of H.C by considering it as a distinct form of capital that shares both production and economic features with traditional capital. Becker, (2009) argues that persons are the primary resource that positively impacts a firm's performance.

- The RB theory, building upon the perspectives of Wernerfelt (1984), and Barney (1991), emphasizes the quality of resources. It specifically focuses on the management of intangible resources and strategies for utilizing existing resources. Fortunately, the advancement of IC theory in recent years has been greatly influenced by the insights and expertise of renowned authors and practitioners such as Kaplan and Norton (1992), Brooking (1997), Stewart (1997), Sveiby (1997), Edvinsson and Malone (1997), and others. The significant difference between a company's market value and book value has led both the business and academic communities to recognize the importance of I.C as a crucial factor in the value creation process for managers, shareholders, and society as a whole (Radjenovic and Krstic, 2017).

Sveiby (1997) argued that there has been difficulty in establishing a clear and universally accepted definition of intellectual capital. While many have discussed the concept, only a few have truly comprehended it, and it has not been widely recognized as valuable in practical terms. Sveiby was the first to suggest a classification for Intellectual Capital, in which I.C was expanded into three main categories. The three types of capital are structural, customer, and human capital. These classifications were based on individual companies, and Nick Bontis' early publications, published in 1991, highlighted the significance of Sveiby's classification. Consequently, this provided an opportunity for Bontis to revise Sveiby's (1998) I.C components by replacing relational capital with customer capital. (Curado and Bontis, 2007; Asare et al., 2014). The foregoing study reveals that the researchers employed many terminologies to define I.C. However, the majority of scholars have embraced three I.C classes, specifically structural, relational, and human capital.

2.5.3 Knowledge-Based Theory

There is no doubt that the majority of the recently published management books have discussed the significance of knowledge-based competitive advantages and knowledge-based work (Davenport & Prusak, 1998; Nonaka, 2009). The book explores the importance of knowledge

in helping a corporation gain an edge over its competitors. An intriguing aspect of all the books is their ability to integrate theory and practice while discussing the firm's knowledge-based thinking. The company's knowledge-based theory (KB theory) is widely acknowledged as a contemporary expansion of the company's resource-based view (RBV) (Bontis, 2001; De Carolis, 2002). The KBV recognizes knowledge as a fundamental and very important strategic resource (Asutay & Ubaidillah, 2023; Faruq et al., 2023; Kasoga, 2020; Kweh et al., 2022; Ky & Lim, 2024; Mohapatra et al., 2019; Weqar & Haque, 2020, 2022). Several theories, including Organizational talents and Competencies, Innovation, New product creation, and Organizational Learning, have greatly influenced the evolution of KB theory. According to Roos et al., (1997), three epistemologies guide practice and research in the field of knowledge based on an epistemological perspective. These are the cognitivist approaches introduced by Kwan, (2003), the connectionist approach depicted by (Zander & Kogut, 1995), and the autopoietic approach presented by (Varela, 1980). The cognitivist perspective posits that organizations function as open systems, continuously developing knowledge by creating increasingly accurate "representations" of the world. The greater the amount of data and information that companies can collect, the more accurate the depiction will be. According to connectionist epistemology, the organization frequently "represents" the external world, however, the approach to reflecting reality varies. However, Autopoietic epistemology only provides a particular understanding of the information received by the system as data.

Ultimately, extracting value from the exchange of knowledge requires more than just technology. Managing knowledge is inherently challenging due to its unpredictable and constantly expanding nature. An organization's ability to effectively manage knowledge is a crucial component of intellectual capital and is essential for maintaining a long-term competitive advantage. An entity's competitive capacity is greatly influenced by its ability to effectively establish, develop, implement, and communicate its knowledge sections. An organization's knowledge is an asset that enables a company to develop and maintain essential skills that contribute to its growth and success when applied in a competitive setting (Hunter et al., 2002). The KB idea suggests that utilizing a firm's intellectual resources, or knowledge resources, is the key to achieving exceptional results. Therefore, managers, owners, and boards of organizations must recognize knowledge as the crucial factor for achieving success and effectively oversee its utilization.

2.5.4 Human Capital Theory

The macroeconomic development theory is the source of the theory of human capital, or H.C theory. During the 1950s, the main factors of production were land, physical capital, labor, and management (Becker, 2009). Specifically, the development and enhancements in physical capital played a vital role in achieving economic prosperity. The pioneering empirical studies conducted by (Becker, 1964; Mincer, 1962; Schultz, 1961) challenged the long-standing notion that physical capital is the primary determinant of economic success. These publications served as an additional crucial source of economic prosperity, highlighting that physical capital is not the primary and most important resource. The fundamental premise of H.C theory is that the cognitive abilities of humans are highly valuable in comparison to other resources of a corporation that contribute to the firm's production process, including both services and goods (Lucas, 1990). According to Becker (2009), schooling enhances production and income by providing individuals with knowledge, skills, and the ability to analyze situations. Consequently, individuals who spend in training and education will ultimately enhance their skill level and become more productive compared to others with lower skill levels. Consequently, investing in H.C will ensure increased earnings. The theories of Becker have a substantial impact on the current literature on staff development and learning (Grant 1996a). Becker's thoughts on H.C theory suggest that an individual's knowledge and abilities can be enhanced through investments in training and education, both of which are kinds of learning (Hatch & Dyer, 2004). Scholz et al. (2007) identified five different methods for measuring H.C, which are described below:

- The market value approach quantifies human capital by utilizing the market value and book value of the organization, as well as considering the contributions of several people. This approach involves comparing a company's book value with its market value to assess its intangible assets. When analyzing changes in market value, researchers commonly use Tobin's Q to measure the performance of I.C (Tseng & James Goo, 2005). However, using this strategy as a substitute for H.C has the drawback of not being able to completely consider the factors that lead to H.C and other internal processes. Furthermore, alterations in a company's market value can be influenced by several causes. Therefore, the market method is most effective and resilient when combined with other performance measures.
- The human resource (HR) indicator strategy, which may be used to support human resource management initiatives, focuses on essential performance indicators and

performance drivers, to identify the HR forces that propel a company's success (B. E. Becker et al., 2008). H.C management is defined by the HR indicator approach as the explanation, aggregation, and efficient control of a subset of critical performance indicators. The HR indicator approach links the performance of H.C to the overall worth of a company. According to (Fitz-Enz, 2000), when organizations have effective H.C management, it should result in improved corporate performance, which can be observed through changes in the company's valuation.

- The accounting approach quantifies a company's investment in its personnel by evaluating five key factors: acquisition, recruitment, experience and development, informal familiarization and training, and formal training and familiarization. The model suggests that organizations can assess their investment in H.C using the main parameter mentioned above. However, the application of this model is hard due to the requirement of standardizing organizational measuring techniques and the complicated challenges related to balance sheet depreciation (Scholz et al., 2007).
- The cost approach has its roots in (Engel, 1883) cost-of-production method, which calculates the H.C value by considering the expenses parents bear for raising their children. According to this concept, investments in intangibles refer to the expenses associated with increasing productivity and the level of skill and expertise of the workforce. It encompasses expenditures on issues like transportation, professional development, education, and health and safety. However, it is important to note that this method should not be considered as an estimation of individual H.C. This is because it only considers the historical expenses and does not include the societal costs invested in persons or the time value of money (Dagum & Slottje, 2000). In addition, Le et al., (2003) identified certain constraints in the use of the cost approach model, specifically the challenge of assessing the value of physical capital based on costs.
- The value-added approach connects the value created by people to their H.C by assessing metrics such as profit per employee or sales per employee, which are indicators of employee productivity. The technique is highly valuable from a firm-level viewpoint as it aims to quantify the contribution made by each person. The approach is regarded as a noteworthy advancement in measuring H.C, incorporating value-added measures that are currently utilized in firms to offer a comprehensive assessment of elements like overall productivity. Nevertheless, this technique has its limitations when the indicators frequently correlate with sales or profitability performance, hence failing

to provide a comprehensive understanding of the actual influence of H.C on various indices.

2.5.5 Organizational Learning Theory

Organizational learning is a multidisciplinary field that draws from various disciplines such as psychology, philosophy, sociology, and business management (Lev, 2000). The theory of organizational learning (OL theory) is typically characterized as the process by which knowledge is developed, retained, and transmitted inside an organization, despite the absence of a specific definition for this term. A corporation is said to have learned from experience when performance or behavior inside the organization changes. Organizational learning is believed to result from experience. Donald Schon and Chris Argyris are recognized as the pioneers who have made substantial contributions to the development of OL theory. According to (Argyris, 1996), organizational learning is solely the result of organizational inquiry. That being stated, when there are discrepancies between the expected and actual results, a person (or group) will research to identify the cause of the inconsistency and, if necessary, find a solution. People will interact or collaborate with other employees of the company as they continue to look into the discrepancies (also known as the organizational inquiry process), and naturally, learning will take place. Therefore, knowledge directly results from these kinds of exchanges amongst people working for the same firm.

In addition, Argyris and Schon (1996) outlined three layers of learning that might exist within a company: (i) single-loop learning, which entails adjusting a plan in response to an undesired outcome (error correction). (ii) Double-loop learning refers to the process of acquiring knowledge and then modifying one's underlying assumptions and beliefs. (iii) Deuterolearning focuses on enhancing the learning system itself by considering the structural and behavioral aspects that determine the learning process. From the early leaders and innovators in organizational learning theory to the present, the focus has primarily been on the firm's capacities and the process of acquiring new information and transforming it into innovation (Njuguna, 2014). Furthermore, by utilizing OL, a company can improve its structural capital, which creates a conducive atmosphere for employees to maximize their productivity (Tunc Bozbura, 2004). OL contributes to the development of significant S.C by establishing procedures, policies, processes, and tacit organizational routines. These elements create a favorable and supportive environment for employees.

2.6 Intellectual Capital Measurement

Recently, there has been a significant amount of attention from both academic scholars and practitioners on the topic of I.C measurement. This method allows for a clear and objective assessment of a company's intangible assets. It was important to measure to extract the true value after identification and the significance highlighted by (Edvinsson & Malone, 1997b; K.-E. Sveiby, 2001). "If you cannot measure it, you cannot manage it" is one of the sayings cited by Kaplan et al. (1996) to emphasize the need to manage the I.C effectively. In his study, Bornemann et al. (1999) found that corporations that effectively managed their intellectual assets had a significant advantage over other companies. Conversely, organizations that improved their intellectual asset management did better than their competitors (Bornemann, 1999). Various notable initiatives have been made to measure I.C, including the development of the balanced scorecard by Robert Kaplan and David Norton in 1992, the Skandia navigator by Edvinsson and Malone in 1994, and the intangible asset monitor by Kirk Sveiby in 1994. Alternatively, financial valuation techniques such as economic value added (VA), Tobin's Q, and value-added intellectual coefficient (VAIC) assist in assessing the economic worth of a company's intangible assets and in comparing its I.C performance with its rivals (Pulic, 1998). However, the majority of these models were created by organizations to quantify and assess their intellectual assets, while some were suggested by scholars in their studies on I.C. This demonstrates the extensive endeavors of several organizations and researchers in creating instruments for quantifying the emerging idea of I.C.

VAIC, being a widely used I.C assessment technique, provides several benefits. The primary obstacles faced by most I.C methods of measurement include the lack of accessible information for external researchers, the qualitative and subjective nature of the relevant information, and the challenge of financially evaluating the related indicator. Nevertheless, employing the VAIC technique partially mitigates these concerns.

2.6.1 Value-added Intellectual Capital Coefficient (VAIC)

The Value Added Intellectual Coefficients (VAIC), established by (Pulic, 1998, 2000a, 2000b) is a recognized tool for assessing the effectiveness of I.C. This method has achieved significant recognition from both practitioners and academia, as evidenced by the works of (Joshi et al., 2013; Nawaz & Haniffa, 2017). The simplicity and resilience of this measure make it suitable for assessing I.C, as stated by Joshi et al. (2012). The method consists of three components: human and structural capital efficiency and capital employed efficiency. Pulic (2000b) states

that the first factor to examine in determining the value-added capacity of an organization is the ability to extract the VAIC and its many components.

The VAIC technique calculates the VAIC value and its elements by utilizing quantitative information obtained from publicly available financial statements of corporations. The VAIC methodology utilizes audited financial statements rather than subjective valuations, such as surveys, to acquire data. This approach ensures a uniform and reliable measure of performance (Shiu, 2006). The utilization of financial data-based measurements allows for the inclusion of "any indicators, relationships, or ratios" that may be compared with traditional financial indicators usually seen in business (Chen, 2009). VAIC, being a standardized measurement method, offers advantages such as easy data gathering and calculation. Additionally, it allows for comparisons to be made among different businesses (Meditinos et al., 2011).

Despite its widespread acceptance, VAIC has faced criticism in the I.C literature, as noted by (Andriessen, 2001; Ståhle et al., 2011). The VAIC technique is not related to I.C as it solely measures the efficiency of a company's human resources and financial expenditure. Another critique asserts that this methodology confuses some accounting terms, such as distinguishing between flow and stock entities. This is particularly evident in the computation of H.C and social capital (Andriessen, 2004). In response to these critics, Iazzolino and Laise (2013) argue that the VAIC approach does not violate any fundamental accounting principles. They suggest that the criticisms stem from differences in the interpretation of human and social capital concepts. In Pulic's work, H.C is defined not as the actual skills and capabilities of employees, but as the investment made in employees in exchange for these characteristics. Similarly, social capital is defined not as a collection of intangible assets, but as the portion of value added created by the characteristics of these intangible assets. Once the concepts are fully understood, the VAIC approach "exhibits logical coherence" (Iazzolino & Laise, 2013).

2.6.2 Modified value-added intellectual coefficient (Extended VAIC models) (MVAIC)

Certain studies in the VAIC literature expand upon the VAIC approach by incorporating additional elements of I.C that Pulic's technique ignores. The study by Nazari and Herremans (2007) is an example of such research. In this study, Nazari and Herremans utilized the I.C classification proposed by Edvinsson and Malone (1997) for Skandia Navigator. However, instead of using Structural capital, they employed Customer capital, renewal capital, and process capital to gain a deeper comprehension of the role of I.C in firm performance. R&D costs were employed as a stand-in for renewal capital, and marketing expenses were used to represent customer capital.

Relational capital (R.C) was employed by Ulum et al. (2014) as the fourth VAIC component. Along with the human, structural capital, and capital employed, they identified relational capital as another component of I.C based on the I.C classifications found in the literature (Bontis, 2001; K. E. Sveiby, 1997). Since marketing costs are perceived as investments in brand value and reputation, they have been utilized as a stand-in for relational capital (Ulum et al., 2014). The efficiency of R.C is computed by dividing marketing expenses by value added (VA), which is identical to Pulic's computation of structural capital efficiency (SCE). Nimtrakoon (2015) expanded upon Ulum et al. (2014) to extend the VAIC technique by including R.C as the fourth component. Furthermore, Xu & Li (2019); Xu & Wang (2019); Yao et al. (2019) have corroborated that the modified VAIC model, which incorporates R.C, is superior to the original VAIC approach for accurately assessing I.C.

Vishnu & Kumar Gupta (2014) introduced RCE as a new element in the VAIC model in their research. However, they utilized marketing, advertising, and selling expenses as a substitute for R.C, as these expenditures are necessary for "establishing and sustaining a connection with stakeholders." An expanded VAIC model was presented in a study by Bayraktaroglu et al., (2019) which included the addition of innovation capital (calculated by R&D expenses) and customer capital (calculated by marketing, advertising, and distribution expenses). The researchers discovered that the suggested model outperforms the original VAIC. Hence in this study, we have employed the MVAIC approach to investigate the impact of intellectual capital on the financial performance of the Indian public and private sector banks.

2.7 Review of Empirical Literature

Based on the established theoretical foundation, it is widely recognized that the investigation of the association between I.C and organizational performance is clear and does not necessitate any additional explanations (Bontis et al., 2000). Although the theoretical foundation is well-defined and brief, the practical aspect of that association remains ambiguous. For instance, the analyses are conducted using diverse methods, specifically focusing on distinct areas and periods. As a result, the results of most studies differ from those of industrialized countries to developing ones. Furthermore, the research findings differ depending on the timing of the study, especially during periods of economic downturn. Moreover, there is a notable absence in both academia and practice of a comprehensive assessment of the exact magnitude of I.C's absolute worth or its proportional contribution to organizations' performance. Utilizing inefficient methods restricts the ability to appropriately compare the obtained results with those

reported in the literature. Despite the limitations in research studies, it is unequivocal that the I.C of a corporation should be regarded as an asset capable of generating added value. Multiple studies in the field of I.C have consistently shown the benefits that companies gain from investing in I.C resources.

2.7.1 Relationship between Intellectual Capital and Firm Performance

As a driver of economic expansion, bank performance plays a significant role in the economy (Mohapatra et al., 2019). I.C plays a crucial function in the growth and development of the organization. Several empirical investigations on the relationship between the I.C and the firm's F.P indicators have discovered a positive correlation (Anifowose et al., 2018; Asutay & Ubaidillah, 2023; Bayraktaroglu et al., 2019; Buallay et al., 2020; Farooque et al., 2023; K. Gupta & Raman, 2021; Innayah et al., 2020; Martens, 2023a; Mondal & Ghosh, 2012; N. Isanzu, 2015; N. T. Nguyen, 2023; Ousama et al., 2019; Ozkan et al., 2017; Prasajo et al., 2022; Riahi-Belkaoui, 2003; Sardo & Serrasqueiro, 2017; Xu et al., 2022; Xu & Zhang, 2021; Zheng et al., 2022).

The studies utilized the VAIC and MVAIC techniques to assess the efficacy of financial indicators, including ROA, ROE, Tobin's Q, ATO, EPS, ROS, and ROCE. The findings indicate that I.C significantly influences firm performance (Barak & Sharma, 2023; Bayraktaroglu et al., 2019; Farooque et al., 2023; Faruq et al., 2023; Kweh et al., 2022; Mollah & Rouf, 2022; Nawaz & Haniffa, 2017; N. T. Nguyen, 2023; Nimtrakoon, 2015; Prasajo et al., 2022; Sayed & Nefzi, 2024; Smriti & Das, 2018; Soewarno & Tjahjadi, 2020; Ulum et al., 2014; Xu et al., 2022; Xu & Wang, 2019; Yao et al., 2019; Zheng et al., 2022).

To measure the performance of listed banks' I.C in the Croatian banking sector from 1996 to 2000, Pulic (2004) employed the VAIC approach. The study documented significant disparities in the ranking of banks, which were determined by their performance and efficiency in creating value. The impact of I.C on Turkish banks was also examined by (Yalama & Coskun, 2007). A sample of banks listed for the year 1995 on the Istanbul Stock Exchange Market was used in the study. The study determined that I.C is more crucial than physical capital in driving banks' productivity development.

In the study conducted by Gigante (2013), information from yearly public financial statements of banks in many European countries (Spain, Poland, Denmark, Finland, Italy, Sweden, Czech Republic, Germany, and Norway) for 2004-2007 was utilized. The research employed regression models to evaluate the link between I.C and performance, as measured by return on

assets (ROA), return on equity (ROE), and market value (MB). The results indicated that while I.C does not affect MB, it does have a substantial positive association with ROA and ROE. In addition, the study discovered that both HCE and CEE have a significant impact on the bank's ROE and ROA. However, SCE is the sole element within the I.C that has a negative association with both ROA and ROE.

In contrast to the results, a study conducted by Ozkan et al. (2017) revealed that there is no significant relationship between banks' I.C and ROA. Moreover, despite the overall insignificance of VAIC, it has been discovered that both CEE and HCE have a positive impact on the bank's ROA. However, of these two components, CEE has a greater impact compared to H.C. Hence, the analyst advised that banks functioning in the Turkish banking market should prioritize the utilization of tangible assets to enhance their return on assets. Chen Goh (2005) examined how Malaysian commercial banks' I.C performed between 2001 and 2003. The study found that banks have better efficiencies of human capital efficiency compared to SCE and CEE. Appuhami et al. (2007) also found a significant positive correlation between I.C and the financial success of firms, particularly banks, in Thailand. A study conducted by Saengchan (2008), in Thailand revealed a strong correlation between the I.C and the financial performance of banks. Research findings have demonstrated that I.C plays a significant role in generating corporate advantages for banks in Thailand. This is due to the strong correlation between the effectiveness of I.C and the profitability of banks. Tran & Vo (2018) conducted an identical study utilizing 16 listed banks in Thailand from 1997 to 2016. They employed the fixed and random effect model as well as the GMM approach. The findings indicated that the profitability of banks was influenced by the efficiency of CEE in generating profits. On the other hand, HCE improves future profitability. According to the previous research conducted by (Muhammad & Ismail, 2009), their study on a selected firm from the banking and insurance industries revealed that I.C is crucial for the financial performance of banks in Malaysia. Additionally, there was no substantial correlation between SCE, HCE, and ROA. Martens (2023) examined the impact of technical efficiency and MVAIC on the performance of Taiwanese banks between 2010 and 2023. The results demonstrate that I.C improves efficiency and increases revenue growth, yet its impact on profitability is complex. Challenges were identified with RCE and HCE, both of which showed a negative correlation with ROE. CEE has a dual impact, enhancing the operational ratio while diminishing the profit margin. In their study, Zheng et al. (2022) examined the association between a bank's I.C and its performance and risk-taking behavior. They analyzed data from 30 commercial banks in Bangladesh from 2002 to 2019 using the GMM method. The findings show that performance and risk-taking

behavior are significantly impacted by the intellectual capital efficiency of HCE, RCE, and SCE.

In addition, Xu et al. (2023) investigated the influence of COVID-19 on the I.C performance of banks in China and Pakistan from 2019 to 2020. The study demonstrates an insignificant, however adverse effect of COVID-19 on the I.C efficiency of the banking industry in both economies. Results reveal that while I.C components have been slightly affected by the COVID-19 pandemic; they are resilient against it. In a study conducted by Nguyen et al. (2023), it was found that the I.C had a notable positive influence on the performance of Vietnamese commercial banks from 2007 to 2020. The findings suggest that the VAIC and its components, HCE, CEE, and SCE, have a favorable impact on bank performance. The study also analyzed the impact of income diversification on bank performance and found a significant and negative correlation. Additionally, Faruq et al. (2023) look into the connection between the performance of Bangladesh's listed banks from 2015 to 2021 and metrics of I.C efficiency. The results indicate that ROA is favorably correlated with the elements of MVAIC, HCE, SCE, RCE, and CE. Similarly, Ting & Lean (2009) researched the proficiency of Malaysian financial institutions and the effect of the I.C on their F.P. The study covered the period from 1999 to 2007. The regression analysis demonstrated a positive correlation between financial success, as measured by ROA, and VAIC. The study also discovered that the outcomes of all three aspects of I.C are linked to the profitability of the examined organizations, except SCE. According to research Ky & Lim, (2024), I.C has a favorable and considerable impact on return on assets. In particular, it was shown that the capital used and human capital were important factors in establishing this relationship in Cambodian banks.

Mondal and Ghosh (2012) conducted a study in India to examine the relationship between the I.C and the financial performance of banks. The study utilized data from 65 banks, spanning ten years from 1999 to 2008. The investigation revealed that there was a considerable variation in the relationship between the bank's I.C and the performance measures of ATO, ROE, and ROA. The study discovered a negative and insignificant relationship between SCE and performance (ROA and ATO). In summary, the study determined that banks' I.C is unquestionably crucial for attaining a competitive edge. In their study, Soriya & Narwal (2015) analyzed the effect of the I.C on the F.P of banks in India. The study found a high correlation between SCE and bank growth, profitability, and employee productivity. A study conducted by Oppong & Pattanayak (2019) discovered that the implementation of I.C significantly enhances the banks' EP and ATO in India. In addition, the study found that all the variables

have a positive and significant correlation with ATO. However, when it comes to EP, only capital utilized is positively and significantly associated with I.C. Tiwari et al. (2023) conducted a study on 39 Indian banks spanning the years 2005-2019. The findings revealed a significant positive influence of the I.C and its two sub-components, namely H.C and C.E on bank productivity. In their study, Mohapatra et al. (2019) discovered that H.C is the sole factor that positively and significantly affects the operating efficiency of banks in India. On the other hand, both S.C and C.E have a negative impact on efficiency.

Weqar et al. (2020) examined 58 Indian banks over 10 years, from 2009 to 2018, utilizing the MVAIC methodology. The research shows that HCE is the primary factor that influences I.C. SCE and CEE are crucial for enhancing profitability, whereas the impact of RCE on the bank's F.P is minimal. The 36 Indian banks that are listed on the BSE were the subject of an investigation by Tiwari et al. in 2023. The findings show that efficiency improvements, not technology advancements, are the main drivers of productivity development. Additionally, the results of the regression demonstrate that bank productivity is strongly positively impacted by the intellectual capital index and both of its sub-components, capital employed and human capital. Consistent with the previous results, the empirical data gathered from 11 banks that are publicly traded on the Tehran Stock Exchange in Iran, as presented by Jafarnezhad & Tabari (2016) also demonstrated that the I.C has a considerable impact on the F.P of these institutions.

Setianto & Sukmana (2016) conducted a study that compared the relationship between I.C and the performance of Islamic banks in Indonesia and Malaysia from 2010 to 2014. The findings suggest significant disparities in I.C performance scores, with Islamic banks in Malaysia outperforming those located in Indonesia in terms of VAICTM scores. Simultaneously, the regression analysis indicates that banks with higher HCE tend to exhibit higher ROE and ROA. Furthermore, there is no association between SCE and ROA and ROE of Islamic banks. The findings also imply that CE highly impacts ROA and ROE in Malaysia and Indonesia. In their study, Al-Azizah & Wibowo, (2023) examined how I.C influenced the F.P of Indonesian banks between 2017 and 2021. The results indicate that the VAIC has a considerable impact on F.P, specifically on ROA, ROE, and ATO. The different elements of VAIC have no impact on F.P. The study conducted by Marsintauli et al. (2023) investigated the connection between banks listed on the Indonesian Stock Exchange's financial performance and their I.C. The study's conclusions showed that these banks' net interest margin and return on assets were significantly impacted by their I.C. However, the research failed to discover any appreciable relationship between I.C and the capital adequacy ratio.

Asutay (2023) examines the I.C performance of Islamic banks (IBs) from 2014 to 2018 using the MVAIC approach. The findings suggest that I.C has a favorable and substantial influence on the F.P metrics of IBs, particularly in terms of profitability. Upon analyzing the components, it was determined that CEE and HCE were the most influential factors of I.C. However, SCE did not have any effect on the bank's financial performance. A study with a similar approach was carried out by Rehman et al. (2023) focusing on Islamic banks in Muslim nations (South Asia, Middle East, South East Asia) from 2008 to 2017. The study indicates that the performance of Islamic banks (IBs) is mostly influenced by their investment in ICE. The findings suggest that SCE and RCE play a crucial role in attaining superior performance at IBs. The findings demonstrate that HCE has an adverse impact on the performance of IBs.

Nawaz and Haniffa (2016) studied the effect of I.C on the 64 Islamic banks operating in 18 diverse geographical sections. The study quantifies I.C by considering three components: H.C, S.C, and C.E. The results indicate a significant and favorable relationship between VAIC and financial performance measured by ROA. Furthermore, their research uncovered a direct correlation between the bank's performance and the CEE and HCE variables. Ismail & Karem (2011) investigated the impact of the I.C on the F.P of banks in Bahrain from 2005 to 2007, focusing specifically on the banking industry. The findings supported that I.C positively impacts financial performance, specifically ROA. The study revealed that all elements of I.C, except SCE, are correlated with the bank's ROA. Al-Musali et al. (2014) found similar results when they used the VAIC technique to examine the I.C performance of listed banks in Saudi Arabia and analyzed the effect of I.C on F.P. I.C is positively associated with banks' F.P, according to annual surveys covering the three years from 2008 to 2010 that used empirical data from banks in the Gulf Cooperation Council (GCC). A study on 198 businesses from two GCC nations Bahrain and Saudi Arabia was also conducted by Hamdan (2018) between 2014 and 2016. The firm performance was assessed using Tobin's Q and ROA, and the VAIC. The study verified a relationship between I.C and financial performance (ROA) based on the analysis from random effects regression.

In a study undertaken by Buallay (2019), the bank efficiency of the Gulf Cooperation Council's Economies (GCC) was examined using data from 59 banks over five years (2012-2016). The study discovered a direct correlation between intellectual efficiency and ROE in IBs. The findings suggest that HCE plays a crucial role in driving the performance of traditional banks, but both CEE and SCE also have an impact on financial performance. A study conducted by Awwad and Qtaishat (2023) examined the performance of 13 Jordanian commercial banks

listed on the Amman Stock Exchange from 2009 to 2018. The study found a positive relationship between competitive advantage, I.C, and F.P in commercial banks. Prasojo et al. (2022) examined the efficacy of Islamic banking institutions over ten years from 2009 to 2019. The findings indicate that the use of VAIC has a significant positive impact on the performance of Islamic Banks, as measured by both ROA and income. SCE is associated with ROA but not with IFIB, whereas HCE and CEE exhibit a positive correlation with both ROA and IFIB.

Based on a study conducted by Joshi et al. (2010) on banks, the researchers analyzed the efficiency of I.C in Australian banks from 2005 to 2007. The results showed a significant association between I.C and the value added by the banks. Furthermore, the research examined that banks had greater levels of human resource productivity compared to their utilization of S.C and C.E. A similar study showed by (Joshi et al., 2013), it was found that HCE has a significant impact on the potential for creating value in Australian financial sector organizations. According to the regression model, the study concluded that neither H.C nor S.C has an impact on the ROA of enterprises in the Australian banking sector. The only part of VAIC that has a significant effect on ROA is CEE. Isanzu (2015) examined banks in Tanzania over four years from 2010 to 2013. The regression study demonstrated a robust and positive association between I.C and the ROA of banks. Among the three elements of I.C, only HCE and CEE exhibit positive and statistically significant effects. In contrast, S.C has a substantial but negative effect on ROA.

Consistent with the results discussed earlier, Alhassan and Asare (2016) also examined the impact of the I.C on the efficiency of 18 banks in Ghana between 2003 and 2011. The study found that I.C has significant effects on the efficiency of banks. Furthermore, the study revealed that, except S.C, all other aspects of I.C had a considerable impact on banks' productivity. Isola & Akanni (2019) also evaluated the influence of I.C on F.P. The results revealed a significant association between I.C and the financial success of enterprises in Nigeria. The results also showed that the most important I.C element that leads to an enhancement in banks' financial performance is HCE. According to Ikapel (2016), CEE is an essential element of I.C that greatly enhances the financial viability of Kenyan banks.

Duho & Onumah (2019) confirmed that I.C drives performance based on a sample of 32 banks in Ghana from 2000 to 2015. Furthermore, out of all the components considered, only HCE had a noteworthy influence on both ROA and Z-score. This indicates that H.C plays a crucial role in enhancing banks' financial viability and stability. Duho (2020) found similar results in their empirical study on the efficiency scores of banks and the impact of I.C on banks'

efficiency. The study utilized data from 32 institutions active in Ghana's banking sector between 2000 and 2015. According to the regression analysis, the results indicated that I.C promotes efficiency in banks in Ghana and also revealed that HCE is a crucial element of I.C to banks' efficiency. Kwaku Mensah Mawutor et al. (2023) conducted a study on sub-Saharan African banks to investigate the correlation between I.C and their performance. The research utilized a panel regression methodology to analyze the performance of 80 banks across 21 countries from 2000 to 2020. The results found that the VAIC, SCE, and HCE positively and significantly influence the performance of banks. However, CEE negatively and significantly affects the profitability of banks, specifically ROA.

2.8 Research Gaps

The review of academic literature confirms the significance of I.C based on theoretical perspectives and empirical evidence. According to Pulic's valuation model (VAIC) (1998; 2000; 2001; 2002), I.C comprises human, structural, and physical/financial capital, and is considered a valuable asset for organizations in today's knowledge-driven world (Al-Azizah & Wibowo, 2023; Al-Musali & Ismail, 2014; Aslam et al., 2024; Faruq et al., 2023; Hamdan, 2018; Joshi et al., 2013; Kwaku Mensah Mawutor et al., 2023; Ky & Lim, 2024; Maditinos et al., 2011; Malchev et al., 2024; Mondal & Ghosh, 2012; N. Isanzu, 2015; Prasojo et al., 2022; Tiwari et al., 2023). To enhance the accuracy and consistency of the conventional VAIC model, in this study MVAIC model is employed as a means of quantifying the efficiency of I.C (Faruq et al., 2023; Martens, 2023a; Sardo & Serrasqueiro, 2017; Vishnu & Kumar Gupta, 2014; Xu et al., 2023). This research aims to enhance the current knowledge base on I.C. and F.P. by examining a period encompassing two significant economic events in India: Demonetization and COVID-19. Moreover, it is worth mentioning that the current study's outcome will bridge the gap by providing a holistic comparative analysis of both public and private sector banks to I.C and F.P and their respective elements. Our study aimed to employ an appropriate econometric method for analyzing longitudinal data, specifically focusing on 2010-2022 which includes the consequences of demonetization and COVID-19. This distinguishes our research from previous studies (Mohapatra et al., 2019; Mondal & Ghosh, 2012; Oppong & Pattanayak, 2019; Soriya & Narwal, 2015; Tiwari et al., 2023; Weqar & Haque, 2020). We conducted panel data analysis using the fixed effect and cross-section random effect models and generalized method of moments (GMM) to investigate the influence of I.C on the financial performance (F.P) of Indian banks. The significance of this study lies in the necessity to provide a fresh analytical framework for banks in India. This is because conventional financial methods only

offer incomplete explanations and have been unsuccessful in uncovering the true origin of organizations' value in this knowledge-based economy (Firrer and Williams, 2003). Furthermore, assessing the I.C performance will demonstrate the significance of including intangible assets in the financial accounts of the companies. This will aid in mitigating the disparities in decision-making, which are believed to be deceptive, among several stakeholders.

2.9 Research Framework

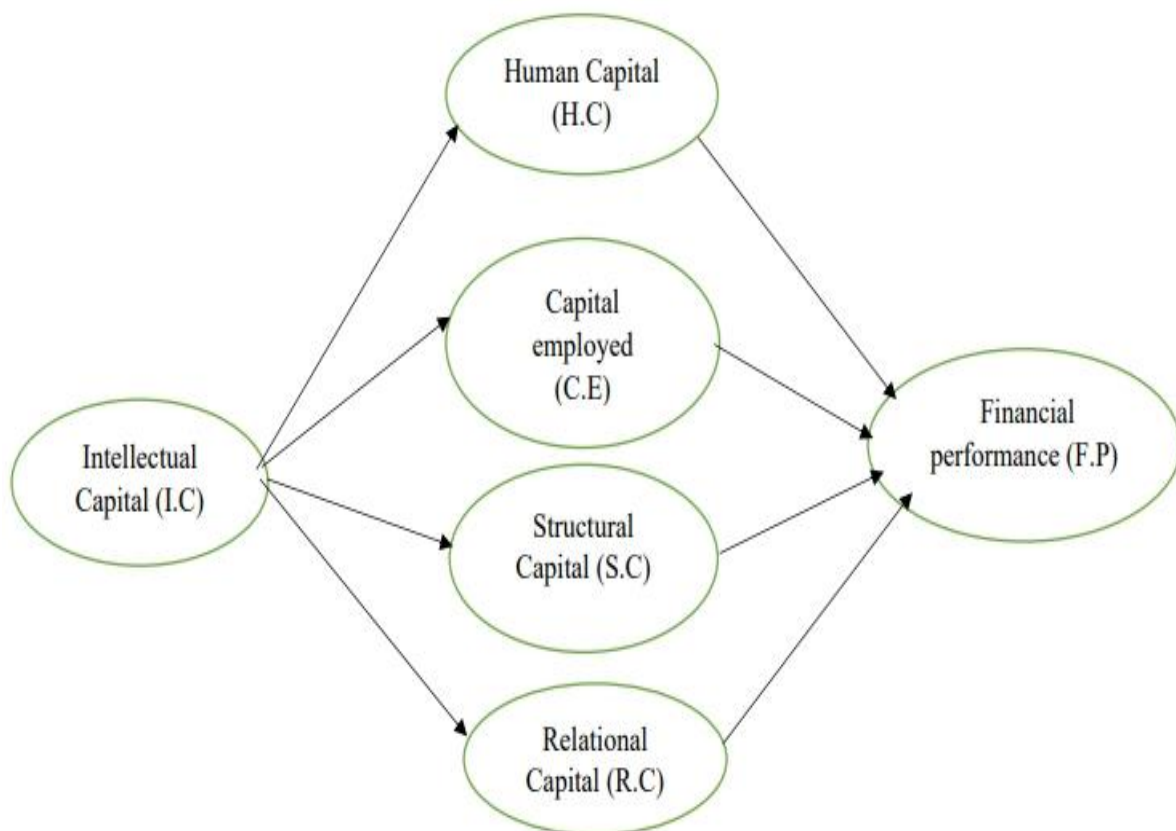


Figure 1: Research Framework

Source: Constructed by the authors

2.10 Chapter Summary

This part of the study provides a comprehensive overview of the existing literature on I.C. The examination of the historical progression of I.C and its conceptualization can be traced back to a paper by John Kenneth Galbraith in 1969 when he was the first to introduce the phrase "Intellectual capital." The term suggests that I.C is considered to be a more powerful and dynamic strategy, rather than just a static form of capital (Edvinsson & Sullivan, 1996). Due to its appeal to several academics, the field of classified I.C expanded into four main categories: structural capital, capital employed, customer capital, and human capital. Based on the literature study, it is evident that researchers have conducted significant studies on the influence of I.C on financial performance in both developed and developing countries, including India. Nevertheless, it is necessary to address the gap by offering a comprehensive comparative examination of intellectual and financial performance and their respective components of I.C. After identifying the I.C elements and research gaps conceptual framework has been designed to demonstrate the relationship between I.C and banks' financial performance. The following chapter outlines a comprehensive approach that was employed to accomplish the research objectives.

CHAPTER 3

RESEARCH DESIGN AND RESEARCH METHODOLOGY

This chapter includes steps of study design to accomplish the research objectives after the literature review and hypothesis creation are finished. The study utilized existing data to achieve the research goals. The primary reason for choosing India as the focus of this study stems from the remarkable expansion of the Indian banking sector in recent times. Additionally, this chapter comprehensively explains the data collection procedures and the statistical techniques used for data interpretation.

Section 3.1 elucidates the research design, which offers a detailed account of the systematic approach to accomplishing the objectives. Section 3.2 and Section 3.3 outline the data collection and tools and techniques employed in the study. Section 3.4 presents methodologies and strategies used in the current investigation. Ultimately Section 3.5 presents a measurement of variables and a summary of variables.

3.1 Research Design

This study utilizes panel data analysis to investigate the impact of I.C on the financial performance (F.P) of 17 private and 12 public sector banks in India from 2010 to 2022. A simple panel least square analysis is conducted with the fixed effect and cross-section random effect and the two-step GMM estimation technique is used to assess the impact of I.C on the F.P of the Indian banks.

3.2 Data collection

The study's data has been gathered from the ProwessIQ database maintained by the CMIE (Centre for Monitoring the Indian Economy). However, certain banks' data was missing, so information about those institutions was taken from their annual reports. Five private sector banks were excluded as they started their operations after 2014. This data primarily consists of the elements that can be utilized to calculate various components of I.C. Several I.C components have been employed as independent variables in our investigation. The variables are H.C, C.E, S.C, and R.C. In addition, two control variables are utilized to assess the impact of these factors on the banks' performance. The study employs numerous financial factors as dependent variables and then utilizes econometric tools to analyze the influence of different components of I.C and control variables. The components of I.C have been quantified using various indicators from income statements and balance sheets. As dependent variables used in

previous studies, the study employs four financial parameters i.e. ROA, ROE, ROCE, and ROS (Asutay & Ubaidillah, 2023; Barak & Sharma, 2024; Faruq et al., 2023; Kasoga, 2020; Kweh et al., 2022; Ky & Lim, 2024; Mohapatra et al., 2019; Weqar & Haque, 2020, 2022). Data for all the independent, control, and dependent variables has been collected from 2010 to 2022.

Data that have been purposefully gathered since the end of the crisis also consider the impact of several economic measures, such as the demonetization and restructuring of public sector banks during that time. The data for certain public sector banks was unavailable owing to causes such as banking sector restructuring. The data from private sector banks in the study period consisted of unbalanced panel data, as it covered the introduction of new banks into the sector. Both sector banks' data sets are characterized as unbalanced panel data. Once the data for the dependent, independent, and control variables was collected, it was organized in a panel format. Each public and private sector bank is granted a unique number value as a common identifier.

3.3 Tools and Techniques

Once the relevant data from various variables has been collected and organized into panel data format, the first step is to examine the nature of the data series for each variable. This is done by conducting descriptive statistics and stationarity tests. The study utilizes various measures of descriptive statistics, including the arithmetic mean, standard deviation, skewness, kurtosis, and the maximum and lower limits of the data set. The white test statistic technique is used before applying the panel data techniques specifically the fixed effect model, cross-section random effect model, and GMM. We found that there is a problem of heteroskedasticity and that is why instead of OLS we have employed panel data techniques. The stationarity of the data series has been verified by conducting a range of unit root tests from several generations, including at level and first. The panel unit root tests have been conducted, with the initial test being performed at the level but data was not stationary at the level. Then we convert the data series at the first difference and conduct the unit root test. Additionally, these tests have been conducted at three distinct levels, namely: without constant and trends, with intercept, and with constant and trends. Upon assessing the stationarity at the first level, we found all the variables were stationary at the first difference. In the subsequent phase, the study employs panel least square estimation approaches, specifically the fixed effect model and cross-section random effect model. To verify and validate the results, the study employs a two-step Generalized method of moments (GMM) estimation.

3.4 Statistical Model Briefing

Panel data analysis allows us to account for factors that are challenging to quantify or calculate, particularly those that exhibit variation over time that is not uniform across countries or companies. Panel data analysis considers the individual differences within a corporation, organization, or country. Panel data analysis can incorporate variables that are appropriate for multilevel or hierarchical modeling across different levels of study (Torres-Reyna, 2007).

3.4.1 Panel Data Analysis with Fixed Effects (FE)

Panel data analysis is commonly used when we want to study the impacts of factors that change over time. In these cases, fixed effects (FE) are often employed. Financial economics assists us in discerning the connections between external and internal factors within an institution (such as a firm or country) (Torres-Reyna, 2007). Every business or country possesses a distinct identity that can potentially influence the exogenous or explanatory variables. When employing the FE (Fixed Effects) method, we operate under the idea that the internal factors of a specific country or entity might influence or bias the exogenous or endogenous variables, and we must manage and account for these aspects. This provides evidence for the premise that there is a correlation between the residual and explanatory components of an entity. By employing fixed effects (FE), we can eliminate the effects of time-invariant descriptions. This enables us to accurately assess the total influence of the exogenous variable on the endogenous variable (Bartels & others, 2008; Kohler & Kreuter, 2005; Stock & Watson, 2007).

3.4.2 Panel Data Analysis with Cross-Section Random Effects (CSRE)

The rationale for employing a random effects model in panel data analysis is based on the premise that, unlike a fixed effects model, variations among firms or countries are unintentional and not connected to the explanatory or exogenous factors under consideration in the model (Torres-Reyna, 2007). The key differentiation between fixed and random effects lies not in their stochastic nature, but rather in whether the unaccounted individual impact represents components that are linked to the model's repressors (Greene, 2008). Exogenous factors that do not change over time can be used as explanatory variables, as random effects presuppose that the error term of the organization is not related to these variables.

3.4.3 Hausman test

The Hausman test is employed to assess the presence of endogeneity in the panel model. Utilizing panel data has numerous advantages compared to only depending on cross-sectional or time series data. However, it is crucial to select an appropriate model to obtain consistent

and reliable outcomes. The Hausman test is a method used to determine the optimal model. It indicates the model to use: a cross-section random effects model or a fixed-effects model. Exogeneity of the variables that are independent and understanding of the parts that are unique to each individual must be considered while selecting a model for panel data. To determine whether a fixed or random effect model is more appropriate, this test was employed to see if the explanatory variables had endogeneity.

A test for the model specification is another term used to describe the Hausman test. When the null hypothesis is accepted or the null hypothesis is not rejected, it suggests that the cross-section random effect model is the most appropriate for the current data series (Sheytanova, 2015). As per Amini et al. (2012), the fixed-effect model is the most appropriate fit for the specified data series when the alternate hypothesis is accepted.

3.4.4 Generalized method of moments (GMM) estimation

The GMM estimator which was proposed by Blundell and Bond (2000) and Arellano and Bover (1995), to address the endogeneity, unobserved heteroskedasticity, and autocorrelation issues in the panel data model (Arellano & Bover, 1995; Blundell & Bond, 2000). Control over two fundamental issues- unobserved heterogeneity and endogeneity issues- is the aim of the generalized technique of moment's analysis (GMM) (Arellano, 2002). The persistence of the variable being estimated as well as the existence of unobserved heterogeneity are both taken into consideration by the GMM estimator. Consequently, the estimates generated by this tool are credible.

To address endogeneity concerns, the system GMM estimator employs lagged values of the dependent variables (in levels and differences) as well as lagged values of extra regressors that may be endogenous. The effectiveness of GMM estimation relies on several assumptions, such as the accuracy of the other predictor variables and the lagged value of the dependent variable, as well as the lack of autocorrelation in the model's error term. Arellano and Bond (1991) proposed three sequential methods to accomplish this objective. Initially, it is necessary to ascertain if the error component of the proposed model displays any autocorrelation. The test statistic follows a standard normal distribution when the null hypothesis assumes no serial connection. The second objective is to verify that the error term in the GMM model follows a conventional normal distribution when there is no serial correlation, and it should not display second-order autocorrelation. The third test is the Sargan (1958) test, also referred to as the J statistics, which is used to identify over-identifying restrictions. When assuming the null

hypothesis of instrument validity, this assesses the validity of the instruments and follows an asymptotic Chi-square distribution.

To examine the distinct impact of every component of I.C on every dependent variable, we provide the following models. The equation shown below represents the model:

$$\text{Model 1: } - \text{ROA}_{it} = \alpha_0 + f(\text{ROA}_{it-1, it}, \text{CE}_{it}, \text{HC}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) + n_i + n_t + \varepsilon_{it}$$

$$\text{Model 2: } - \text{ROE}_{it} = \alpha_0 + f(\text{ROE}_{it-1, it}, \text{CE}_{it}, \text{HC}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) + n_i + n_t + \varepsilon_{it}$$

$$\text{Model 3: } - \text{ROCE}_{it} = \alpha_0 + f(\text{ROCE}_{it-1, it}, \text{CE}_{it}, \text{HC}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) + n_i + n_t + \varepsilon_{it}$$

$$\text{Model 4: } - \text{ROS}_{it} = \alpha_0 + f(\text{ROS}_{it-1, it}, \text{CE}_{it}, \text{HC}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) + n_i + n_t + \varepsilon_{it}$$

The following are the GMM equations to investigate the combined effect of intellectual capital (MVAIC) on the financial performance of public and private sector banks.

$$\text{Model 5: } - \text{ROA}_{it} = \alpha_0 + f(\text{ROA}_{it-1, it}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) + n_i + n_t + \varepsilon_{it}$$

$$\text{Model 6: } - \text{ROE}_{it} = \alpha_0 + f(\text{ROE}_{it-1, it}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) + n_i + n_t + \varepsilon_{it}$$

$$\text{Model 7: } - \text{ROCE}_{it} = \alpha_0 + f(\text{ROCE}_{it-1, it}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) + n_i + n_t + \varepsilon_{it}$$

$$\text{Model 8: } - \text{ROS}_{it} = \alpha_0 + f(\text{ROS}_{it-1, it}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) + n_i + n_t + \varepsilon_{it}$$

Where ROA_{it} , ROE_{it} , ROCE_{it} , and ROS_{it} , are the different measures of profitability of Indian public sector banks it in year, n_i is the unobserved firm-specific effects, n_t is the time-specific effects and ε_{it} is the error term. The remaining variables in the above equations are the different measures of I.C. used as explanatory variables. MVAIC reflects the combined effect of different components of I.C.

3.5 Measurement of variables

The study utilizes dependent, independent, and control variables, which are listed in Table 1. The first stage of the analysis focuses on the dependent variable, which is a proxy for profitability. This variable is used to assess the financial performance of both public and private sector banks in India. The second stage outlines the independent variables according to the MVAIC model. The third step outlines the control factors that have a significant impact on our dependent variables. The concluding stage elucidates the regression model, which investigates the correlation between intellectual capital and the profitability of both public and private banks in India.

3.5.1 Dependent Variables

This research seeks to examine the impact of intellectual capital (I.C) on the financial performance of banks, as previously mentioned in the preceding chapters. The study aims to assess the financial performance of banks in terms of profitability. The bank's profitability has

been assessed using metrics such as return on assets, return on equity, return on capital used, and return on sales. These metrics reveal the financial performance of the banks under study. The banking literature acknowledges multiple factors that influence the profitability of banks. Currently, there is no definitive theoretical or empirical evidence that supports any certain proxy measure of financial performance over another (Firer and Williams, 2003). Nevertheless, Damodaran (2007) observed that a significant portion of the information utilized by researchers in valuation and corporate finance is obtained from accounting statements. The prevailing measures of returns commonly employed are based on accounting earnings, which are categorized as Return on Invested Capital, Return on Equity, Return on Sales, and Return on Assets. In addition, various studies have utilized Return on Assets (ROA), Return on Equity (ROE), Return on Capital Employed (ROCE), and Return on Sales (ROS) as measures of profitability. These studies can be found in Chapter 2 of the present study and include works by Firer and Williams (2003), Shiu (2006), Kamath (2008), Puntilo (2009), Makki and Lodhi (2009), Mehralian et al. (2012), Mondal and Ghosh (2012), Britto et al. (2014), Bontis (2015), Dzenopoljac et al. (2016), Ofumu and Aliyu (2018), and Oppong et al. (2019). Thus, following the existing body of knowledge, this study employs return on Assets (ROA), return on Equity (ROE), return on capital employed, and return on sales (ROS) as measures to assess the financial performance of public and private sector banks in India, specifically focusing on their profitability. The dependent variables are addressed in the subsequent sub-sections.

- Return on Assets (ROA) is a measure of a firm's profitability, calculated by dividing its operating income by its total assets. This metric is used to assess the financial performance of a company. Various studies Ting and Lean, (2009); Ismail and Kareem, (2011); Mondal and Ghosh, (2012); Joshi et al., (2013); Gigante, (2013); Musali and Ismail, (2014); and Isanzu, (2015) have examined the concept of ROA and its significance. Return on Assets (ROA) measures the bank's ability to create income from its assets, indicating its management competence. Additionally, it illustrates the effectiveness with which banks utilize their assets to generate income, and potentially even the operational efficiency of banks (Jahan, 2012).
- ROE is regarded as a metric that measures a company's profitability and its effectiveness in creating profits. A company's ability to convert its equity financing into profits is directly proportional to its Return on Equity (ROE). Therefore, a higher ROE indicates a better performance in this regard. ROE can be calculated by dividing the net income by the shareholders' equity.

- Return on capital employed (ROCE) is an accounting metric used to measure the return earned on the capital that has been invested in a particular investment. Typically, it is commonly defined in practical terms as follows: This metric calculates the net operational profit before interest and tax concerning the invested capital. It is based on the research conducted by Britto et al. (2014), Sherif and Elsayed (2016), and Dzenopoljac et al. (2016).
- Return on sales (ROS) is a metric that quantifies the effectiveness with which a company converts its sales revenue into profits. ROS is determined by dividing operating profit by net sales. ROS is most valuable when evaluating firms within the same industry. A rising ROS suggests that a company is enhancing its operational efficiency, whereas a declining ROS may indicate potential financial difficulties in the future. ROS has a strong correlation with a company's operating profit margin.

3.5.2 Independent variable

This research employs the MVAIC approach, which has been extensively utilized in prior empirical investigations for evaluating intellectual capital (Aybars & Oner, 2022; Buallay et al., 2019; N. P. Tran & Vo, 2020; Vidyarthi, 2019; Weqar et al., 2020; Xu & Wang, 2019). To evaluate the influence of intellectual capital (I.C) on financial performance (F.P), several researchers (Kasoga 2020; Meles et al. 2016; Isanzu 2015; Nawaz and Haniffa 2017) have utilized the value-added intellectual coefficient (HC, SC, and CE) as suggested by Pulic (1998). However, the VAIC model does possess specific constraints. To overcome these constraints, the researchers developed the MVAIC framework, which includes an additional element of I.C called Relational Capital (R.C). Relational capital involves a company's engagements with several stakeholders, including customers, vendor partners, creditors, shareholders, and marketing distributors. So, MVAIC is the combination of four performance variables. This model is constructed based on multiple mathematical formulations, which involve the calculation of the value-added efficiency for each firm, as demonstrated below.

V.A is classified as Output-Input. A bank's output refers to its total sales or net revenues, whereas its input includes all expenses involved in creating value, minus employment costs. Another way to calculate V.A is the Operating profit plus employees' cost, Depreciation, and Amortization.

A firm's I.C efficiency is determined by its human capital (H.C), capital employed (C.E), structural capital (S.C), and relational capital (R.C). These components can be characterized as:

$$C.E = \text{financial assets} + \text{physical capital}$$

$$H.C = \text{wages and salaries}$$

$$S.C = VA - HC$$

$$R.C = \text{marketing, sales, and advertising costs}$$

Hence, the subsequent elements of I.C, which are determined by the efficacy it generates, are as follows:

$$HCE = V.A/H.C$$

$$SCE = S.C/V. A = (V.A-H.C)/V. A$$

$$CEE = V.A/C. E$$

$$RCE = R.C/V. A$$

Where:

- CEE refers to the efficiency achieved by an organization through the utilization of physical and financial capital. This efficiency is measured by the value added (VA) and indicates the company's net worth, which encompasses both physical and financial capital. The value added generated by the capital utilized can be quantified as CEE. I.C, as stated by Pulic (2004), is a variable that relies on both physical and financial capital. It is important to note that I.C alone does not provide any value. Therefore, when constructing the I.C efficiency index, it is essential to consider the capital employed (El-Bannany, 2008).
- Human Capital Efficiency (HCE) refers to the effectiveness of the workforce employed by a company, which is determined by the value added (VA) and the investment made in human resources, including wages and salary. According to the MVAIC model, personnel expenditures are considered an investment rather than a cost, as demonstrated previously. The correlation between VA and H.C demonstrates the capacity of H.C to create value inside an organization.
- SCE refers to the efficiency of structural capital, which is a measure of the proportion of total value added (VA) that is derived by structural capital. Based on the approach, structural capital is the outcome of the previous achievements of human capital, such

as standards, licenses, patents, organization, image, and customer relationships. Structural capital (S.C) contributes to the process of value development for a specific period (Komnenic and Pokrajcic, 2012). According to Pulic's (2004) estimates, deducting human capital (H.C) from the value-added (VA) results in obtaining structural capital (S.C), which is the remaining amount. This form of capital is not an autonomous indicator, as shown by this equation. Indeed, the outcome is dependent upon the VA produced and exhibits an inverse relationship with H.C. This indicates that when the share of H.C in the created value-added (VA) increases, the proportion of S.C decreases. This elucidates the reason for the distinct acquisition of SCE.

- RCE stands for relational capital efficiency, which quantifies the percentage of total value added (VA) that comes from relational capital (R.C). R.C is the result of an organization's ability to engage in effective communication with its stakeholders, including government entities, customers, suppliers, and competitors. The calculation of relational capital involves the incorporation of expenses related to marketing, sales, and advertising.
- MVAIC is the sum of all the value-added components. So, MVAIC is equal to $HCE + CEE + SCE + RCE$.

In many aspects, this study is dependent upon and highly interested in using this framework or technique; Using publicly available data, this analysis will facilitate comparisons between Indian public and private sector banks in terms of their intellectual capital participation and its impact on their financial performance. Consequently, the effectiveness of banks in utilizing their investment in I.C resources (such as human, structural, physical capital, and relational capital) may be assessed to attain the desired goals. The utilization of the model also offers a means for incorporating quantitative data, which is a fundamental element of the research design of the study. Furthermore, the utilization of this model enhances the legitimacy of this study as the publicly accessible data used as input for the model has been authenticated by an external auditor. Therefore, utilizing this model in the study enhances accuracy, thereby bolstering the trustworthiness of the work.

The model is distinctive in its approach to intellectual capital research. According to Iazzolino and Laise (2013), the model does not have any impact on the fundamental accounting rules or contradict them. The MVAIC model is selected for this study because of its superior performance compared to other approaches such as Balanced Scorecard, Intangible Asset

Monitor, Skandia Navigator, VAIC, and others in measuring I.C. This is attributed to its transparency and simplicity, as noted by Joshi et al. (2010) and Khanhossi et al. (2013).

To overcome the certain limitations of VAIC, the researchers developed the MVAIC framework, which includes an additional element of intellectual capital known as Relational Capital (RC). Relational capital refers to a company's engagement with different stakeholders, including consumers, vendor partners, creditors, shareholders, and marketing distributors. Therefore, the MVAIC technique (Bayraktaroglu et al. 2019; Buallay et al. 2020; Tran and Vo 2018; Weqar et al. 2020; Xu and Li 2019) is employed to assess the impact of intellectual capital on financial performance.

3.5.3 Control variables

To account for the potential influence of other factors that could explain a bank's performance, this study used two control variables: leverage and bank size. These variables have the potential to affect the productivity and profitability of banks.

Bank size

Alhassan and Asare (2016) defined them as the natural logarithm of the total asset to control the influence of bank size on the generation of wealth. The magnitude of a financial institution is a crucial factor in assessing both its efficiency and its financial success. Due to economies of scale, larger enterprises can cut production costs. Reduced productivity costs will lead to increased profitability. Furthermore, large corporations are significantly more innovative and forward-thinking due to their substantial financial resources, which enable them to take such actions (Gutherie et al., 2006). Large banks demonstrate innovation by leveraging their considerable financial resources to invest in intellectual assets that enhance their performance. Consequently, it is anticipated that banks of greater magnitude should allocate resources toward acquiring knowledge, to enhance their performance. This study predicts a favorable influence on banks' productivity and profitability.

Leverage

Financial leverage and debt structure are metrics used to assess the impact of debt servicing on a company's performance and wealth generation. These metrics are produced by dividing the total debt by the book value of total assets (Riahi-Belkaoui, 2003). In 2010, the Basel Committee on Banking Supervision (BCBS) included a leverage ratio as part of the Basel III reform package. As the leverage level increases, the bank's ability to withstand adverse shocks on its balance sheet also increases. Therefore, banks with higher leverage levels would have

the capacity to endure any forthcoming shocks. As a result, investors will allocate more funds to banks that have a high level of leverage, enabling them to absorb potential losses. This increased investment will enhance the efficiency of banks and ultimately have a positive effect on their profitability. Therefore, in this study, we anticipate the influence of debt on the productivity and profitability of banks.

These two control factors were chosen because of the significant contributions they make to the overall performance of the company (Aybars & Oner, 2022; Buallay et al., 2019; Kapoor & Saihpal, 2022; Weqar et al., 2020; Xu & Wang, 2019).

3.6 Summary of variables

Table 1: Description of variables

S. No	Variable name	Variable abbreviation	Description of Variables
Independent Variables			
1.	Capital Employed Efficiency	CEE	CEE = The ratio of value-added divided by CE (VA/ CE) CE = Equity + Long-term Borrowings. Value-added = Operating profit + Employee cost + Depreciation
2.	Human Capital Efficiency	HCE	HCE = The ratio of value-added divided by HC (VA/HC) HC = Total employee expenditure.
3.	Structural Capital Efficiency	SCE	SCE = The ratio of structural capital divided by VA [(VA – HC)]/ VA. SC = Value-added – Human capital
4.	Relational Capital Efficiency	RCE	RCE = The ratio of value-added divided by relational capital (VA/RC) RC = The amount invested in marketing, selling, and advertising expenses
Independent Variables			
5.	Return on assets	ROA	EBIT/ Total assets

			EBIT = Earnings before interest and tax
6.	Return on equity	ROE	Profit available to equity shareholders/ Shareholders' equity
7.	Return on capital employed	ROCE	EBIT/ Shareholders fund+ Long term debts
8.	Return on sales	ROS	EBIT/ Net Sales EBIT = Earnings before interest and tax
Control variables			
8.	Total assets	(SIZE)	The Natural logarithm of total assets
9.	Financial Leverage	(LEV)	Debt/ Shareholder's Equity
Source: Author's compilation			

3.7 Chapter Summary

This chapter elucidated the planning and preparation processes included in the study aimed at quantifying the utilization of I.C and its impact on financial performance. The chapter encompassed the methodology and design employed in this investigation, the data collected from the research, and the subsequent analysis of the data. The examination of the research method and design provided detailed explanations for the utilization of a quantitative research method. The data discussion encompassed the sample population, data source, and data analysis methodologies. In addition, the chapter included an explanation of the many econometric models used in the study to evaluate the relationship between I.C and a bank's financial performance. This work utilized the fixed effect and cross-section random effect models, as well as the dynamic panel model estimation proposed by Arellano and Bover (1995) and Blundell and Bond (1998). The following section examines the analyses conducted using these techniques.

CHAPTER 4

DATA ANALYSIS AND RESULTS

4.1 Introduction

This section focuses on the data analysis and study findings about the effectiveness of I.C in both sector banks in India, as outlined in the study's objectives. The study also examines the impact of the I.C on the financial performance of public and private sector banks in India, as measured by MVAIC, and the bank's profitability as measured by ROA, ROE, ROCE, and ROS. The analysis takes into account two bank-specific control variables, leverage and size. The regression findings are calculated using fixed and random effect models, as well as a dynamic panel model estimation (GMM) proposed by Arellano and Bover (1995) and further modified by Blundell and Bond (1998). The process begins with describing the descriptive statistics of the variables utilized, a correlation matrix. This is followed by confirming the stationarity of the data using various unit root tests and an examination of intellectual capital performance using regression techniques.

4.2 Descriptive statistics

Table 4.1 displays the descriptive statistics concerning the variables employed in quantifying intellectual capital and profitability from 2010 to 2022. The measurements and the sample are briefly described. To communicate quantitative data in a comprehensible manner, descriptive statistics are employed. In this research, the standard deviation and mean are employed to define the characteristics. The mean and standard deviation of the sample are shown below.

Table 4.1: Mean and standard deviation of variables

Private sector banks											
Variable	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
Mean	1.079	7.679	2.131	-6.611	7.739	0.487	0.153	0.646	9.038	10.908	11.519
Std. Dev	4.903	13.010	0.857	13.805	3.052	0.285	0.141	3.310	4.209	3.558	1.370
Skewness	13.748	-3.163	-0.415	-3.840	0.494	0.949	8.090	12.618	3.561	0.511	0.124
Kurtosis	199.918	15.576	3.215	24.343	3.938	3.657	107.82	182.539	45.310	3.034	2.322
Jarque-Bera	364034.2	1824.935	6.780	4738.131	17.109	37.182	103594.7	301320.6	16874.63	9.648	4.804
Probability	0.000	0.000	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.090
Observations	221	221	221	221	221	221	221	221	221	221	221
Public sector banks											
Variable	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
Mean	0.099	0.983	1.625	-11.915	6.131	0.556	0.814	0.803	8.306	15.887	12.896
Std. Dev	0.824	17.395	0.412	13.379	1.873	0.551	0.094	1.656	2.420	2.607	0.932
Skewness	-1.598	-2.539	-0.295	-1.473	0.134	10.825	-4.500	9.742	5.011	0.145	0.489
Kurtosis	5.848	13.467	3.987	5.700	2.878	128.972	31.874	109.224	45.334	5.548	3.139
Jarque-Bera	119.214	879.851	8.633	103.850	0.563	10695.8	5945.996	75811.38	12302.36	42.773	6.344
Probability	0.000	0.013	0.000	0.000	0.754	0.000	0.000	0.000	0.000	0.000	0.041
Observations	156	156	156	156	156	156	156	156	156	156	156
Source: Constructed with E-views 12 by the authors											

The average returns indicate that private-sector banks' financial performance measures (ROA, ROE, and ROCE) are considerably greater than those of public-sector banks. This suggests that private sector banks have successfully and proficiently utilized their assets and equity. Moreover, the findings suggest that private banks in India demonstrate efficiency and effectiveness in earning profits from each unit of invested capital and utilized assets. This implies that private-sector banks are more lucrative than public-sector banks. Public sector banks have a significantly unfavorable ROS compared to private sector banks. Compared to other subcomponents of I.C, HCE contributes the highest amount of 7.739 in private sector banks and 6.131 in public sector banks (Al-Azizah & Wibowo, 2023; Asutay & Ubaidillah, 2023; Faruq et al., 2023; Nguyen et al., 2023; Ozkan et al., 2017; Sohail Rana & Hossain, 2023; Weqar & Haque, 2022; Xu & Wang, 2019). This finding demonstrates that the success of banks' I.C in India relies more heavily on H.C than on other forms of I.C. According to Alhassan and Asare (2016), human capital is the main intellectual resource that influences the other elements of I.C. HCE is the most important part of the I.C, as shown by the majority of research on banks from various countries (Chen Goh, 2005; Mohapatra et al., 2019; Oppong & Pattanayak, 2019; Sayed & Nefzi, 2024; Setianto & Sukmana, 2016; S. Singh & Kansal, 2011; Weqar & Haque, 2020). Both sector banks exhibited low CEE values, suggesting that they faced challenges in generating value from the capital they used during the research period. Furthermore, it has been discovered that banks in India rely more heavily on intangible assets, such as human capital and relationship capital, rather than physical assets or financial assets. The mean value of MVAIC is higher in private sector banks (9.038) than in public sector banks (8.306), indicating that both types of banks successfully utilize I.C. The average value suggests that both private and public sector banks in India depend on and effectively utilize intellectual capital to achieve a competitive advantage. According to the mean score obtained, the average creation rate for private banks is 9.038 for every monetary unit utilized, whereas the average creation rate for public banks is 8.306 for every monetary unit utilized. The standard deviation and coefficient of variation indicate that the ROA, ROE, ROS, RCE, and SCE of private sector banks exhibit significant volatility. Using a control variable demonstrates that the percentage of debt in public sector banks is greater than that in private sector banks. The average size of both sector banks is equivalent, with a slight disparity.

4.3 Spearman correlation matrix of independent variables

As per the recommendations of Kennedy (1985), a correlation value greater than 0.8 indicates the presence of multicollinearity among factors. Similarly, Hair, Anderson, Tatham, and Black (1995) and Blumberg et al. (2014) proposed that a correlation exceeding 0.8 indicates the presence of multicollinearity. Multicollinearity refers to a linear relationship between independent variables, which can introduce bias into regression models (Gujarati, 2004).

Table 4.2: Correlation matrix

Private sector banks											
	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
ROA	1.000										
ROE	0.123	1.000									
ROCE	0.199	0.357	1.000								
ROS	0.181	0.881	0.120	1.000							
HCE	0.144	0.527	0.404	0.398	1.000						
CEE	-0.079	0.040	-0.491	0.209	-0.148	1.000					
SCE	-0.122	-0.476	-0.023	-0.432	-0.445	0.037	1.000				
RCE	-0.087	-0.422	0.243	-0.475	-0.131	-0.121	0.896	1.000			
MVAIC	0.026	0.037	0.450	-0.084	0.597	-0.134	0.417	0.713	1.000		
LEV	-0.102	-0.254	-0.654	-0.091	-0.086	0.664	0.099	0.001	-0.013	1.000	
SIZE	0.161	0.096	0.633	-0.057	0.356	-0.601	-0.154	0.071	0.269	-0.438	1.000
Public sector banks											
	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
ROA	1.000										
ROE	0.948	1.000									
ROCE	0.474	0.434	1.000								
ROS	0.942	0.895	0.277	1.000							
HCE	0.447	0.445	0.048	0.554	1.000						
CEE	0.133	0.131	-0.003	0.156	-0.079	1.000					
SCE	0.438	0.478	0.074	0.497	0.779	-0.052	1.000				
RCE	-0.291	-0.311	-0.126	-0.270	-0.106	-0.028	-0.175	1.000			
MVAIC	0.193	0.180	-0.047	0.299	0.713	0.125	0.403	0.588	1.000		
LEV	-0.269	-0.293	-0.247	-0.143	0.163	-0.096	0.042	0.095	0.171	1.000	
SIZE	0.134	0.125	0.200	-0.008	-0.077	-0.177	0.066	-0.170	-0.214	-0.085	1.000
Source: Constructed with E-views 12 by the authors											

Table 4.2 presents the correlation matrix between private and public sector banks. The analysis employs four endogenous, five exogenous, and two control variables. The test results in the correlation matrix indicate that they fall below the specified threshold, indicating the absence of multicollinearity. For example, the correlation coefficient between HCE and MVAIC is 0.597 for private-sector banks and 0.713 for public-sector banks. Similarly, the correlation coefficient between SCE and MVAIC is 0.417 for private-sector banks and 0.403 for public-sector banks. The correlation coefficient between CE and MVAIC is -0.134 for private-sector banks and 0.125 for public-sector banks. All variables except SCE and RCE for private-sector banks have values below the specified limit. The correlation coefficient between them is 0.896. This indicates that the primary independent variables are not significantly connected.

The first objective is to assess the level of correlation between various components of intellectual capital in both public and private sector banks. Regarding private sector banks, there is a negative correlation between HCE and the other three components of I.C. Conversely, the situation of CEE is linked negatively to SCE and RCE while being positively linked to HCE. Nevertheless, there is a positive correlation between SCE and all other components of I.C (CEE, HCE, and RCE). RCE demonstrates a negative correlation with HCE and CEE, and a positive correlation with SCE. In contrast, public sector banks show a negative relationship between HCE and both CEE and RCE, but a positive correlation with SCE. Simultaneously, CEE exhibits a negative correlation with SCE, HCE, and RCE. SCE exhibits a negative correlation with both CEE and RCE, although it shows a favorable association with HCE. RCE exhibits an adverse correlation with the remaining components of I.C.

4.4 Unit root test

The study utilizes the LLC test proposed by Levin et al. (2002) and two sets of Fisher-type tests using ADF and Phillips-Perron (PP) as proposed by Choi (2001) and Maddala & Wu (1999) to assess stationarity in the panel data. The inclusion of the unit root test is crucial in this study due to the researchers' goal of examining the long-term correlation between I.C and financial performance. Initially, several distinct panel unit root tests are run on a level for various parameters. None of the variables were found to be consistently constant. Thus, these tests are conducted immediately upon detecting the first difference. The test results indicated that all variables are stationary at the first difference, indicating the absence of a unit root. The panel unit root results for the first difference of both public and private-sector banks are presented in Table 4.3 and Table 4.4, respectively.

Table 4.3 Panel unit root results for public-sector banks

	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
LLC											
Without	-9.648	-9.963	-11.146	-7.245	-10.907	-9.819	-10.029	-9.872	-10.684	-11.544	-3.792
C&T	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
With C&T	-1.139	-1.140	-5.658	-0.361	-7.910	-5.493	-3.808	-2.384	-8.931	-7.381	-6.114
	(0.000)	(0.126)	(0.000)	(0.058)	(0.000)	(0.000)	(0.000)	(0.008)	(0.000)	(0.000)	(0.000)
With C	-2.127	-1.561	-5.795	-0.131	-7.140	-5.678	-4.593	-4.067	-8.629	-8.533	85.892
	(0.000)	(0.042)	(0.000)	(0.047)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ADF- Fisher Chi-square											
Without	121.852	131.272	150.752	101.571	145.326	131.709	142.722	133.186	151.153	156.838	68.867
C&T	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
With C&T	32.225	40.784	65.312	31.547	63.087	50.773	52.491	43.667	68.583	61.108	57.941
	(0.054)	(0.096)	(0.001)	(0.088)	(0.001)	(0.032)	(0.022)	(0.123)	(0.000)	(0.002)	(0.006)
With C	53.429	61.279	86.950	44.140	96.317	77.421	86.245	78.0125	100.635	95.288	54.756
	(0.018)	(0.002)	(0.000)	(0.014)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)
PP-Fisher Chi-square											
Without	201.934	228.206	230.687	190.294	200.859	212.871	225.637	235.784	208.769	215.710	100.266
C&T	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
With C&T	108.128	136.751	174.761	108.441	132.847	153.851	52.491	153.491	161.422	173.238	117.904
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.022)	(0.000)	(0.000)	(0.000)	(0.000)
With C	121.294	150.007	180.138	114.732	156.971	161.089	187.838	201.182	175.782	205.867	85.892
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Source: Constructed with E-views 12 by the authors											

Table 4.4: Panel unit root for private-sector banks

	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
LLC											
Without	-6.369	-7.302	-8.544	-5.281	-9.446	-8.714	-10.099	-10.729	-12.554	-9.037	-4.928
C&T	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
With C&T	0.579	-0.490	-4.607	3.315	-4.864	1.729	-7.831	-9.293	-22.381	-4.080	-2.398
	(0.019)	(0.011)	(0.000)	(0.995)	(0.000)	(0.958)	(0.000)	(0.000)	(0.000)	(0.000)	(0.008)
With C	0.873	0.100	-3.756	3.921	-4.164	0.408	-4.804	-7.066	-12.561	-4.257	-3.661
	(0.808)	(0.540)	(0.000)	(0.000)	(0.000)	(0.658)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ADF- Fisher Chi-square											
Without	67.182	75.325	96.316	56.459	104.544	95.140	113.130	105.948	134.240	97.232	54.751
C&T	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
With C&T	28.874	32.937	41.726	20.047	36.085	31.550	48.811	43.472	67.560	38.515	19.001
	(0.024)	(0.010)	(0.013)	(0.522)	(0.050)	(0.013)	(0.002)	(0.008)	(0.000)	(0.030)	(0.751)
With C	26.924	29.699	46.415	21.209	60.923	46.622	62.146	55.659	95.371	54.056	79.847
	(0.308)	(0.194)	(0.003)	(0.026)	(0.000)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PP-Fisher Chi-square											
Without	158.181	175.345	160.857	147.972	183.668	199.800	200.482	177.455	191.093	164.359	80.458
C&T	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
With C&T	107.957	128.170	145.106	85.186	113.463	149.634	125.157	116.136	134.111	120.982	75.144
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
With C	89.715	104.017	123.944	83.240	138.775	157.796	165.302	119.716	166.419	123.251	79.847
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Source: Constructed with E-views 12 by the authors											

4.5 Empirical results of fixed and cross-section random effect models

Regarding the second and third objectives, this part looks at the dynamic relationship between the financial performance of Indian public and private banks and I.C components. The utilization of pooled ordinary least squares regression in examining the impact of I.C on business performance is hindered by the presence of heterogeneity among different groups. An alternative and more suitable approach to address unobserved effects and potential heterogeneity is the utilization of fixed and random effects in panel modeling. Hsiao (2003) asserts that the panel data econometric method offers several advantages, including the ability to compensate for potential heterogeneity and to find effects that cannot be detected by cross-sectional or time-series analysis alone. The regression results are estimated using the panel least square approach including both fixed-effect (FE) and cross-section random effects (CSRE) and a generalized method of moments (GMM). The independent variables in this study are the various components of I.C (C.E, H.C, S.C, and R.C, while the control variables consist of leverage and size. The profitability measures (financial performance indicators) ROA, ROE, ROCE, and ROS are dependent variables.

Table 4.5.1: Panel least squares estimation result using the cross-section random and fixed effect ROA

Variables	Public sector Banks				Private sector banks			
	Fixed effect		Cross-section random effect		Fixed effect		Cross-section random effect	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
CEE	-0.447**	-2.405 (0.017)	-0.437**	-2.544 (0.011)	-0.137	-0.041 (0.966)	-0.085	-0.025 (0.979)
HCE	0.071*	3.422 (0.008)	0.068*	3.559 (0.005)	0.536**	2.072 (0.039)	0.537**	2.092 (0.037)
SCE	-2.914	-1.626 (0.106)	-2.960***	-1.767 (0.079)	-4.792	-0.485 (0.627)	-4.826	-0.491 (0.623)
RCE	-7.873*	-4.608 (0.000)	-7.618*	-4.797 (0.000)	0.123	0.317 (0.751)	0.126	0.326 (0.744)
LEV	-0.072*	-5.021 (0.000)	-0.073*	-5.414 (0.000)	0.022	0.105 (0.916)	0.014	0.068 (0.945)
SIZE	0.281**	3.399 (0.009)	0.111**	2.046 (0.042)	-1.819	-0.551 (0.582)	-1.552	-0.518 (0.604)
C	1.643	0.904 (0.367)	3.183	2.258 (0.025)	0.669	1.235 (0.218)	0.635	1.108 (0.269)
R-squared	0.802		0.745		0.113		0.039	
Adjusted R-squared	0.778		0.735		0.005		0.009	
Durbin–Watson stat	1.279		1.126		1.187		1.124	
F-statistic	32.974 (0.000)		72.812 (0.000)		1.048 (0.408)		1.33 (0.242)	

Note: *p≤0.01; **p≤0.05; ***p≤0.1

Source: Constructed with E-views 12 by the authors

Table 4.5.1 presents the findings of the panel least square approach, which includes ROA as a dependent variable. The data are presented individually for banks in the public and private sectors to assess and compare the influence of the I.C on the ROA. CEE, HCE, and RCE are the three significant variables in the fixed effect case of public sector banks. The variables CEE and RCE demonstrate a statistically significant negative influence on ROA, while HCE has a statistically significant positive influence on ROA. The variable SCE does not exert a statistically significant influence on the financial metric of ROA. Both the control variables also have a notable influence on the financial performance, namely the ROA. Leverage indicates a detrimental effect on ROA, while size demonstrates a strong positive impact on ROA. The adverse effects of leverage indicate that an increase in debt will decrease financial performance. On the other hand, the large scale of public sector banks encourages them to improve their performance. According to the FE model, in the context of public sector banks, HC incentivizes the banks to allocate more funds, resulting in an improvement in financial performance. CEE and RCE refuse to allocate more funding to improve the financial performance of public sector banks. The FE model for public sector banks has a substantial R-square and adjusted R-square (0.802 and 0.778), indicating that the exogenous variables and control variables effectively account for 80% of the variance in the model. The Durbin-Watson ratio quantifies the presence of autocorrelation or serial correlation and has a specific value of 1.279. The data indicates the presence of positive autocorrelation since the associated value is less than 2. However, the F-statistic is quite high and the related p-value is substantially less than 0.01. Essentially, we can conclude that the current model is an accurate model for predicting financial performance by considering several aspects of I.C and two control variables.

Additionally, Table 4.5 presents the outcomes of the CSRM model. All the components of the I.C in the current model are determined to be significant. The three factors, CEE, RCE, and SCE, have a statistically significant negative impact on ROA. The finding is in line with (Asare et al., 2017; Haris et al., 2019; Kwaku Mensah Mawutor et al., 2023) who found CEE has a negative and significantly impacting ROA. The significance of the SCE is observed at a 10% level, with a p-value less than 0.10. Once again, the two control variables have been determined to be statistically significant in the CSRE model. The leverage has a negative impact on the ROA, whereas the size has a positive impact on the ROA. The R-square and adjusted R-square values are 0.745 and 0.735, respectively. Given that the discrepancy between the two values is less than 0.05, it can be concluded that the current model adequately accounts for 74.5% of the variation in the dependent variable, as explained by various exogenous variables. Nevertheless,

the Durbin-Watson ratio indicates the existence of auto-correlation as it is below 2. However, the F-statistic ANNOVA value is significantly larger and the P-value is less than 0.01. The results indicate that the overall cross-section random effect model for public sector banks is a suitable model for predicting financial performance (ROA). The Hausman test yields a significantly higher result for public sector banks, with an accompanying p-value of less than 0.05 percent. A significant p-value suggests that the FE model is superior to the CSRE model in terms of financial performance when considering various components of I.C and control factors.

Table 4.5.1 also displays the outcomes of private-sector banks for the FE and CSRE models, in private-sector banks HCE significantly positively affects ROA. It is recommended that private sector banks allocate more resources to HCE to improve their financial performance. The remaining independent variables are insignificant as their T-statistics are relatively low and the p-values exceed 0.05. There is a Durbin-Watson ratio of less than two, and the related and adjusted R-squares are relatively low. The same outcomes are likewise reported by the cross-section random effect model. Once again, HCE is determined to have a significant and favorable impact on the financial performance of private-sector banks in India. The CSRE model exhibits low values for both R-square and modified R-square, while the Durbin-Watson ratio is below 2. The other statistical tests similarly do not support the concept.

When comparing the impact of I.C on the financial performance of public and private sector banks, it becomes evident that public sector banks have a greater number of components of I.C that influence their financial performance. The variables CEE, RCE, and SCE exert a negative and statistically significant influence on the financial performance of public sector banks, while HCE has a favorable and statistically significant impact on profitability measures (ROA) in both sector banks. The findings of this study are consistent with those of prior investigations (Al-Musali & Ismail, 2014; Duho & Onumah, 2019; Faruq et al., 2023; Ismail & Kareem, 2011; Joshi et al., 2013; Ozkan et al., 2017; Poh et al., 2018; Prasojo et al., 2022; Tiwari et al., 2023; Tran & Vo, 2018; Weqar & Haque, 2020; Xu et al., 2023). A key factor in the profitability of banks is the expansion of human resources through investments in human capital. This offers anecdotal evidence that banks' returns on assets, capital, and profit are increased when they invest in their employees. In the context of public sector banks, the values of R square and adjusted R square are significantly greater. However, in the case of private-sector banks, these values are considerably lower. This indicates that the independent variables used are unable to explain a significant amount of the variance observed in private-sector banks. Based on these findings, it is recommended that both private and public sector banks invest more in HCE to

enhance their financial performance. However, in the case of public sector banks, it is crucial to identify the factors within I.C that are negatively impacting and weakening their financial performance.

Table 4.5.2: Panel least squares estimation result using the cross-section random and fixed effect ROE

Variables	Public sector Banks				Private sector banks			
	Fixed effect		Cross-section random effect		Fixed effect		Cross-section random effect	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
CEE	-4.910	-1.103 (0.271)	-6.727***	-1.744 (0.083)	10.560**	2.051 (0.041)	10.259	2.027 (0.439)
HCE	0.992**	1.980 (0.049)	1.136*	2.612 (0.009)	2.621*	6.509 (0.000)	2.586*	6.502 (0.000)
RCE	-121.698*	-2.979 (0.003)	-132.090*	-3.661 (0.003)	-1.021***	-1.691 (0.092)	-1.050***	-1.752 (0.081)
SCE	-18.073	-0.421 (0.673)	-38.071	-1.002 (0.317)	-4.044	-0.263 (0.792)	-3.558	-0.233 (0.815)
LEV	-1.923*	-5.601 (0.000)	-1.775	-5.780* (0.000)	-0.799**	-2.393 (0.017)	-0.799**	-2.418 (0.016)
SIZE	5.160**	2.604 (0.012)	1.316	1.269 (0.206)	0.988	0.192 (0.847)	-0.371	-0.083 (0.933)
C	12.328	0.283 (0.776)	74.053	1.930 (0.055)	0.143	0.170 (0.865)	0.300	0.381 (0.703)
R-squared	0.746		0.698		0.569		0.565	
Adjusted R-squared	0.715		0.686		0.516		0.552	
Durbin–Watson stat	1.573		1.421		2.617		2.602	
F-statistic	23.912 (0.000)		57.438 (0.000)		10.810 (0.000)		42.537 (0.000)	

Note: *p≤0.01; **p≤0.05; ***p≤0.1

Source: Constructed with E-views 12 by the authors

Table 4.5.2 presents the findings of the panel least square estimation, which utilized CSRE and FE, for both public and private sector banks in India. The table utilizes ROE as the dependent variable while employing various components of I.C as the independent variables. When analyzing public sector banks using the FE approach, the most significant variables are HCE and RCE. RCE has been demonstrated to have a significant impact at a 1% level and exerts a negative influence on financial performance. However, it is important to note that HCE does have a statistically significant beneficial influence, with a significance threshold of 5%. Both the control variables, namely leverage and size, were shown to be statistically significant at the 1% and 5% levels, respectively. The R Square and adjusted R square values of the FE model are significantly higher (0.746 and 0.715). The statement implies that the combination of explanatory factors and control variables accounts for 74.6% of the model's explanation. A high F statistic or ANOVA score indicates that the fixed model is a strong predictor of financial performance as measured by ROE. The Durbin-Watson statistic is over 1.50, indicating the absence of significant autocorrelation issues. The outcomes of the Random effect model are similar to those of the FE model, with the only difference being that the CEE variable is significant in the current model, and the leverage of a control variable is determined to be significant. The CSRE accounts for approximately 70% of the variance, as indicated by the R square value of the model (0.698). The F statistics associated with the current model are significantly high, indicating that the random effect model is a suitable match for predicting the financial performance of public sector banks using ROE.

In the fixed effect model, the findings from Indian private sector banks indicate that the variables CEE and HCE are statistically significant at the 5% and 1% levels, respectively. Both elements have an impact on the financial success of the institutions. Nevertheless, CEE has a negative influence on performance, while HCE has a positive impact on it. RCE, which is a part of I.C, has been determined to have a substantial impact at a 10% level of significance. This variable has also a negative effect on performance. Utilize a control variable that has been determined to be statistically significant at a 5% significance level. The R square and adjusted R square values for the FE model are 0.569 and 0.516, respectively. The 56.9% indicates the proportion of variance that may be accounted for by the various explanatory variables. The FE model's associated F-statistic exceeds 10 and is statistically significant at a 1% level. This indicates that the model is a suitable fit for forecasting performance using ROE.

The CSRE analysis of private sector banks reveals that the variables CEE and HCE have an important and positive effect on financial performance, specifically on ROE, at a significance level of 5% and 1% respectively. The variable RCE is determined to be statistically significant

at a significance level of 10% with a p-value of less than 0.01. These variables also demonstrate a negative correlation with ROE. The control variable's leverage is likewise determined to be statistically significant and has a negative correlation with ROE. The R square and adjusted R square values of the random effect model are 0.565 and 0.552, respectively. These values indicate that the significant variables in the model effectively account for 56.5% of the variation. The F statistic, which is extremely significant, indicates that the random effect model for private sector banks is a well-fitting model. Using ROE as a dependent variable, the FE model is more appropriate than the other two models in the instance of a public sector bank; the related chi-square value is 13.805 and the p-value is 0.031, which is less than 0.05. On the other hand, private sector banks exhibit a low chi-square statistic and a high p-value. This indicates that we reject the null hypothesis that the FE model is appropriate and instead accept the alternative hypothesis that the CSRE model is more suitable for the data series of private sector banks.

This section of the analysis focuses on comparing the outcomes of banks in the public and private sectors. According to the CSRE model, the CEE efficiency negatively affects public sector banks. The findings align with earlier studies, indicating that capital utilization has an adverse effect on the organization's financial success (Kwaku Mensah Mawutor et al., 2023; Mohapatra et al., 2019; Ting et al., 2021; Xu et al., 2020), whereas it positively affects the ROE of private-sector banks (D. T. Nguyen et al., 2023; Setianto & Sukmana, 2016; Tiwari et al., 2023). The variable HCE has a similar positive influence on both sector banks. The findings are consistent with previous studies that highlight the importance of human capital as a crucial factor in enhancing organizational value (Kweh et al., 2022; Nawaz, 2019; Poh et al., 2018; Prasojo et al., 2022; Soewarno & Tjahjadi, 2020; Tiwari et al., 2023; Weqar & Haque, 2020). The RCE has a major negative impact on both sector banks (Bayraktaroglu et al., 2019; Martens, 2023b; Soewarno & Tjahjadi, 2020; Weqar & Haque, 2020). The role of SCE in both sector banks is minimal and has no impact on an organization's financial success. The results are similar to the previous findings (Asutay & Ubaidillah, 2023; Ismail & Karem, 2011; Nawaz, 2019; Ting et al., 2021). The analysis reveals that the control variable has a substantial and negative impact on performance in both private sector banks and public sector banks.

Table 4.5.3: Panel least squares estimation results using the cross-section random and fixed effect ROCE

Variables	Public sector Banks				Private sector banks			
	Fixed effect		Cross-section random effect		Fixed effect		Cross-section random effect	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
CEE	0.097	0.616 (0.538)	-0.043	-0.297 (0.766)	0.063	0.303 (0.761)	0.072	0.354 (0.723)
HCE	-0.008	-0.496 (0.620)	0.006	0.393 (0.694)	0.034**	2.110 (0.036)	0.034**	2.126 0.034
RCE	0.699	0.482 (0.630)	-0.551	-0.406 (0.685)	0.240*	9.782 (0.000)	0.241*	9.914 (0.000)
SCE	1.171	0.770 (0.442)	-0.129	-0.090 (0.928)	-4.484	-7.191* (0.000)	-4.513	-7.284* (0.000)
LEV	-0.035*	-2.943 (0.003)	-0.032*	-2.836 (0.005)	-0.038*	-2.814 (0.005)	-0.040*	-3.021 (0.002)
SIZE	-0.060	-0.865 (0.388)	0.024	0.513 (0.608)	-0.403**	-1.936 (0.054)	-0.355**	-1.956 (0.051)
C	2.110	1.369 (0.173)	2.067	1.431 (0.154)	0.078	2.291 (0.023)	0.072	2.260 (0.024)
R-squared	0.431		0.078		0.589		0.571	
Adjusted R-squared	0.361		0.041		0.539		0.558	
Durbin–Watson stat	1.178		1.020		0.805		2.225	
F-statistic	6.163 (0.000)		2.117 (0.005)		11.738 (0.000)		43.563 (0.000)	

Note: *p≤0.01; **p≤0.05; ***p≤0.1

Source: Constructed with E-views 12 by the authors

In Table 4.5.3, the dependent variable used is ROCE. Upon examining the public sector banks in the FE model, none of the I.C components have been considered significant due to the variables' associated p-value being larger than 0.05 and the T-statistic being less than 1.96. The only factor that has a negative and significant impact on ROCE is the leverage of a control variable. Similarly, in the context of the CSRE model for public sector banks, it is seen that leverage has an adverse impact on the ROCE. However, the remaining elements of I.C do not exert a noteworthy positive or negative influence on the ROCE. The FE model demonstrates a higher level of explained variation, as indicated by the R square and modified R square values. Conversely, the CSRE model exhibits a relatively low level of explained variance. The F statistics or ANOVA value is determined to be statistically significant in both models. For private-sector banks, all the components of I.C, except CEE, are determined to be significant. Both HCE and RCE have a notable positive influence on ROCE. The SCE indicates a considerable negative and significant influence. Both the control variable leverage and size exhibit a statistically significant negative influence on ROCE. The FE model exhibits a somewhat larger explained variance compared to the CSRE model, as indicated by the corresponding R-squared value. The F-statistic value is statistically significant in both models. For public sector banks, the HT showed a significant Chi-square value of 16.873, indicating that the FE model is more suitable than the CSRE model. This significance is observed at a 1% level. In contrast, for private sector banks, the chi-square value of HT at 6 degrees of freedom is 2.800, with a p-value of 0.833. Accepting the null hypothesis indicates that the CSRE model is more appropriate for private-sector banks. When comparing the panel least square estimation findings of both sector banks, it is evident that none of the elements of I.C are significant in the case of public sector banks. Contrarily, HCE holds greater significance than CEE and SCE in determining the bank's performance due to its notable and favorable impact on private-sector banks (Faruq et al., 2023; Weqar & Haque, 2020). RCE also has a beneficial influence on the overall success of the organization. The study is consistent with the earlier investigations (Faruq et al., 2023; Rehman et al., 2022). Emphasis should be placed on the reasons why SCE has a detrimental effect on the bank's financial performance, as seen by the negative and considerable impact it has on profitability (Chowdhury et al., 2018; Kweh et al., 2022; Mondal & Ghosh, 2012; Weqar & Haque, 2020). Based on the data, we may conclude that private-sector banks make better use of the I.C elements more effectively and efficiently than public-sector banks.

Table 4.5.4: Panel least squares estimation results using the cross-section random and fixed effect ROS

Variables	Public sector Banks				Private sector banks			
	Fixed effect		Cross-section random effect		Fixed effect		Cross-section random effect	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
CEE	-2.395	-0.742 (0.459)	-2.552	-0.795 (0.427)	7.198	1.464 (0.144)	6.807	1.409 (0.160)
HCE	0.617***	1.722 (0.087)	0.633***	1.778 (0.077)	3.153*	8.201 (0.000)	3.125*	8.226 (0.000)
RCE	-76.307*	-2.640 (0.009)	-77.524*	-2.696 (0.007)	-2.233*	-3.872 (0.000)	-2.287*	-3.996 (0.000)
SCE	0.803	0.026 (0.979)	-0.674	-0.022 (0.982)	22.149	1.511 (0.132)	23.188	1.592 (0.112)
LEV	-0.832**	-2.977 (0.035)	-0.834	-3.026 (0.243)	-0.115	0.319 (0.717)	-0.145	-0.462 (0.644)
SIZE	2.049	1.154 (0.250)	2.073	1.172 (0.243)	1.664	0.339 (0.734)	-0.948	-0.222 (0.299)
C	-0.006	-0.011 (0.990)	-0.012	-0.022 (0.982)	0.477	0.594 (0.553)	0.781	1.040 (0.299)
R-squared	0.705		0.700		0.651		0.645	
Adjusted R-squared	0.665		0.687		0.609		0.634	
Durbin–Watson stat	2.524		2.487		2.188		2.162	
F-statistic	17.732 (0.000)		53.444 (0.000)		15.326 (0.000)		59.470 (0.000)	

Note: *p≤0.01; **p≤0.05; ***p≤0.1
Source: Constructed with E-views 12 by the authors

Table 4.5.4 presents panel least square estimation outcomes employing FE and CSRE models, with ROS as the dependent variable. When public sector banks use the FE model, the RCE is found to be a significant variable at a 1% level. Furthermore, it is negatively associated with ROS. The HCE demonstrates a statistically significant positive impact at a significance level of 10%. Both of the other two constituents of I.C do not exhibit any significant positive or negative effects on ROS. Utilizing a control variable demonstrates a notable adverse impact on ROS. The outcomes of the cross-section random effect model for public sector banks closely resemble those of the fixed effect model. The HCE variable has a strong beneficial impact, while the RCE variable negatively correlates with ROS. It has been determined to be statistically significant at a significance level of 1%. The R-squared values for both the FE model and the CSRE models are relatively high, with values of 0.705 and 0.700, respectively. Both models account for 70% of the variation in the dependent variable, which is the ROS. The F-statistic for the FE model is 17.732, whereas for the CSRE model, it is 53.444. These values hold great significance for both concepts.

In contrast, private sector banks demonstrate a noteworthy level of HCE in both FE and CSRE models, with statistical significance at the 1% level. This increased efficiency has a beneficial impact on the ROS. RCE is statistically significant at a 1% level, indicating a strong negative correlation with ROS. None of the other independent and control variables were found to have a significant impact on either of the models. The R-squared values for the models of private sector banks are 0.651 and 0.645, respectively. The FE model accounts for 65% of the variance in ROS, while the CSRE model accounts for 64.5% of the variance in ROS. The Durbin-Watson ratio falls within the acceptable range, indicating the absence of autocorrelation issues. The ANOVA values for the association are statistically significant at a 1% level, indicating that both models are a strong fit for predicting ROS. In public sector banks, the chi-square value associated with HT is quite low, specifically 1.033, with a p-value of 0.984. This indicates that we accept the null hypothesis, suggesting that the CSRE model is better appropriate for public sector banks. Similarly, for private sector banks, it is recommended to use the CSRE model due to the low chi-square value and the p-value being much larger than 0.05.

When comparing the outcomes of public and private sector banks, we observe that the identical factor of I.C has a similar impact on ROS. This suggests that HCE has a beneficial impact on the profitability of both sector banks (Gigante, 2013; Poh et al., 2018; Prasajo et al., 2022; Tiwari et al., 2023; Tran & Vo, 2018; Weqar & Haque, 2020). The only distinction is that the HCE is statistically significant at the 10% level for public sector banks, but for private sector

banks, it is significant at the 1% level. RCE plays a large role in both the banking sector and has a negative impact on financial performance measures profitability (Bayraktaroglu et al., 2019; Soewarno & Tjahjadi, 2020; Weqar & Haque, 2020).

Table 4.5.5: Panel least squares estimation result using the cross-section random and fixed effect ROA (MVAIC)

Variables	Public sector Banks				Private sector banks			
	Fixed effect		Cross-section random effect		Fixed effect		Cross-section random effect	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
MVAIC	0.008	0.209 (0.834)	0.001	0.270 (0.787)	-0.060	-0.792 (0.429)	-0.057	-0.752 (0.452)
LEV	-0.080*	2.968 (0.003)	-0.079*	-3.161 (0.001)	0.076	0.367 (0.713)	0.068	0.330 (0.741)
SIZE	-0.291**	-1.911 (0.057)	0.043	0.506 (0.613)	-0.011	-0.003 (0.997)	0.389	0.140 (0.888)
C	5.125	2.472 (0.014)	0.784	0.647 (0.518)	0.367	0.693 (0.488)	0.317	0.618 (0.536)
R-squared	0.237		0.233		0.079		0.003	
Adjusted R-squared	0.154		0.217		-0.016		-0.011	
Durbin–Watson stat	2.769		2.755		1.197		1.116	
F-statistic	2.872 (0.000)		14.232 (0.000)		0.828 (0.671)		0.226 (0.877)	
Note: *p≤0.01; **p≤0.05; ***p≤0.1								
Source: Constructed with E-views 12 by the authors								

Table 4.5.5 presents the panel least square estimation of CSRE and FE employing ROA as the outcome variable. Firstly, in the context of public sector banks, the combined intellectual capital (MVAIC) does not have a significant impact on either of the methods. Nevertheless, the influence of a control variable is notably significant on the ROA when considering FE and CSRE models. Size is an additional control variable that has a notable influence on the FE model for public sector banks. For public sector banks, the R-square and adjusted R-square values are 0.237, 0.233, 0.154, and 0.217, respectively. This indicates that in the cases of the CSRE and the FE model, the independent and control variables account for between 23 and 24 percent of the variance in the dependent variable. The FE and CSRE models have F-statistic or ANOVA values of 2.872 and 14.232, respectively. Both of these numbers are statistically significant at the 1% level. The current models demonstrate a strong overall suitability for estimating the influence of I.C on ROA.

In addition, this table also illustrates the combined impact of I.C on ROA for private sector banks. For both FE and CSRE models, none of the factors exhibited a statistically significant influence on the dependent variable. Neither of the control variables has significant effects on ROA. The values of the associated and adjusted R-squares are extremely low, and the corresponding F-statistic or ANOVA values are not statistically significant. Both models are not suitable for accurately predicting ROA using the combined I.C and two control variables. The findings of HT show that for public sector banks, the chi-square value is 7.571 and the p-value is statistically significant at a 10% level of significance. In the context of public sector banks, the FE model is more appropriate. However, in the case of private sector banks, we may state that the CSRE model is appropriate based on the chi-square statistic and related p-value, even if none of the models fit the data very well.

Table 4.5.6: Panel least squares estimation result using the cross-section random and fixed effect ROE (MVAIC)

Panel least squares estimation using the cross-section random and fixed effect ROE								
Variables	Public sector Banks				Private sector banks			
	Fixed effect		Cross-section random effect		Fixed effect		Cross-section random effect	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
MVAIC	-0.028	-0.560 (0.576)	-0.028	-0.549 (0.583)	-1.156*	-7.663 (0.000)	-1.155*	-7.701 (0.000)
LEV	-5.643*	-10.151 (0.007)	-5.523*	-10.040 (0.001)	-0.230	-0.556 (0.578)	-0.229	0.559 (0.576)
SIZE	8.089**	2.187 (0.030)	8.512**	2.312 (0.022)	8.826	1.406 (0.180)	8.226	1.522 (0.129)
C	-3.359	-2.705 (0.007)	-3.587	-2.705 (0.007)	-1.411	-1.345 (0.180)	-1.337	-1.371 (0.171)
R-squared	0.447		0.437		0.274		0.270	
Adjusted R-squared	0.387		0.424		0.199		0.259	
Durbin–Watson stat	2.731		2.689		2.310		2.299	
F-statistic	7.467 (0.001)		36.223 (0.003)		3.649 (0.000)		24.625 (0.000)	
Note: *p≤0.01; **p≤0.05; ***p≤0.1								
Source: Constructed with E-views 12 by the authors								

Table 4.5.6 displays the outcomes of the public and private sector banks' FE and CSRE models. The primary objective of this table is to examine the effect of combined I.C. as assessed by MVAIC on ROE, a financial performance metric. The combined impact of I.C. is not determined to be significant in any model for public sector banks because the corresponding p-value is significantly more than 0.05. On the other hand, both the FE and CSRE models for public sector banks show that the control variable's leverage is significant at the 1% level as the p-value of less than 0.01. Size is an additional control variable that FE and CSRE models also find to be significant at the 5% level. In terms of associated R-square values, the FE model has 0.447, while the CSRE model has 0.437. This indicates that the CSRE model explains 43.7 percent of the dependent variable's variance, whereas the FE model can explain 44.7 percent. For PSU banks, the ANOVA and F-statistics from both models are statistically significant. Looking at private sector banks, we can see that combined I.C. has a considerable impact on ROE, the performance indicator. Nonetheless, ROE is significantly and negatively affected by I.C. This suggests that the various components of I.C. are having an effect on or reducing the ROE for private sector banks. Regarding private sector banks' FE and CSRE, the control variables' size and leverage do not appear to have a notable effect on ROE. Private sector banks have an associated R-square value of 0.274 and an adjusted R-square value of 0.199. It indicates that the independent variable accounts for 27.4% of the variance and the control variable for 27.4% of the variance in this model. The corresponding and modified R-squared values for the CSRE model are 0.270 and 0.259, respectively. Both the control variables and the independent variable (MVAIC) account for 27% of the variance in private sector banks, according to the R-squared value. Once again, at the 1% level of significance, the ANOVA value is determined for the private sector banks that use both the FE and CSRE models. We accept the alternative premise that FE is a better fit for public sector banks based on HT. The CSRE model is better suited to private sector banks because we cannot reject the null hypothesis in this case

Table 4.5.7: Panel least squares estimation result using the cross-section random and fixed effect ROCE (MVAIC)

Variables	Public sector Banks				Private sector banks			
	Fixed effect		Cross-section random effect		Fixed effect		Cross-section random effect	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
MVAIC	0.005	0.255 (0.798)	0.014	0.083 (0.933)	0.064*	11.973 (0.000)	0.064*	12.125 (0.000)
LEV	-0.033*	-2.835 (0.005)	-0.032*	-2.850 (0.005)	-0.042*	-2.904 (0.004)	-0.045*	-3.087 (0.002)
SIZE	-0.106	-1.607 (0.110)	-0.007	-0.015 (0.873)	-0.210	-0.941 (0.347)	-0.136	-0.705 (0.481)
C	3.520	3.911 (0.000)	2.242	3.228 (0.001)	0.053	1.417 (0.158)	0.043	1.282 (0.201)
R-squared	0.414		0.049		0.466		0.445	
Adjusted R-squared	0.356		0.030		0.411		0.437	
Durbin–Watson stat	1.180		1.043		2.312		2.239	
F-statistic	7.131 (0.000)		2.619 (0.005)		8.424 (0.000)		53.318 (0.000)	

Note: *p≤0.01; **p≤0.05; ***p≤0.1

Source: Constructed with E-views 12 by the authors

In Table 4.5.7 the ROCE is the dependent variable in this table, with combined I.C. (MVAIC) serving as the independent and explanatory variable. We can also anticipate their effects on ROCE by looking at the control variable. The combined I.C. explanatory variable does not appear to have any noticeable effect on ROCE in either the FE or CSRE models that are relevant to public sector banks, since the corresponding p-value is significantly greater than 0.05. At the 1% level, ROCE is significantly affected by only one control variable that accounts for leverage. The FE model has an R-squared value of 0.414 and an adjusted R-squared value of 0.356. This indicates that 41.4% of the dependent variable can be adequately explained by the independent variable along with two control variables. With an ANOVA score over 7 and a p-value under 0.01 (indicating significance at the 1% level), the FE model provides a good fit. However, the CSRE model has very low R-squared and adjusted R-squared values. Overall, CSRE for public sector banks is a well-fitting model, as the independent and control variables can only explain 4.9% of the variance. The F-statistic is significant at the 1% level, further supporting this conclusion.

The application of panel least squares regression, specifically employing FE and CSRE, to analyze the relationship between ROCE and private sector banks is extremely interesting. The combined impact of I.C (MVAIC) has a statistically significant positive effect on the ROCE at a 1% level of significance ($p\text{-value} < 0.01$). The control variable's leverage exhibits a statistically significant negative influence in both models, with a significance level of 1%. The R-squared values for the FE model and the CSRE model are 0.466 and 0.445, respectively. The modified R-square for the FE model is 0.411, while for the CSRE model, it is 0.437. In the FE model, the combination of the independent variable and two control variables accounts for 46.6% of the variation. Similarly, in the case of the CSRE model, the independent variable and two control variables explain 44.5% of the variation in the model. The Durbin-Watson ratio is employed to assess the presence of autocorrelation. However, in the current model, the values of this ratio in both models are close to 2. Autocorrelation is not a concern in this case. Similar to previous models, the F-statistics are determined to be statistically significant in both models. We reject the null hypothesis, which states that the FE model is better appropriate for the current public sector bank model, as the related chi-square value is more than 9 and the p-value is less than 0.05, states HT. Conversely, for public sector banks, the chi-square value is relatively low and the p-value is much more than 0.05. This indicates that we can accept the null hypothesis, which suggests that the CSRE model is more appropriate for private-sector banks.

Table 4.5.8: Panel least squares estimation result using the cross-section random and fixed effect ROS (MVAIC)

Variables	Public sector Banks				Private sector banks			
	Fixed effect		Cross-section random effect		Fixed effect		Cross-section random effect	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
MVAIC	-0.014	-0.373 (0.709)	-0.013	-0.367 (0.713)	-1.346*	-8.652 (0.000)	-1.349*	-8.724 (0.000)
LEV	-2.470*	-6.081 (0.000)	-2.430*	-6.047 (0.000)	0.477	1.118 (0.265)	0.448	1.062 (0.289)
SIZE	5.049**	1.869 (0.063)	5.215**	-1.890 (0.060)	10.292	1.591 (0.113)	8.205	1.472 (0.142)
C	-1.713	-1.888 (0.061)	-1.715	-1.890 (0.060)	-1.201	-1.110 (0.268)	-0.952	-0.9470 (0.344)
R-squared	0.232		0.226		0.316		0.307	
Adjusted R-squared	0.149		0.209		0.245		0.297	
Durbin–Watson stat	2.508		2.488		1.920		1.900	
F-statistic	2.795 (0.001)		13.656 (0.000)		4.467 (0.000)		29.521 (0.000)	

Note: *p≤0.01; **p≤0.05; ***p≤0.1

Source: Constructed with E-views 12 by the authors

The results of panel least square estimation using CSRE and FE models are presented in Table 4.5.8. This table aims to analyze the impact of the combined I.C and two control variables on the ROS for both public and private sector banks. In the context of public sector banks, the overall impact of I.C as evaluated by MVAIC does not show a significant impact on ROS when using FE and CSRE models. Nevertheless, the two control variables, leverage, and size, demonstrate significant effects on the ROS. The presence of leverage has a notable detrimental influence on ROS, whereas the size of the models has a largely favorable impact on ROS. The FE model has an associated R square of 0.232 and an adjusted R square of 0.149. In the CSRE model, the values for these variables are 0.226 and 0.209, respectively. The R-squared values indicate that the FE model and CSRE explain 23.2% and 22.6% of the variation in the dependent variable, respectively. Both models have a Durbin-Watson ratio close to 2, indicating the absence of significant autocorrelation issues. Both models have F-statistics that are significant at a 1 percent level, indicating that both models are good fits. The HT value suggests that the CSRE is more appropriate for public sector banks, as the p-value exceeds 0.05.

However, in private-sector banks, the combined effect of I.C, as evaluated by MVAIC, is determined to be significant in both models. Nevertheless, the collective influence of I.C signifies the negative impacts on ROS. In both models, the two control variables do not have a significant impact on ROS, as indicated by the p-value being greater than 0.05. In the context of private sector banks, the R square values are relatively high in both the FE model (0.316) and the CSRE model (0.307) as compared to public sector banks. The adjusted R square values are 0.245 and 0.297. The R square value associated with both models suggests that over 30% of the variance in the dependent variables can be explained by the explanatory variables. Both models of private sector banks have a DW ratio close to 2, indicating the absence of autocorrelation issues in both models. The ANOVA value or F-statistic values are significant for both models. However, in the case of the CSRE model, this value is relatively high. This indicates that both models are suitable for analyzing the impact of combined MVAIC on the dependent variable ROS. According to the statistics of HT, the CSRE model is shown to be better appropriate for analyzing private sector banks when utilizing ROS as the dependent variable.

4.6 Hausman Test

The Hausman test is a statistical method used to determine the optimal model. It indicates the model to use: a cross-section random effects model (CSRE) or a fixed-effects (FE) model. It is

crucial to select an appropriate model to obtain consistent and reliable outcomes. When the null hypothesis is accepted or the null hypothesis is not rejected, it suggests that the cross-section random effect model is the most appropriate for the current data series (Sheytanova, 2015).

Table 4.5.9: Hausman test results for fixed effect and cross-section random effect models

Test Summary	Variables	Public sector banks			Private sector banks		
		Chi-Sq. Statistic	Chi-Sq. d. f	Probability	Chi-Sq. Statistic	Chi-Sq. d. f	Probability
	ROA	14.033	6	0.029	0.134	6	1.000
	ROE	13.805	6	0.031	1.011	6	0.985
	ROCE	16.873	6	0.009	2.800	6	0.833
	ROS	1.033	6	0.984	2.705	6	0.844
	ROA (MVAIC)	7.571	3	0.055	0.308	3	0.958
	ROE (MVAIC)	8.349	3	0.039	0.471	3	0.925
	ROCE (MVAIC)	9.014	3	0.029	1.432	3	0.697
	ROS (MVAIC)	0.496	3	0.919	1.426	3	0.699

Source: Developed by the authors with E-views 12

4.7 Generalized method of moments (GMM) estimation

This section analyzes the dynamic correlation between I.C and the financial performance of Indian public and private sector banks, focusing on the second and third objectives. The regression findings are estimated using a dynamic panel model estimation technique known as System GMM, originally introduced by Arellano and Bover (1995) and further modified by Blundell and Bond (1998). To tackle the problems of endogeneity, unobserved heteroskedasticity, and autocorrelation in the panel data model, we utilized the Generalized Method of Moments (GMM) technique. The following table shows the result of GMM.

Table 4.7.1: Results of generalized method of moment estimation (GMM)

Variables	Public Sector Banks								Private Sector Banks							
	ROA		ROE		ROCE		ROS		ROA		ROE		ROCE		ROS	
	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.
LAG	-0.29*	-8.91	-0.31*	-14.67	-0.28*	-23.53	-0.30*	-1.41	-0.00	-0.00	0.26*	1.81	0.21*	0.47	0.33*	1.85
(Δ)		(0.00)		(0.00)		(0.00)		(0.00)		(0.99)		(0.00)		(0.00)		(0.00)
CEE	-1.05*	-2.966	-27.45*	-5.29	-0.10**	-2.50	-10.74*	-1.31	1.74**	2.10	0.00	0.00	-0.30	-0.63	11.95*	5.54
		(0.00)		(0.00)		(0.02)		(0.00)		(0.05)		(0.99)		(0.53)		(0.00)
HCE	0.11*	2.97	3.06*	5.11	0.01**	2.31	1.71	1.63	-0.26	-1.28	3.67*	5.00	0.03	0.28	3.48*	4.40
		(0.00)		(0.00)		(0.03)		(0.00)		(0.21)		(0.00)		(0.78)		(0.00)
RCE	-0.00	-1.03	-0.05	-0.62	0.00*	3.36	-162.94**	-2.10	0.90	0.71	-6.70	-0.74	0.30	0.57	-6.99**	-2.81
		(0.30)		(0.53)		(0.00)		(0.05)		(0.48)		(0.46)		(0.57)		(0.01)
SCE	-0.03*	-3.85	-0.68***	-1.97	-0.00*	-5.43	-82.70	-1.04	-37.49***	-1.75	131.47	0.85	-0.87	-0.07	87.71	1.10
		(0.00)		(0.06)		(0.00)		(0.31)		(0.09)		(0.40)		(0.94)		(0.28)
LEV	-0.43*	-10.51	-14.23*	-13.25	-0.03*	-3.22	-0.04	-0.03	-0.07	-1.04	-2.38*	-5.65	-0.07	-1.42	-1.73*	-5.29
		(0.00)		(0.00)		(0.00)		(0.97)		(0.31)		(0.00)		(0.17)		(0.00)
SIZE	-0.42	-1.03	2.38	0.63	0.00	1.61	-2.62	-0.10	0.13	0.11	-4.34***	-2.01	-0.105	-0.79	2.82	1.66
		(0.30)		(0.52)		(0.12)		(0.91)		(0.91)		(0.06)		(0.43)		(0.11)
Sargan test	15.54		19.51		17.56		3.27		4.14		7.83		12.25		9.51	
	(0.48)		(0.24)		(0.35)		(0.40)		(0.94)		(0.64)		(0.26)		(0.48)	
Correlation 1	0.00		0.18		NA		0.80		0.94		NA		0.86		0.75	
Correlation 1	0.22		NA		0.99		0.85		NA		NA		0.87		0.77	

Source: Constructed with E-views 12 by the authors

Note: *p≤0.01; **p≤0.05; ***p≤0.1

Table 4.7.1 analyzes the influence of various elements of I.C and two control variables on the financial performance of both public and private sector banks using the GMM estimation model. The present table illustrates the influence of several components of I.C on four financial indicators, specifically ROA, ROE, ROCE, and ROS. Regarding public sector banks, the lag variable of the endogenous variable exhibits a significant impact. The presence of the I.C element CEE is associated with a consistently negative and significant impact across all four models of financial performance metrics. The HCE demonstrates a statistically significant positive impact on all four endogenous variables, as indicated by the p-values being either less than 0.01 or 0.05. This indicates HCE is the most advantageous aspect of I.C and plays a crucial role in creating value for banks (Gigante, 2013; Mohapatra et al., 2019; Nawaz, 2019; Poh et al., 2018; Setianto & Sukmana, 2016; Soewarno & Tjahjadi, 2020; D. B. Tran & Vo, 2018; Weqar & Haque, 2020). The subsequent factor, RCE, demonstrates a solely positive and significant influence on ROCE (Barak & Sharma, 2023) while exhibiting a negative and large impact on ROS. The last component of the I.C, as stated in the SCE reports, demonstrates a noteworthy adverse effect on the ROA and ROCE at a significance level of 1 percent. However, in the case of ROE, its significance is observed at a 10 percent level. The impact of a control variable is found to be statistically significant in all the exogenous variables except for ROS. The leverage exerts a substantial adverse influence on all the dependent variables. The size is a control variable that does not have a significant positive or negative impact in any of the four models of public sector banks.

The p-value of the Sargan test should be greater than or equal to 0.05. A higher p-value indicates better results for the Sargan test. However, Roodman (2009) suggests that its value should exceed 0.25. The Sargan test is a statistical test used to assess the validity of overidentifying restrictions. The joint null hypothesis posits that the instrument is both a valid instrument and uncorrelated with the error term. In our scenario, the J-statistic or Sargan test p-value is significantly more than 0.05, indicating that all exogenous variables are valid instruments and satisfy the requirement of overidentified restrictions. The serial correlation, as determined by the Arellano and Bond (1991) approach, exhibits a positive value for all four models. In the case of the first model (ROA), the correlation of the first order is not statistically significant, as the p-value is less than 0.05. However, the second-order correlation rejects the null hypothesis and displays positive values in both models. The serial correlation tests conducted by Arellano and Bond (1991) should demonstrate that both the first-order and second-order statistics are statistically significant. In our study, the first-order serial correlation is statistically significant for the first model at a 5% level, while the second-order serial

correlation is not statistically significant. However, in model two, neither the first-order nor the second-order serial correlation is statistically significant. Similarly, in the case of the third model, the first-order correlation is not available (NA), and the second-order correlation is also not statistically significant. In the last model, both the first and second-order correlations are not deemed significant.

In private sector banks, the lag variable of the endogenous variable in the case of ROE, ROCE, and ROS is showing a considerably significant impact. The CEE is demonstrating a noteworthy positive influence on the ROA (Gigante, 2013; Ozkan et al., 2017; Poh et al., 2018) and the ROS. The findings align with the previous studies (Gigante, 2013; Ozkan et al., 2017; Tiwari et al., 2023; D. B. Tran & Vo, 2018). The HCE is also demonstrating a noteworthy positive influence on the ROE and the ROS. The RCE is demonstrating a solely positive and statistically significant influence on ROS. The SCE is determined to be insignificant to the financial performance of the banks (Asutay & Ubaidillah, 2023; Ismail & Kareem, 2011; Setianto & Sukmana, 2016; Ting et al., 2021). The control variable exhibits a statistically significant negative influence on both ROE and ROS. However, the variable of size does not have a significant effect on the dependent variables. The Sargan test conducted on private sector banks demonstrates that for all four dependent variables, we cannot reject the null hypothesis. This implies that the various exogenous variables serve as valid instruments and are not connected with the error terms. Firstly, in the case of ROA, correlation 1 (Arellano and Bond) is not deemed to be statistically significant. Correlation 2 does not apply applicable to ROA. Correlations 1 and 2 are not accessible in the context of ROE. For the third model (ROCE), the p-values indicate that correlations 1 and 2 are not statistically significant. In the case of the last variable (ROS), correlations 1 and 2 are not deemed statistically significant.

Table 4.7.2: Results of generalized method of moment estimation results (MVAIC)

Variables	Public Sector Banks								Private sector banks							
	ROA		ROE		ROCE		ROS		ROA		ROE		ROCE		ROS	
	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.	Coff.	T-stat.
LAG (Δ)	-0.32*	-12.91 (0.00)	-0.35*	-21.95 (0.00)	-0.30*	-22.32 (0.00)	-0.17	-2.42 (0.03)	0.84	25.67 (0.00)	0.43	4.35 (0.00)	0.30	4.45 (0.00)	0.03	2.53 (0.02)
MVAIC	0.00**	2.37 (0.02)	0.07*	3.55 (0.00)	0.00	0.36 (0.71)	0.00	0.20 (0.84)	-0.06	-1.94 (0.06)	0.37	-0.37 (0.02)	0.07	1.60 (0.00)	-1.26	-15.61 (0.00)
LEV	-0.50*	-10.95 (0.00)	-14.28*	-24.44 (0.00)	-0.04*	-6.52 (0.00)	-2.49	-5.05 (0.00)	0.06	5.46 (0.00)	-1.78	-8.01 (0.00)	-0.13	-19.71 (0.00)	0.70	8.35 (0.00)
SIZE	0.19	0.73 (0.47)	4.68	1.34 (0.19)	0.01	0.82 (0.41)	7.54	1.59 (0.13)	1.21	8.18 (0.00)	-6.83	-2.08 (0.05)	-0.22	-2.22 (0.82)	5.91	2.23 (0.04)
Sargan test	19.24 (0.44)		21.96 (0.28)		7.27 (0.43)		8.36 (0.39)		15.50 (0.27)		9.62 (0.40)		12.14 (0.51)		14.15 (0.36)	
Correlation 1	0.00		NA		0.95		NA		0.04		0.14		NA		0.04	
Correlation 2	0.44		0.45		0.96		0.64		0.65		NA		0.02		0.38	

Source: Constructed with E-views 12 by the authors

Note: *p≤0.01; **p≤0.05; ***p≤0.1

Table 4.7.2 presents the outcomes of the GMM model applied to both public and private sector banks. The combined effect of intellectual capital (MVAIC) and the lag of its own dependent variable serve as the explanatory variables. For all four financial metrics employed as dependent variables, significant lags were identified at a 1 percent level, except for ROS. The variable's lag in the instance of ROS is determined to be statistically significant at a 5 percent level. The aggregated I.C evaluated via MVAIC is determined to be significant in the context of ROA and ROE. Although it does not indicate any significant impact on ROCE and ROS. The control variable exhibits a statistically significant negative influence on all four variables. While size does not have a substantial effect on the dependent variables. For public sector banks, the J statistics or Sargan test indicate that we cannot exclude the null hypothesis. This implies that all the exogenous variables are valid instruments and are not connected with error terms for all four dependent variables. The correlation between Arellano and Bond in the case of ROA is determined to be statistically significant with a p-value less than 0.05. However, the second correlation is not found to be statistically significant with a p-value more than 0.05. There is no available correlation for ROE and ROS, whereas for ROCE, it is not considered significant. Correlation 2 is determined to be statistically insignificant for the remaining three dependent variables.

The GMM results of private sector banks indicate that the lag of the own endogenous variable is significant for all four dependent variables. Furthermore, the overall effect of I.C (MVAIC) is observed to be statistically significant for all four dependent variables. The combined I.C demonstrates a noteworthy negative influence on ROA, ROE, and ROS, while it exhibits a considerable positive effect on ROCE. The use of a control variable reveals both the positive and negative significant effects on the dependent variable. The variable has a notable positive effect on ROA and ROS, whereas it has a notable negative effect on ROE and ROCE. The size is a control variable that has a positive and large impact on ROA and ROS, but a negative and significant impact on ROE. The p-value of the Sargan test for private-sector banks across all four dependent variables is not statistically significant, indicating that all the explanatory and control variables are valid instruments. For private sector banks, the Arellano and Bond correlation 1 is determined to be statistically significant concerning the ROA and ROS. However, the significance of ROE is insignificant, and the availability of ROCE is non-existent. Correlation 2 is determined to be statistically insignificant concerning the variables ROA and ROS. While the availability of ROE is uncertain, ROCE is statistically significant at a 5 percent level.

4.8 Chapter Summary

Data analysis was conducted in this chapter. The analyses were conducted in accordance with the specified study goals. Chapter One of this paper outlines the research objectives, one of which is to analyze the intellectual capital efficiency of Indian public and private-sector banks and their influence on their financial performance. The Modified Value Added Intellectual Coefficient model was utilized to quantify the value of intellectual capital in the selected banks in India. The application of descriptive statistics analysis aimed to determine the specific element of intellectual capital that contributes the most to the efficiency of value creation. The first objective of the study involved utilizing a correlation matrix to analyze the relationship between human capital, relational capital, structural capital, and capital used in the Indian banking sector. Regarding the second and third aims, the fixed effect and cross-section random effect model and dynamic. The application of System GMM was used to examine the impact of intellectual capital on the financial performance of banks. Before presenting the analysis of the relationship between I.C and both sector bank performance, various essential tests including normality tests, descriptive statistics, correlation analysis, and other diagnostic tests were conducted to ensure accurate regression results.

CHAPTER –5

DISCUSSION AND IMPACT OF INTELLECTUAL CAPITAL

5.1 Introduction

Theories like the knowledge-based theory (KB theory) and the resource-based theory (RB theory) contend that intangible assets, or I.C, are essential to an organization's growth and competitive advantage in a knowledge-based era. Academics and researchers have shown the importance of I.C to companies in the current era of knowledge. This has been proved by Firer and Williams (2003), Trans and Vo (2018), Oppong et al. (2019), Oppong and Pattanayak (2019), Joshi et al. (2013), etc. This study analyzed the impact of the I.C on the financial performance (F.P) of Indian public and private sector banks. The study examined I.C performance using the MVAIC measuring approach, which is known for its distinctiveness and uniqueness. Our study aimed to employ an appropriate econometric method for analyzing longitudinal data, specifically focusing on the period from 2010-2022 that includes the consequences of demonetization and COVID-19. We conducted panel data analysis using the fixed and cross-section random effect models and generalized method of moments (GMM) to investigate the influence of I.C on financial performance. The study analyzed a panel data set consisting of 29 Banks and observed a varied association between intellectual capital performance and bank profitability. The findings will be further elaborated in the subsequent section.

5.2 Major findings of the study

The current study initially assesses the influence of the I.C on the financial performance of both public and private sector banks in India from 2010 to 2022. The Modified Value-Added Intellectual Coefficient (MVAIC) technique was used to assess the I.C performance of banks. According to this study, the average MVAIC performance of public banks in India is 8.306, whereas private banks have an average performance of 9.038. The average value suggests that Indian banks in both the public and private sectors are heavily dependent on and efficiently utilizing I.C, indicating their adoption of a knowledge-driven economy. However, private sector banks demonstrate superior utilization of I.C compared to public sector banks. The exceptional I.C performance of these banks can be linked to the stiff competition they face in India. To maintain a competitive advantage in this knowledge-based economy, banks have had to effectively manage their I.C. (Wiklund and Shepherd, 2003).

In this study, it was observed that HCE, which reflects human capital, had the highest mean score among the I.C components of SCE, HCE, CEE, and RCE for both sector banks in India. This suggests that commercial banks in India derive greater benefits from their investment in human capital compared to their investments in structural, physical, and relational capital. According to Alhassan and Asare (2016), human capital is the main intellectual resource that influences the other components of intellectual capital. This study supports the main ideas of the RB theory and HC theory, which argue that investing in human resources leads to economic benefits for a company, which in turn creates a competitive advantage Barney, (1991); Amit and Schoemaker, (1993); Grant (1996); and Stewart (1997). Based on the theories mentioned above, the concept of H.C refers to the distinct abilities, expertise, and proficiencies that people of an organization possess. These qualities can be highly useful when combined with the firm's implicit knowledge, serving as a foundation for gaining a competitive edge.

Within the institutions that were sampled, there was compelling evidence indicating that the average values of HCE recorded by all commercial banks in this study were greater than the average values of CEE, SCE, and RCE. Currently, banks in India are placing more importance on valuing intangible assets rather than actual assets. The leaders of commercial banks in different areas of the Indian banking industry may be effectively utilizing intangible resources in comparison to physical resources. The low physical asset ratio of banks in this study can be linked to the prevalent low capital structure across most banks in India. The majority of banks in India have insufficient capital, which restricts their ability to address unforeseen losses and minimize bankruptcy expenses.

Among the components of I.C, test results in the correlation matrix indicate that they fall below the specified threshold, indicating the absence of multicollinearity. Hair et al. (2013) and Blumberg (2014) proposed that a correlation exceeding 0.8 indicates the presence of multicollinearity. The correlation coefficient between HCE and MVAIC is 0.597 for private-sector banks and 0.713 for public-sector banks. The correlation coefficient between SCE and MVAIC is 0.417 for private-sector banks and 0.403 for public-sector banks. The correlation coefficient between CE and MVAIC variables is -0.134 for private-sector banks and 0.125 for public-sector banks. This suggests that the main independent variables are not significantly correlated. Multicollinearity is the presence of a linear relationship between independent variables, which can result in biased regression models.

When we compare the impact of I.C on the financial performance of public and private sector banks. The results revealed that public sector banks have a greater number of components of

I.C that influence their financial performance. The HCE has a favorable and statistically significant impact on profitability measures (ROA, ROE, ROCE, and ROS) in both sector banks in both models (FE, CSRE, and GMM). The findings of this study are consistent with those of prior investigations (Al-Musali & Ismail, 2014; Duho & Onumah, 2019; Faruq et al., 2023; Ismail & Kareem, 2011; Joshi et al., 2013; Ozkan et al., 2017; Poh et al., 2018; Prasojo et al., 2022; Tiwari et al., 2023; Tran & Vo, 2018; Weqar & Haque, 2020; Xu et al., 2023). A key factor in the profitability of banks is the expansion of human resources through investments in human capital. This offers anecdotal evidence that banks' returns on assets, capital, and profit are increased when they invest in their employee.

5.3 Impact of Intellectual Capital on Financial Performance

The relationship between I.C and banks' financial performance (profitability), is measured by indicators such as ROA, ROE, ROCE, and ROS. while examining the different elements of I.C.

5.3.1 Impact of Intellectual Capital on Human Capital (H.C)

It is evident from the results that HCE (Human Capital Efficiency) has a positive and significant association with ROA (Return on Assets), ROE (Return on Equity), ROCE (Return on Capital Employed), and ROS (Return on Sales) in the context of public sector banks. In the case of private sector banks, HCE shows a positive relationship with ROA and ROS only. This suggests that investments made in human capital (H.C), such as training and other proactive measures, contribute significantly to the profitability of banks. Investing in H.C is crucial for banks' profitability since it leads to growth in human resources. The findings offer empirical support for the established assertions and predictions that H.C is a fundamental determinant of profitability in the service industry (Asutay & Ubaidillah, 2023; Barney, 1991; Chen Goh, 2005; Duho, 2020; Duho & Onumah, 2019; Faruq et al., 2023; Gigante, 2013; Grant, 1996; Hamdan, 2018; Joshi et al., 2010; Kwaku Mensah Mawutor et al., 2023; N. Isanzu, 2015; Ozkan et al., 2017; Poh et al., 2018; Prasojo et al., 2022; S. Singh & Kansal, 2011; Stewart, 1997; Tiwari et al., 2023; D. B. Tran & Vo, 2018; Weqar & Haque, 2020; Zheng et al., 2022). Based on the aforementioned theories, the concept of H.C refers to the distinct abilities, expertise, and proficiencies possessed by employees of an organization. When combined with the implicit knowledge of the company, these attributes can serve as a foundation for gaining a competitive edge.

India is not only the most populated country in the world, but it also has the highest proportion of young people in its population. Hence, the aforementioned discovery unequivocally demonstrates that banks are capitalizing on India's exceptional human resources to attain higher profits utilizing human development. The human element is crucial in the knowledge management process and knowledge-based companies. The managers of banks in India have recognized the potential of human capital and have initiated an unprecedented effort to effectively utilize this valuable resource in areas such as quality, management, and development, to meet their business goals. Moreover, the finding that human capital is the most crucial intellectual asset of commercial banks in India emphasizes the undeniable importance of the fundamental principle of human capital theory (HC theory) in the banking industry. Employees' capacity for learning is very valuable in comparison to other resources utilized in the production of goods and services (Lucas 1990). Applying the findings within the framework of banks in India to the human capital theory suggests that investing in and promoting the development of human resources will enhance their level of expertise and productivity, hence justifying higher earnings and ensuring steady financial performance.

5.3.2 Impact of Intellectual Capital on Structural Capital (S.C)

According to the results of the study, SCE has an adverse effect on the profitability of public sector banks, as evidenced by negative effects on metrics such as ROA, ROE, and ROCE. However, there is no observed correlation between SCE and profitability indicators in the case of private-sector banks (Ismail & Kareem, 2011; Muhammad & Ismail, 2009; Setianto & Sukmana, 2016; Ting et al., 2021). This indicates that the structural capital of commercial banks in India reduces sales, invested capital, return on equity, and return on assets (Alhassan & Asare, 2016; Asutay & Ubaidillah, 2023; Gigante, 2013; Mohapatra et al., 2019; Mondal & Ghosh, 2012; N. Isanzu, 2015; Setianto & Sukmana, 2016). Illustrating that structural capital is not a superior investment tool for banks' profitability, and to a significant degree, it is rather detrimental to their overall profitability growth. From a technical standpoint, the above results could be linked to the measurement of SCE in the MVAIC model. According to Fourati and Affes (2013), the value employed to estimate the SCE may not provide a complete measure as it disregards organizations' relational capital and innovative capital. Hence, due to the potential inaccuracy of SCE as a measure, it is detrimental to the profitability of banks. It might also be seen as suggesting that banks with structural resources aren't profitable. Commercial banks in India may not be fully leveraging their investments in structures such as bank procedures,

strategies, systems, policies, and rules, to enhance profitability. This is the reason why the additional value gained from this investment decreases the banks' profitability.

Cetorelli and Goldberg (2010) argue that foreign banks played a significant role in transmitting the effects of the 2007 financial crisis to developing economies, leading to substantial losses for banks worldwide. Financial integration on a worldwide scale and structural changes at a domestic scale necessitated and led to several structural modifications, namely to banks' processes, operations, and rules. Hence, the adverse correlation shown between SCE and banks' profitability may be attributed to the alterations in organizational frameworks resulting from financial integration, which could have impeded banks' capacity to engage in collusion, consequently diminishing their profitability.

5.3.3 Impact of Intellectual Capital on Capital Employed (C.E)

According to the findings, CEE has a negative and statistically significant effect on the profitability indicators (ROA, ROE, ROCE, and ROS) examined in this study for public sector banks (Kwaku Mensah Mawutor et al., 2023; Mohapatra et al., 2019; Ting et al., 2021; Xu et al., 2020). However, in the case of private sector banks, CEE is positively correlated with ROA and ROS only. Capital-employed efficiency (CEE) in private banks enhances both profitability and overall efficiency, resulting in a favorable impact (Asutay & Ubaidillah, 2023; Mondal & Ghosh, 2012; Ozkan et al., 2017; Soriya & Narwal, 2015; Ting et al., 2021; Tiwari et al., 2023; Tran & Vo, 2018). The success of an organization is determined by its ability to strategically allocate its money towards creating value. Findings reveal that public sector banks in India have not been making more money by efficiently allocating their capital to create value; however, this is not the case for private sector banks. The RB theory suggests that possessing adequate physical or financial resources can enable enterprises to achieve returns that exceed the average (Barney, 1991). However, when it comes to public sector banks in India, investing in these resources does not result in significant profits. The primary problem is the lack of sufficient capitalization among most commercial banks in India, which restricts their ability to effectively address challenges that may come from unforeseen losses, such as non-performing assets, and vice versa for the private sector banks.

The analysis in Table 4.1 shows that public sector banks had the lowest value-added (0.551) from invested capital compared to other components of I.C. In a comparable vein private sector banks had the second lowest value-added (0.487) from invested capital, with structural capital being the lowest. Consequently, it is unsurprising that the value-added generated by public

sector banks from their capital utilized does not result in enhanced profitability. However, this statement does not hold for private-sector banks. Goh (2005) states that banks rely heavily on physical capital for their operations, but the ultimate quality of the services and products they offer to clients depends on I.C. Because of this, banks supply IC and intangible services instead of material resources, which determines the worth of the services rendered (Kamath, 2007). Hence, it is clear that in the contemporary competitive landscape, the primary factors that determine a firm's value are its intellectual resources, while capital (financial/physical) takes on a secondary role.

5.2.4 Impact of Intellectual Capital on Relational Capital (R.C)

Finally relational capital, the final component of I.C, adversely affects the profitability indicators (ROA, ROE, and ROS) of both sector banks. However, it does not have any impact on the ROA of private-sector banks. It has a significant and positive effect on the Return on Capital Employed (ROCE) of both sector banks (Barak & Sharma, 2023). Illustrating that relational capital is not a superior investment tool for banks' profitability, and to a significant degree, it is rather detrimental to their overall profitability growth (Bayraktaroglu et al., 2019; Martens, 2023b; Soewarno & Tjahjadi, 2020; Weqar & Haque, 2020). Furthermore, it could be construed as suggesting that banks with relational capital assets are not very lucrative. Indian commercial banks may not be fully capitalizing on their investments in sales and advertising expenses, which could hinder their ability to cultivate stronger connections with stakeholders and enhance profitability.

5.3.5 Impact of Intellectual Capital on Modified Intellectual Capital Coefficient (MVAIC)

Ultimately, the combined intellectual capital (MVAIC) demonstrates a mixed impact (positive and negative) on the profitability metrics of both sector banks. Nevertheless, it does not exert any influence on the Return on Assets (ROA) of private-sector banks. It has a significant and beneficial impact on the Return on Capital Employed (ROCE) of both sector banks and also a positive and significant impact on the return on assets and return on equity in public sector banks. This illustrates the need to allocate resources toward intellectual assets to optimize a company's return on assets and capital investment. This suggests that intellectual capital typically has a substantial and favorable influence on the financial performance of banks (Awwad & Qtaishat, 2023; Khalique et al., 2013; Mondal & Ghosh, 2012; Nguyen, 2023; Oppong & Pattanayak, 2019; Ozkan et al., 2017; Prasajo et al., 2022; Riahi-Belkaoui, 2003).

As a result, regulators should prioritize investment in intellectual capital within the banking industry.

In summary, the study concludes that the bank's profitability is primarily influenced by human capital efficiency, whereas the other variables do not have a positive impact. The profitability is not influenced by the results gained from the other components, namely structural, relational, and capital-employed efficiency. According to Table 4.1 examination of intellectual capital performance, banks in India over the sample period had, on average, little value added from their investments in physical, relational, and structural assets. This analysis confirms that India's commercial banks are not adequately managing and investing their structural, relational, and physical capital. This supports the claim made by Kaplan & Norton (2004) that the different capital bases and bank structures in India are not sufficiently significant to enhance performance. The study highlights the importance for Indian commercial banks to prioritize the application of organizational learning theory (OL Theory), which emphasizes the enhancement of structural capital to create a conducive environment for employees to be productive. Additionally, the study emphasizes the significance of resource-based theory (RB Theory), which suggests that the integration of both intangible and tangible assets in the production process can result in increased productivity. The RB theory and OL theory suggest that intellectual resources, such as structural, physical, and relational capital, are crucial for gaining a competitive advantage. Therefore, effective management of these resources can lead to differences in performance among commercial banks in India. Furthermore, according to Anifowose et al. (2018), the concept of I.C is still expanding, indicating the need for additional efforts from relevant authorities to enhance it. This would enable the results of I.C elements to be correlated with the level of growth in India's knowledge-based economy.

5.4 Chapter Summary

This chapter analyzed the study results to determine the level of consistency between the findings and earlier investigations. The findings in this study align with the research discussed in the literature review of I.C. Regarding the relationship between I.C and bank profitability, the study revealed that most banks utilize their intellectual capital resources, particularly the human capital components, to enhance profitability.

CHAPTER 6

SUMMARY, CONCLUSION, LIMITATIONS, AND FUTURE RESEARCH

6.1 Introduction

This chapter presents the final findings and conclusions derived from the research conducted in this study. The aim of this chapter is multifaceted: It aims to present a comprehensive overview of the research conducted throughout this study, spanning from the first chapter to the last chapter. Additionally, it discusses the implications of the study and highlights the notable limitations of this research, thereby identifying potential avenues for future investigation.

6.2 Summary of Research Findings

The fundamental objective of this research is that the global economy has transitioned to a new paradigm, in which knowledge assets, particularly I.C, are recognized as crucial resources for achieving company success and a key driver of sustained competitive advantage. The substantial economic growth in many nations is attributed to their extensive investment and dependence on I.C, which plays a crucial role in the advancement of a knowledge-based economy. Furthermore, in recent decades, the banking industry has experienced significant transformations, and banks have operated within an exceedingly volatile and demanding atmosphere. Banks have been adversely affected by the financial crisis, namely the worldwide financial crisis that occurred in 2008. Several rapidly developing economies, such as India, encountered this dilemma, which in certain instances resulted in economic catastrophe. Indian banks have encountered various obstacles over time, prompting the implementation of mergers and acquisitions and other survival strategies by numerous institutions. Indian banks were also confronted with two significant occurrences, namely demonetization and the COVID-19 pandemic. A study conducted by Chowdhury et al. (2018) found that intangible assets, specifically I.C, were highly valued resources in the knowledge-based economy. These assets played a crucial role in enhancing innovation within the banking sector. Therefore, it is crucial to assess the value generated by investing in I.C to the performance of banks as a strategic asset during this era of knowledge. The banks in India have undergone substantial reorganization and rigorous review. To thrive in the knowledge economy, banks, being enterprises that heavily rely on knowledge, need to effectively utilize intellectual resources or I.C. The study aims to analyze the influence of the I.C on the financial performance of both public and private commercial banks operating in India. To accomplish the study's purpose, a sample size of the

top 29 banks in India, consisting of 14 public banks and 17 private banks, was selected to reflect the whole banking sector in the country. In addition, the study employed ROA, ROE, ROCE, and ROS as metrics to assess banks' profitability, given their significance in driving banks' expansion. The independent variables consist of the components of I.C, namely human capital, capital employed, structural capital, and relational capital. Furthermore, two control variables (leverage and size) are employed to evaluate the influence of these characteristics on the banks' performance. To determine the connection between these variables, a dynamic panel regression strategy was employed, specifically using a fixed and cross-section random effect model, as well as the generalized method of moments (GMM).

Based on the findings of this study, it was determined that banks in India generate significant value by investing in I.C resources. When considering the efficiencies resulting from I.C and its various components, it was found that human capital was the most crucial resource compared to relational capital efficiencies (RCE), structural capital efficiencies (SCE), and capital employed efficiencies (CEE). This is logical because India is the most populous country in the world and has the youngest population. From an investment and business perspective, India offers great potential for growth, entrepreneurship, and innovation in several sectors. Thus, the outcome underscores the significance of making substantial investments in human resources, a concept supported by many business theories such as Resource-based theory (RB theory) and Human capital theory (HC theory) (Al-Musali & Ismail, 2014; Duho & Onumah, 2019; Faruq et al., 2023; Prasajo et al., 2022; Tiwari et al., 2023; D. B. Tran & Vo, 2018). Furthermore, the CEE, which signifies the financial and physical capital of banks, is insufficient in India. This inadequacy is the reason why banks in India have low capitalization. It is worth noting that the capital requirement for banks in India is relatively modest compared to other nations' banking sectors.

Based on the evaluation of bank financial performance using profitability measures, it can be concluded that the profitability ratios of both public and private commercial banks in India are satisfactory. However, there is no consistent improvement in profitability over the investigated period. Based on this observation, it can be inferred that commercial banks in India can invest in lucrative ventures. However, they must address substantial inefficiencies to maintain and get greater returns from their investments. The study yielded additional findings about the correlation between intellectual capital and the financial performance (probability and productivity) of banks. These results are as follows:

The study indicates that investing in I.C leads to increased productivity and profitability. Furthermore, the degree of I.C investments directly influences the growth productivity and

subsequent profitability of both public and private commercial banks in India. This suggests that increasing investments, improving management, and enhancing the measurement of I.C resources are the solutions to achieving a healthy, productive, and profitable banking unit. The RB theory and KB theory propose that collective knowledge resources, known as I.C, contribute to developing competitive advantage and generating economic returns for a company (Barney, 1991; Amit and Schoemaker, 1993).

The discovery of HCE supports the H.C theory within the realm of I.C components. It provides evidence to support the conclusion that H.C is the sole crucial element that propels banks' productivity and profitability growth (Faruq et al., 2023; Tiwari et al., 2023; D. B. Tran & Vo, 2018). Thus, the best way to increase profitability and productivity is to invest in H.C through training and development initiatives. Therefore, the increase in the level of I.C achieved by investing in H.C plays a crucial role in enhancing banks' productivity and profitability.

The study on CEE finds that the low capital base of banks in India, both public and private, presents a significant challenge in terms of creating value and improving profitability and productivity. This is due to the difficulty in leveraging the minimum capital available. According to the RB hypothesis, one can generate above-average returns if they possess the appropriate financial resources (Barney, 1991). Nevertheless, given their smaller capital basis in comparison to other emerging nations, this is uncommon among Indian commercial banks, both public and private.

Surprisingly, the study discovered that there was either a negative or insignificant association between SCE, banks' productivity, and profitability growth. Specifically, the study indicated that SCE diminishes productivity in both public and private commercial banks, resulting in reduced earnings for these banks. Barney (1991) has pointed out that banks in India are not effectively utilizing their organizational resources. Therefore, both public sector banks in India suffer from a deficiency in well-established organizational structures, processes, and procedures that are necessary for enhancing profitability and productivity.

The study found that investment in advertisement and selling expenses (RCE) in both sector banks did not effectively enhance the value, profitability, and productivity. The study found that there was either a negative or insignificant correlation between RCE and main financial performance measures. Barney (1991) has highlighted that the intergroup link within and outside a firm is not being adequately utilized by both sector banks in India. Hence, both public and private sector banks in India must prioritize their engagement with stakeholders to enhance their operational effectiveness and productivity.

6.3 Findings

The core study findings suggest that public and private commercial banks in India generate above-average value when they invest in I.C resources. It has been noticed that in commercial banks (both public and private) in India, the performance (the value added) of all the components of I.C (namely, capital employed efficiency, relationship capital efficiency, and structural capital efficiency) is lacking, except for human capital. Public and private commercial banks in India see higher profitability and increased productivity when they invest in human capital. The productivity development of commercial banks in India, especially public sector banks, has experienced a fall from 2010 to 2022. This can be attributed to the absence of technology advancements and efficient management controls. The capital adequacy of the majority of commercial banks (both public and private) in India is notably insufficient. This hinders their ability to generate value from the low capital and presents a substantial obstacle in utilizing such a minimal capital base to enhance productivity and profitability. The association between SCE, and banks' financial performance (profitability growth) is inversely proportional, as a fall in investments in SCE leads to a decline in efficiency, consequently resulting in a reduction in banks' earnings. The association between relational capital efficiency and the bank's financial performance is also negative, as investment in RCE reduces the bank's profitability. The correlation between the overall intellectual capital (MVAIC) and the financial performance measures of the majority bank is positive. Investing in intellectual capital improves the bank's profitability and productivity.

6.4 Research Implications

The examination of I.C on the financial performance of public and private sector banks in India is of interest to several stakeholders, including consumers, suppliers, management, owners, regulators, policymakers, and banking regulators. Therefore, various conclusions can be inferred by utilizing the data from banks in India, including theoretical, managerial, and practical implications.

6.4.1 Theoretical Implications

Examining the significant creation of value by I.C and its influence on the growth of profitability contributes to the I.C theory and its ongoing normative literature by empirically verifying and validating this claim in existing research. The theory of intellectual capital (IC theory) posits that intangible assets, that are not disclosed in the balance sheet, play a crucial role in creating value for enterprises (Kolaković, 2003). Investing in I.C enhances the profitability and efficiency of banks. This study has validated the assertion in the IC theory and

the evidence in the I.C literature that I.C is crucial for companies' performance. Furthermore, it emphasizes that the economic progress of economies relies entirely on the investment and effective management of knowledge assets.

Amit and Schoemaker (1993), Barney (1991), and Penrose (1959) all assert that a firm's economic returns and competitive advantage are created by the combination of its intellectual resources. The study undoubtedly contributes to this notion. This research study has shown that banks' investments in I.C resources have increased over the study period. Consequently, the value efficiency gained from I.C investment has also increased. The knowledge-based theory (KB theory) is an extension of RB theory that emphasizes knowledge as the primary resource for companies in the present era.

Moreover, the research indicates that human capital is the primary intellectual resource for both public and private banks in India. This highlights the undeniable significance of human capital theory in the banking industry. Like other resources used in the production of products and services, workers' capacity for learning is equally important (Lucas 1990). Applying the findings to the banking sector in India, both public and private, in the framework of the human capital theory suggests that investing in and focusing on the development of human resources will enhance their level of expertise, boost productivity, and provide a rationale for increased earnings. Thus, this study enhances the understanding of the HC theory by conducting empirical tests and supporting the investment in and prioritization of human capital as the primary knowledge resource in both sector banks in India. The study revealed that Indian banks are currently prioritizing investment in I.C to enhance profitability and efficiency in response to the challenges and possibilities in the business landscape. The availability of intangible resources is the foundation for establishing a competitive edge (Stewart, 1997).

6.4.2 Managerial Implications

This study demonstrates that investments in I.C contribute to the rise of banks' profitability. Commercial banks in India, both public and private, are utilizing intellectual resources to lower production costs, enhance productivity, and ultimately maximize profits. Therefore, this study suggests that organizations should prioritize the utilization of intellectual capital resources (intangible assets) to enhance their value, increase productivity, and improve profitability. Therefore, it is strongly urged that the bank authorities and regulators in the banking industry allocate the necessary funds for strategic investments in I.C to ensure a profitable return on investment.

This study suggests that banks in India should address management inefficiencies and implement current technical tools, which are known to have certain downsides, as the productivity development of Indian banks, both public and private, has been found to be inadequate. Banks must employ strategic measures to optimize the utilization of limited resources. Therefore, it is recommended that cutting-edge technologies like big data analytics and visualization be applied to optimize efficiency in the banks. Bank managers can optimize efficiency by monitoring input utilization, managing non-performing loans, and leveraging decision-making tools to get valuable insights. This can aid in reducing the expenses associated with manufacturing and operations, while simultaneously enhancing efficiency. Furthermore, embracing cutting-edge technologies would enable banks to expand their presence by offering a wide array of services and catering to new segments of the market. Implementing technological advancements will facilitate the growth of banks and enhance their profitability. The findings indicate a notable explanation for the failure of investments in physical and financial capital (CEE) to support the RB hypothesis, which suggests that possessing appropriate physical or financial resources can enable enterprises to achieve returns that exceed the average (Barney, 1991). The reason for this is the presence of inadequate banking rules and a low capital base in the banking sector in India, which falls short of international requirements. The capital requirement for banks, including both statutory and liquid requirements, is currently set at a very low level. This is a challenge for banks as they struggle to effectively utilize and make returns on the capital they have invested. The implementation deadline for Basel III rules in India was set for March 2019. Some countries have already implemented certain parts of the Basel 3 agreement.

The efficiency of capital used had a negative correlation with the financial performance criteria. This suggests that Central Banks, in collaboration with the Ministries of Finance, can develop and execute policies aimed at strengthening the financial resources of banks. This can be achieved by implementing strategies to increase capital accumulation and regularly evaluating the capital efficiency of banks.

Moreover, the findings indicate that the allocation of resources and efficient usage of human capital are the key factors that determine the profitability of banks in India. This suggests that banks, being reliant on information and skills, necessitate a certain degree of originality and resourcefulness from their workers to outperform in this competitive environment. Banks are unable to operate without depending on highly skilled individuals to attain greater productivity and profitability. Therefore, management should carefully prioritize the human capital element to enhance efficiency and profitability. This can be accomplished by implementing effective

training programs that establish a strong foundation for employees to adapt to the evolving nature of the sector, as influenced by current financial circumstances. In addition, by efficiently overseeing the personnel, a human resource manager will establish a connection between human resource policy and the achievements of the firm.

The finding that banks place little value on structural capital investments has significant managerial consequences, as it severely impacts profitability and productivity growth. Low-level structural capital refers to the presence of inadequate processes, technology infrastructure, internal policies, and organizational culture. Therefore, the bank management of different banking conglomerates in India should strive to enhance the amount of S.C. Structural capital serves as a means of effectively addressing both the external and internal difficulties faced by banks. The basic objective of banks should be to enhance value, which not only helps shareholders but also all other stakeholders.

Relational capital refers to the marketing aspect, and the promotion of bank products requires meticulous consideration. The data suggest that investing in relational capital reduces the profitability of banks in India. It is important to highlight that high marketing and advertising costs might decrease cash inflow, leading to a reduction in sales income and overall earnings. Thus, bank managers and policymakers must decrease expenses associated with advertising and marketing by implementing dynamic frameworks, such as the integration of cutting-edge technology, to effectively promote a wide range of goods and cater to emerging market groups. This study found that commercial banks in India that rely on S.C experience decreased returns. The banking industry relies heavily on innovation and technological advances to meet client needs, which is surprising given its service nature. However, if these mechanisms of structure are not properly established and maintained, they might become harmful rather than helpful. To reap the benefits of S.C investments, banks must implement effective management mechanisms to maximize their returns. This emphasizes the need for experienced, capable, and qualified employees to manage innovations and technology and meet client requests. Banks that can improve their customer service through H.C are more likely to survive. Both sector banks in India should identify and equip key employees to achieve high HCE. Consistent and effective training is essential for employee and manager performance. According to Edvinsson and Malone (1997), having competent and technologically equipped employees shapes structural capital, and greater S.C leads to improved H.C.

6.4.3 Practical Implications

It is time for the Indian accounting community to recognize and incorporate intellectual capital resources into financial accounts. This study shows that intangible assets (I.C) account for most value creation in service-based and knowledge-based organizations like banks. Removing knowledge resources in accounting accounts is a mistake, as they are crucial for a company's success in the knowledge economy. The Enhanced Business Reporting Consortium (EBRC), a Washington DC-based multi-stakeholder organization, presented a new accounting system to improve I.C transparency standards. The system intends to deliver comprehensive information to shareholders and all parties, enabling informed decision-making. The Enhanced Business Reporting framework enables organizations to provide more information about their intangible assets, helping investors make more informed decisions. The framework compels organizations to publish information on their skills and resources, including employee and customer satisfaction, creativity, intellectual property, technology, and supply chain. We urge that leaders in India's accounting community, particularly in the banking sector, establish a comprehensive framework to improve I.C disclosure, following the example of frontrunners. This would allow banks and enterprises to disclose more information about their intangible assets, leading to better-informed judgments for decision-makers, managers, investors, and others.

According to a point of view of practicality, business managers need to investigate and assess the functions that I.C plays in their organizations. In this age of the digital and knowledge-based economy, administrators are required to have an in-depth awareness of the crucial role that I.C plays in the improvement of financial performance. According to the findings of this study, Indian financial institutions need to ensure that they effectively manage the efficiency of each component of their I.C, which includes their capital employed, human capital, structural capital, and relational capital. It has been demonstrated that I.C plays a crucial role in the achievement of financial success as well as a sustainable competitive advantage in the banking industry. To enhance economic performance and growth, Indian banks should therefore encourage I.C investment. Thus, policymakers can use this research as a reference when formulating future, I.C development policies in the banking sector.

6.5. Limitations and Scope for Future Research

Although this work has significant contributions and directions, it does have drawbacks that may restrict its generalizability. This study included 12 public and 17 private commercial banks from 2010 to 2022. However, by considering all public sector banks but excluding five private sector banks due to a lack of data, the study's overall generalizability may be called into question, as it only considers some of India's commercial banks. The choice of the other banks may have altered the study's outcomes. To provide a broader analysis, this study advises that subsequent studies on the subject comprise all banks. This study will contribute to a deeper understanding of the empirical as well as theoretical links between I.C and bank financial performance. The research used the MVAIC model and secondary data to assess bank I.C efficiency, which has been widely recognized as a reliable measurement. Other ways for investigating an organization's efficiency can be considered in future research. In the future, researchers can use primary data to determine how I.C. influences a company's financial success. This analysis expands beyond the banking sector to include education, IT sectors, manufacturing, insurance, and pharmaceutical. It highlights the importance of government policies and decisions to improve India's intellectual capital. Additionally, this investigation does not examine how I.C and its components affect bank performance across countries. Future research may widen the inquiry to include other financial organizations or banks operating in South Asian countries. Future studies could include relevant financial performance metrics for banks to analyze both I.C and financial performance.

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LIST OF PUBLICATIONS

S.no	Title of the papers	Authors	Impact factor in SSCI and ABDC category list	Proof of it being attached in the SSCI/SCIE list as an attachment
1.	Analyzing the impact of intellectual capital on the financial performance: A comparative study of Indian public and private banks	Monika Barak; Dr. Rakesh Kumar Sharma	SSCI 4	Attached
2.	Does intellectual capital impact the financial performance of Indian public sector banks? An empirical analysis using GMM	Monika Barak; Dr. Rakesh Kumar Sharma	SSCI 3.7	Attached
3.	Investigating the Impact of Intellectual Capital on the Sustainable Financial Performance of Private Sector Banks in India	Monika Barak; Dr. Rakesh Kumar Sharma	SSCI 3.3	Attached
4.	Effect of Intellectual Capital on the Financial Performance of Indian Public Sector Banks	Monika Barak; Dr. Rakesh Kumar Sharma	C Category ABDC list	Accepted

PAPERS PRESENTED AT CONFERENCES

S NO.	Authors	Year	Title of Paper	Name and Place of Conference
1.	Monika Barak, Dr. Rakesh Kumar Sharma	29 th July 2022	Investigating the impact of intellectual capital on the performance of the Indian Public sector banks	Gyan Jyoti Institute of Management & Technology, Mohali (Punjab)
2.	Monika Barak, Dr. Rakesh Kumar Sharma	January 9-10, 2023	Examining the impact of intellectual capital on the financial performance of the Indian Public sector banks? An empirical analysis using GMM	IIM, Visakhapatnam

Article

Investigating the Impact of Intellectual Capital on the Sustainable Financial Performance of Private Sector Banks in India

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Abstract: The study aims to investigate the impact of intellectual capital (I.C) on the sustainable financial performance (F.P) of private sector banks (PSBs) in India. Data were gathered from 17 banks between 2010 and 2021 using Prowessiq (CMIE) and their annual financial reports. To evaluate the ways in which intellectual capital (I.C) affects sustainable financial performance (F.P), the modified value-added intellectual coefficient (MVAIC) methodology was applied. The human capital (HC), capital employed (CE), structural capital (SC), and relational capital (RC) were utilized as independent factors together with three control variables (leverage, size, and GDP), the return on capital employed (ROCE), and return on equity (ROE), which were used as dependent variables. The results show that RC and SC have a clear, statistically significant relationship with ROCE. Additionally, HC and CE have a direct positive and statistically significant effect on ROE. Overall, all of the I.C. components have significant impacts in increasing the efficiency and profitability of Indian private sector banks. Furthermore, the total intellectual capital (MVAIC) exhibits a statistically significant negative association with ROE but a substantial positive association with ROCE. It is advised that policymakers and managers focus more on the various I.C components because they are the key engines generating value for the banks in order to preserve a more sustainable F.P.



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Keywords: sustainable financial performance; MVAIC; private banks; intellectual capital

JEL Classification: C1; C3; J24

1. Introduction

Intellectual capital (I.C) has become an important issue in today's fast-growing, technology-driven, and knowledge-based world. I.C is defined as a firm's innovation, experience, knowledge, client contacts, and people expertise that provide a long-term competitive advantage and add value to the firm [1,2]. Work, workers, and workplaces are being restored faster than ever as the world recovers from the pandemic. Firms are now emphasizing intangible assets (particularly human capital) over physical and financial resources [3]. As a crucial intangible asset in this knowledge-driven era, employees are regarded as adept at transforming knowledge into the commodities and services that assist an organization in increasing its financial health and worth [4]. Intangible assets include more than just stakeholder relationships, patents, goodwill, staff knowledge investment, and copyrights [5]. The organization defines I.C as intangible assets, specifically with respect to firms that can utilize them to generate value by transforming them into products, services, and new processes.

Four key elements frame I.C: human capital (HC), capital employed (CE), structural capital (SC), and relational capital (RC) [6–12]. HC comprises employees' expertise, capabilities, commitment, experience, expertise, professionalism, and intellectual abilities [13,14]. All of these can be used to achieve and improve the organization's value [3,15–17]. CE

(comprising financial and physical capital) is essential for generating wealth for the organization. SC is related to intellectual property and databases, such as trademarks, copyrights, innovations, and patents. It also includes infrastructure resources associated with the organizational structure, culture, management system, policies, techniques, methodology, and the firms' operations that encourage the human resource to create and use their knowledge [14,17,18]. Metaphorically, HC acts as the backbone of the firm. As a result, banks must use their workforce efficiently and effectively to build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation (SDGs 9). The relationships that an organization has with its stakeholders, which include the suppliers, marketing channels, customers, creditors, shareholders, and the government, are referred to as RC. The success of an organization is dependent on the quality of its internal and external relationships [4,6,17,19].

Several studies have been conducted in developed countries to determine the effects of intellectual capital (I.C) on financial performance (F.P). The findings showed that I.C is a tactical resource that enhances an organization's value performance and competitiveness [20]. The supremacy of I.C encapsulates the conversion of the industrial economy into a knowledge-based economy in the twenty-first century. Indeed, in developing countries such as India, less substantial literature on the link between firm performance and intellectual capital efficiency has been produced. As a developing country, India needs to tap into and expand this intellectual capital in order to restructure its economy. Since gaining its independence in 1947, India's economy has passed through a number of phases of growth. The government has undertaken numerous initiatives at various levels to promote economic growth and stimulate domestic and foreign investment.

By acting as a financial mediator between diverse parties, the banking industry serves as the backbone for a country's sustainable economic development [21]. A financial system's contribution to sustainable economic growth increases when resources are effectively generated and allocated. A well-functioning financial intermediation system also assists in the economic risk mitigation process. When productivity is increased in a way that, for instance, strengthens the capital buffers that absorb risk, it can lead to more and better innovations, investment returns, and the increased safety and stability of the banking industry. Likewise, profitability or efficiency metrics may serve as early warning signs of changing financial system strengths or weaknesses. Therefore, researchers have always been interested in investigating and measuring productivity and profitability in the banking sector. This study attempts to assess I.C's effectiveness in regard to private sector banks, taking into account the importance of I.C as well as its components (HC, CE, SC, RC) in order to promote sustained, inclusive, and sustainable economic growth, as well as full and productive employment for all (SDG's 8). India is in the process of transforming from a developing to a developed economy; thus, it is essential that the banking sector has a strong and sustainable foundation. Currently, there are 22 private sector banks, 12 public sector banks, 44 foreign banks, and 43 and 1484 regional and urban cooperative banks, respectively. In the financial year of 2021–2022, the total assets of the public sector banks were USD 1594.51 billion and those of private sector banks were USD 925.05 billion.

In the current situation, the COVID-19 pandemic has had a negative effect on a number of sectors in India and throughout the world. This pandemic has halted years of progress in every country. Because of this paradigm shift, it is now critical to understand why countries should invest in I.C (specifically HC). HC is at the forefront of innovation. At the HC Experience Summit 2022, industry experts recently stated that employee experience is more important than customer experience because the former contributes to enhanced workforce productivity and adds value to the firm. To mitigate the economic impact of COVID-19, the Indian banking sector has shifted to a knowledge-based orientation and diversification approach, demonstrating the essence of I.C in the country. It is critical to invest in human capital to enable workers to be productive and innovative in order to build long-term value, competitiveness, and sustainable development. To succeed in the corporate sector, every economy relies on knowledge and intangible assets. Every economy aspires to be

a “knowledge economy”. In the current period, a pool of intangible assets can provide a competitive advantage by improving corporate performance by providing innovative products to global customers at reasonable prices. Every entity seeks to profit in order to survive in the business world, since intangible assets are essential inputs required to excel and grow in today’s corporate world. Innovation can be provided through products, processes, and positions in the banking industry. This innovation is undoubtedly dependent on investments in various sources or assets. In the current study, we took human capital, capital employed, structural capital, and relational capital as the proxies for I.C. These intellectual capital proxies can further drive innovation in the banking sector. As I.C is a major element of the banking sector that is essential to survival in the business world, financial performance is a much more important aspect.

This is the primary reason for conducting this research, which aims to investigate intellectual capital (I.C) and its effects on the sustainable financial performance (F.P) of private sector banks (PSBs) and to analyze their relevance for attaining SDGs 8 and 9. The study takes into consideration 17 PSBs, including data obtained from financial statements that were collected from annual reports and the Prowessiq database from 2010 to 2021. The technique employed is panel data estimation, and it is carried out in three different ways (with the fixed effect and with the cross-section random effect and without fixed and random effects). The productivity and profitability of the bank are the two dimensions used to assess its sustainable F.P. For the following reasons, in our research, we selected sustainable F.P measures. Firstly, there is a strong correlation between long-term organizational success and sustainable F.P. Secondly, I.C, which has relevance for both financial and non-financial achievements over a long period of time, is a component of long-term productivity and growth. However, less extensive literature is available that can allow us to identify the link between I.C and banks’ sustainable F.P [22,23], especially in SAARC nations, where literature is scarce. Therefore, this research offers extensive knowledge of the influence of I.C on the sustainable F.P of the Indian private sector banks (PSBs).

The current study adds to the existing literature in several ways. First, less literature has concentrated on I.C and its application during the COVID-19 economic downturn. In order to determine its impact on private banks in India, our analysis took the COVID-19 era into consideration. Accordingly, these studies are more prevalent in the west, while they are less prevalent in Asia, in general, and India, in particular. Our research revealed that I.C had a significant favorable impact on sustainable F.P. The study’s findings allow us to offer several recommendations for private sector banks in terms of the management and application of intellectual capital (I.C). I.C is one of the essential resources that offer a business a long-term competitive advantage and enhance the performance of the business in a modern knowledge-driven environment. In contrast to earlier research, this study used the MVAIC technique to assess how I.C. affects the sustainable F.P of Indian PSBs.

This article’s remaining sections are as follows. Section 2 contains a review of the relevant literature. Section 3 discusses the research design and methodology of the study. Section 4 concerns the empirical findings and discussions, while Section 5 summarizes the study’s conclusions and provides a discussion, followed by the limitations and scope for future research.

2. Literature Review

2.1. Valuation of Intellectual Capital

Intellectual capital (I.C) has been defined by several scholars from various perspectives. Some define it as intangible assets, and some describe it as knowledge-based resources that offer a business a competitive advantage [24]. I.C refers to an organization’s capacity to generate value, compete effectively, and perform well by utilizing its intangible resources [25]. Intellectual property, information, education, and experience that can be leveraged to increase the value of the company are all included in a recent definition of intellectual capital [26]. I.C is defined by the authors of [27] as the knowledge-related challenges experienced by enterprises. In addition, [16] defines I.C as the entire intangible

assets that are not included in the company's balance sheet. In fact, despite the increasing importance of I.C. to scholars and business management, the existing literature lacks a well-recognized definition.

A broad consensus classifies the I.C. into three components, referred to as the VAIC model by [7,8] and including HC, CE, and SC [11,25,28]. The education, experience, abilities, expertise, and competencies of personnel are regarded as the most valuable component of I.C, since they assist a business in achieving its goals and add value to the organization [13–15]. HC also considers the education and training of staff members, their loyalty, satisfaction, and creativity [29,30]. SC is associated with the organizational structure and the organizational culture that provide support to human capital and produce value through the effective application of technology [16]. The ability of a business to produce value depends on its physical and financial capital, or CE [31]. However, there are drawbacks to the VAIC model. To overcome these drawbacks, the authors of [10,11] created the MVAIC model, which includes an additional element of intellectual capital, namely RC. RC includes a firm's relationships with its customer, suppliers, shareholders, creditors, and marketing channels [4,32]. Additionally, the term "RC" can refer to a company's networks with outside organizations, as well as its internal relationships [33]. Through the use of the MVAIC, this study applies HC, SC, CE, and RC to a comprehensive degree.

2.2. Intellectual Capital and Firm Performance

Numerous studies have demonstrated that I.C improves bank financial performance and has the potential to provide a business with a competitive advantage [21,31,34–37]. Various approaches, such as the MVAIC [20,38–40] and the VAIC, have been used by various researchers to measure the degree of I.C [21,31,37]. Additionally, earlier research used a variety of econometric methodologies, including GMM techniques [20] and OLS techniques [34]. Previous research indicated a positive association [22,41,42], while some studies supported a conflicting relationship between the firm F.P and I.C [43,44].

I.C was found to be inversely correlated with SC but positively correlated with CE and HC, according to an analysis of the Tanzanian banking sector in [45]. A substantial positive association between F.P and I.C was found in a [34] study of Indian banks, and [46] an investigation of the Malaysian financial industry revealed a similar relationship between the VAIC and ROA. The research performed by the authors of [47] was conducted in Uganda and examined whether I.C was a significant factor in small and medium audit practices, but not in simple cases when professional acting was used. Additionally, I.C works with professionalism to improve how small and medium audit practices operate. HC, an element of I.C, has a considerable influence on an organization's performance according to a [48] study conducted in Luxembourg and Belgium, utilizing data from 200 banking institutions.

According to [42], there was a considerable positive correlation between the SCE and ROA, the growth of sales, ATR, and Tobin's Q in Tanzanian service and manufacturing enterprises between 2010 and 2019. Using a panel of 37 Indian banks, the authors of [49] found that the aggregate I.C had positive but minor impacts on cost efficiency, revenue efficiency, and profit efficiency. In the study reported in [5] on Ghanaian insurance firms, it was found that there is a correlation between insurers' profitability and I.C. In contrast to capital employed (CE), structural capital (SC) and human capital (HC) have less impact on performance, according to a study reported in [36]. As per [3], a study on Malaysian banks, I.C has a substantial association with F.P in terms of ROA, ROE, and leverage. Human capital is a crucial element in Ghana for cost and pure technical efficiencies, according to [50]. Additionally, CEE and HCE have favorable impacts on profit efficiency.

Vietnamese commercial banks were examined by the authors of [51], who came to the conclusion that there was a positive association between I.C and the efficiency of the banks' total cost, purely technical, and allocative functions. In their investigation of Bangladeshi banks, the authors of [52] discovered that while SC and RC exhibit a positive relationship, HC is negatively related to banks' performance and risk-taking behavior.

Another study was conducted by the authors of [53] on the South Korean manufacturing industry, and they discovered that CE was the important factor affecting firm performance, followed by HC and SC. They also discovered that RC had a negative impact on firm profitability. According to [1], both HC and CE determine a firm's profitability. Recently, the authors of [54] proposed an extended VAIC model for the Turkish manufacturing sector that included innovation and customer capital, and they discovered that SCE had a favorable effect on the firms' profit growth and that innovation capital efficiency directly affected the firms' productivity.

In a study on the Malaysian public sector, the authors of [55] discovered a strong theoretical association between intellectual capital and long-term economic growth. According to the study, there are specific forms of I.C that are crucial for promoting the public sector's sustainable economic performance. Using linear regression analysis, the authors of [56] discovered that 8 of the 12 variables used to quantify I.C had a significant effect on the assessment of innovation output. According to [57], the efficiency of bank branches in Taiwan is negatively associated with RC rather than SC or HC. The productivity of insurance firms is positively impacted by I.C, CE, and HC according to the authors of [58], who used panel data analysis and the GMM estimation approach to evaluate Ghanaian insurance companies. Another study by the authors of [59] found that HC is a key component of I.C with respect to technical efficiency among non-listed banks and overseas banks. However, numerous studies have supported an inverse association between organizational effectiveness and I.C [20,34,39,41,44,60].

India's economy is among the fastest-growing in the world, and it will rank among the top three global economic powers in the next 10 to 15 years [61]. A few additional empirical studies have also been carried out to assess the relationship between the F.P and I.C of the banking sector [34,35,49,62,63], but this association needs to be confirmed for many other sectors in various nations. Little research, however, has been conducted in India, and that which exists demonstrates inconsistent and diverse results. In two ways, the current study differs from earlier studies. Firstly, in this research, we applied panel data analysis, which was performed using three different methods (with the fixed effect and with the cross-section random effect and without fixed and random effects). Secondly, we used the MVAIC technique, which takes into account the HC, CE, SC, and RC parts of I.C.

3. Research Design and Methodology

3.1. Research Framework

The main motivation for conducting the current study was to precisely comprehend how various elements of intellectual capital (I.C) affect the sustainable financial performance (F.P) of PSBs banks and to analyze their relevance for attaining SDGs 8 and 9. Productivity and profitability, which are gauged by ROE and ROCE, are the dimensions or factors used to assess sustainable F.P. According to our hypothesis, the elements of intellectual capital are favorably correlated with sustainable F.P, which ultimately contributes to the achievement of Sustainable Development Goals 8 and 9. Figure 1 displays the four components of I.C, and these four components demonstrate their impacts on sustainable F.P. The United Nations' Sustainable Development Goals 8 and 9 were taken into consideration when selecting the sustainable F.P parameters.

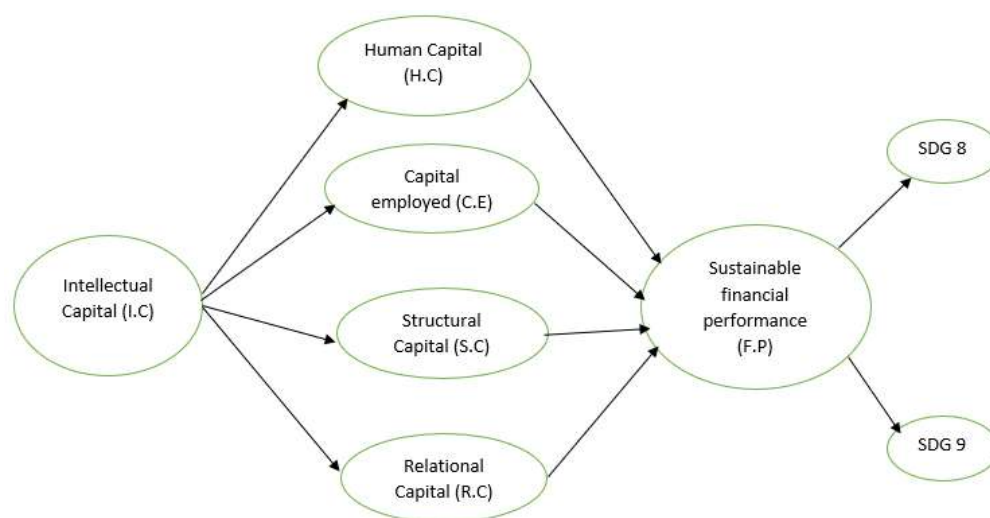


Figure 1. Research framework. Source: Developed by the authors.

3.2. Data Collection

The current study applies a modified value-added coefficient methodology (MVAIC) and investigates the impact of I.C on the sustainable financial performance (F.P) of private sector banks (PSBs) in India. The data of the PSBs were collected from financial annual reports and the Prowessiq database of the Center for Monitoring the Indian Economy (CMIE). Out of 22 PSBs, data for 17 banks were gathered from 2010 to 2021. Five banks were not included, as they only began their operations after 2014.

3.3. Methodology

The study employs panel data analysis to examine the impact of I.C on sustainable financial performance (F.P). A simple panel least squares analysis is conducted with the fixed effect and cross-section random effect and without fixed and random effects. This study uses the MVAIC to assess the impact of I.C on sustainable F.P. Many researchers from various nations, such as the authors of [22,31,40,54,60,64], have applied the MVAIC and panel regression technique. The different proxies are used to represent the human capital efficiency (HCE), capital employed efficiency (CEE), structural capital efficiency (SCE), and relational capital efficiency (RCE). The data for the different variables of each private sector bank are organized in panel form. In the first stage, descriptive statistics and a correlation matrix of variables are generated to understand the nature and relationships between variables. In the second stage, before running the panel estimation [65–68], the stationarity of the variables is checked. The various unit root tests of Levin, Lin and Chu (LLC), Im, and Pesaran and two sets of Fisher-type tests using ADF and Phillips–Perron (PP) tests, as defined by [69–72], were used to examine the stationarity of the data series of various variables. We discovered that the data series of these various variables were not at the stationary level. Then, we observed the first difference, since all of the variables were discovered to be stationary at the first difference. The panel estimation was performed later. The firm performance was assessed using two dependent variables: the return on equity (ROE) and return on capital employed (ROCE) [22,39,40,54,73]. The current study attempted to fill a gap by including the ROCE as a dependent variable, which has been overlooked in previous research. The models were developed for each dependent variable. At the first stage of estimation, the impacts of independent elements of intellectual capital (HC, CE, RC, and SC) on each dependent variable were examined. In addition, the combined effect was studied using the above-mentioned variables (measured through the MVAIC). The study used three control variables, including the firm size [22,53,64], leverage [1,22,40], and GDP, employed to minimize outside influences.

3.3.1. Statistical Model Briefing

Using panel data, we can control for variables that are difficult to measure or compute, such as those that change over time but not consistently across nations or businesses. The individual heterogeneity of a firm, organization, or country is taken into account in panel data analysis. Variables suitable for multilevel or hierarchical modeling at various levels of analysis can be included in panel data analysis [66].

3.3.2. Panel Data Analysis with Fixed Effects (FE)

When we are primarily interested in examining the influences of variables that diverge over time, panel data analysis is typically conducted with fixed effects (FE). FE aids us in identifying the relationships between exogenous and endogenous factors within an entity (company, country, etc.) [66]. Each organization or country has a different identity that may or may not have an impact on the exogenous or explanatory variables. When using FE, we make the assumption that the internal factors of a particular country or entity may affect or prejudice the exogenous or endogenous variables, and we must take control of these factors. This serves as a support for the hypothesis that the residual and explanatory factors of an entity are related. With FE, the influences of such time-invariant descriptions are eliminated, allowing us to evaluate the overall impact of the exogenous variable on the endogenous variable [74–76].

3.3.3. Panel Data Analysis with Cross-Section Random Effects (CSRE)

The use of a random effects model in panel data analysis is justified by the assumption that, in contrast to a fixed effects model, differences between companies or countries are unintended and unrelated to the explanatory or exogenous variables considered in the model [66]. The crucial distinction between fixed and random effects is not whether or not they are stochastic but rather whether the neglected individual effect illustrates components that are associated with the model's repressors [77]. Time-invariant variables can serve as explanatory variables, since random effects (RE) assume that the organization error term is not associated with the exogenous variable.

3.4. Measurement of Variables

The entire information about the variables is provided below (Table 1).

Table 1. The MVAIC is calculated mathematically as shown below.

S. No	Variables	Sign	Description of Variables	Citations
Independent Variables				
1.	Capital Employed Efficiency	CEE	CEE = The ratio of value added divided by CE (VA/CE) CE = Equity + long-term borrowings Value added = operating profit + employee cost + depreciation	[11,62,78–80]
2.	Human Capital Efficiency	HCE	HCE = The ratio of value added divided by HC (VA/HC) HC = Total employee expenditure	
3.	Structural Capital Efficiency	SCE	SCE = The ratio of structural capital divided by VA [(VA–HC)]/VA SC = Value added–human capital	
4.	Relational Capital Efficiency	RCE	RCE = The ratio of value added divided by the relational capital (VA/RC) RC = The amount invested in marketing, selling, and advertising expenses	
5.	Modified Value-Added I.C	MVAIC	MVAIC = The overall intellectual capital (CEE + HCE + SCE + RCE)	

Table 1. Cont.

S. No	Variables	Sign	Description of Variables	Citations
Dependent Variables				
6.	Return on Equity	(ROE)	Profit available to equity shareholders/shareholders’ equity	[40,78]
7.	Return on Capital Employed	(ROCE)	EBIT/capital employed EBIT = Earnings before interest and tax	
Control Variables				
8.	Financial Leverage	LEV	Debt/shareholder’s equity	[34,49,81,82]
9.	Total Assets	Size	The natural logarithm of total assets	
10.	Gross Domestic Product	GDP	The total government spending and consumer investment plus (exports–imports)	

Source: developed by the authors.

3.5. Models

Four regression models were developed to assess the impact of intellectual capital (I.C) on the banks' sustainable financial performance. Models 1 and 2 examine how I.C elements (HC, CE, SC, and RC) relate to the return on equity (ROE) and return on capital employed (ROCE), respectively. Similar to model 2, models 3 and 4 investigate how, combined, I.C (MVAIC) is related to ROE and ROCE, respectively.

Model (1)

$$\text{ROE} = \alpha + \beta_0 + \beta_1 (\text{HCE})_{it} + \beta_2 (\text{CEE})_{it} + \beta_3 (\text{SCE})_{it} + \beta_4 (\text{RCE})_{it} + \beta_5 (\text{SIZE})_{it} + \beta_6 (\text{LEVTA})_{it} + \beta_7 (\text{GDP})_{it} + e_{it}$$

Model (2)

$$\text{ROCE} = \alpha + \beta_0 + \beta_1 (\text{HCE})_{it} + \beta_2 (\text{CEE})_{it} + \beta_3 (\text{SCE})_{it} + \beta_4 (\text{RCE})_{it} + \beta_5 (\text{SIZE})_{it} + \beta_6 (\text{LEVTA})_{it} + \beta_7 (\text{GDP})_{it} + e_{it}$$

Model (3)

$$\text{ROE} = \alpha + \beta_0 + \beta_1 (\text{MVAIC})_{it} + \beta_2 (\text{SIZE})_{it} + \beta_3 (\text{LEV})_{it} + \beta_4 (\text{GDP})_{it} + e_{it}$$

Model (4)

$$\text{ROCE} = \alpha + \beta_0 + \beta_1 (\text{MVAIC})_{it} + \beta_2 (\text{SIZE})_{it} + \beta_3 (\text{LEV})_{it} + \beta_4 (\text{GDP})_{it} + e_{it}$$

4. Results and Discussion

4.1. Descriptive Statistics and Correlation Analysis

The descriptive statistics for each dependent and independent variable are shown in Table 2. The value produced by HC, one of the four components of I.C, is comparatively high, because HC demonstrates the highest mean value. Similar results have also been found in other investigations [1,22,40,53,83–85]. According to Pulic's 2000 study, HC produces 25–40% of the total value added. The average of SC, HC, and RC, taken together, is 10.588, which is significantly higher than the average of CE (0.509). In comparison to HC,

the mean values of the other intellectual capital components are fairly low. According to earlier studies, businesses generate more value through I.C than they do through physical assets [22,39,53,54,64,83–85]. The leverage, GDP, and size have mean values of 11.161, 16.042, and 11.409, respectively. The high values of the standard deviation and CV of the various independent and dependent variables signify the high volatility of various I.C components and various profitability indicators. The Jarque–Bera statistics indicate that the data series of different variables are not normally distributed, except for the size of the control variable.

Table 2. Descriptive statistics of independent variables and dependent variables.

	N	Mean	S. D	Skewness	Kurtosis	Jarque–Bera	Probability	CV%
HC	187	8.046	3.094	0.388	4.011	12.667	0.001	38.453
CE	187	0.509	0.295	0.869	3.392	24.738	0.000	57.956
SC	187	0.851	0.150	−8.010	100.439	75,977.28	0.000	17.626
RC	187	0.652	3.589	11.654	155.552	185,564.2	0.000	550.460
MVAIC	187	10.061	4.265	2.902	35.143	8313.125	0.000	42.391
ROE	187	7.310	13.984	−2.941	13.492	1127.503	0.000	191.299
ROCE	187	2.119	0.870	−0.423	3.349	6.547	0.037	41.057
LEV	187	11.161	3.593	0.461	3.060	6.661	0.035	32.192
GDP	187	16.042	0.428	−0.467	1.389	27.023	0.000	2.667
SIZE	187	11.409	1.343	0.109	2.244	4.817	0.089	11.771

Source: developed by the authors with E-views 12.

According to the multiple correlation analysis in Table 3, the independent variables HC, SC, CE, and MVAIC have positive correlations with the dependent variable ROE. In contrast, RC is negatively correlated with ROE. HC, RC, and MVAIC are positively correlated with ROCE, while CE and SC are negatively correlated with ROCE. The CE shows negative associations with the other components, namely HC (−0.159), RC (−0.124) and SC (−0.022). Additionally, HC also shows negative correlations with CE (−0.159) and RC (−0.144) and a positive correlation with SC (0.413). RC shows a negative association with the other three components of I.C, viz., CE (−0.124), HC (−0.144), and SC (−0.918). However, SC is positively correlated with HC (0.413), followed by CE (−0.022) and RC (−0.918).

Table 3. Correlation Analysis.

	ROE	ROCE	HC	CE	SC	RC	MVAIC	LEV	GDP	SIZE
ROE	1.000	0.354	0.576	0.061	0.494	−0.424	0.082	−0.250	−0.292	0.081
ROCE	0.354	1.000	0.397	−0.492	−0.014	0.257	0.470	−0.649	0.169	0.664
HC	0.576	0.397	1.000	−0.159	0.413	−0.144	0.607	−0.088	−0.292	0.380
CE	0.061	−0.492	−0.159	1.000	−0.022	−0.124	−0.152	0.647	−0.124	−0.583
SC	0.494	−0.014	0.413	−0.022	1.000	−0.918	−0.439	−0.089	−0.129	0.143
RC	−0.424	0.257	−0.144	−0.124	−0.918	1.000	0.695	0.006	0.107	0.076
MVAIC	0.082	0.470	0.607	−0.152	−0.439	0.695	1.000	−0.017	−0.135	0.304
LEV	−0.250	−0.649	−0.088	0.647	−0.089	0.006	−0.017	1.000	−0.186	−0.416
GDP	−0.292	0.169	−0.292	−0.124	−0.129	0.107	−0.135	−0.186	1.000	0.286
SIZE	0.081	0.664	0.380	−0.583	0.143	0.076	0.304	−0.416	0.286	1.000

Source: developed by the authors with E-views 12.

4.2. Unit Root Test

The unit root tests were carried out to investigate whether the data series of the different independent, dependent, and control variables are stationary or not. In the present study, the tests of Levin, Lin and Chu (LLC), Breitung test statistics, and two sets of Fisher-type tests using ADF and Phillips–Perron (PP) tests, as proposed by Maddala and Wu and Choi, were used.

Hypothesis 0 (H0). *There is a unit root, and the data series of different variables are not stationary.*

Hypothesis 1 (H1). *There is no unit root, and the data series of different variables are stationary.*

In the initial stage, unit root tests were run at a certain level. However, none of the data series of the various variables (independent, dependent, and control) were discovered to be stationary at this level. Unit root tests were then performed at the first difference.

Table 4 reports the outcomes of test investigating the panel unit root of three dependent, four independent, and three control variables at the first difference. According to the LLC test, the data series of all the independent and three control variables at first difference are stationary. According to the LLC test, the data series of all the independent and dependent variables are stationary except for the size. SC is stationary at the 5% significance level. The results of the maximum tests reveal that the data series of all the variables are stationary at the first difference. Although some of the tests show non-stationarity regarding the data series of some variables, the maximum tests show that the data series are stationary at the three different levels (without C and T, with C, and with C and T). We reject the null hypothesis that the data series of the different variables are not stationary and accept the alternate hypothesis that the data series of all the independent, dependent, and control variables are stationary at the first difference.

Table 4. Panel unit root at the first difference.

	ROE	ROCE	HC	CE	SC	RC	MVAIC	LEV	SIZE	GDP
LLC										
None	−10.008 (0.000)	−10.420 (0.000)	−11.490 (0.000)	−9.725 (0.000)	−12.711 (0.000)	−6.300 (0.000)	−12.341 (0.000)	−12.213 (0.000)	−4.574 (0.000)	−7.474 (0.000)
With C and T	−3.819 (0.000)	−8.919 (0.000)	−5.830 (0.000)	−2.926 (0.000)	−1.645 (0.049)	0.236 (0.593)	−6.865 (0.000)	−8.385 (0.000)	−33.855 (1.000)	−5.537 (0.000)
With C	−3.841 (0.000)	−7.834 (0.000)	−7.906 (0.000)	−3.597 (0.000)	−4.662 (0.000)	−0.891 (0.186)	−9.666 (0.000)	−6.519 (0.000)	−27.672 (1.000)	−0.308 (0.378)
Breitung t-stat										
None	−4.596 (0.000)	−6.477 (0.000)	−5.997 (0.000)	−5.174 (0.000)	−6.244 (0.000)	−5.556 (0.000)	−6.759 (0.000)	−6.947 (0.000)	−0.800 (0.211)	−5.272 (0.000)
With C and T	−2.285 (0.011)	−4.084 (0.000)	−1.553 (0.060)	−1.558 (0.059)	1.850 (0.967)	−2.044 (0.020)	−1.189 (0.117)	−3.087 (0.001)	−2.025 (0.021)	−2.120 (0.017)
With C	−2.658 (0.003)	−4.100 (0.000)	−2.102 (0.017)	−2.973 (0.001)	−2.718 (0.003)	−2.688 (0.003)	−2.033 (0.021)	−3.752 (0.000)	−3.888 (0.000)	−3.148 (0.000)
ADF										
None	123.658 (0.000)	143.038 (0.000)	142.930 (0.000)	115.837 (0.000)	146.966 (0.000)	108.553 (0.000)	144.098 (0.000)	148.635 (0.000)	82.568 (0.000)	79.980 (0.000)
With C and T	42.021 (0.162)	63.966 (0.001)	47.091 (0.067)	39.511 (0.237)	54.658 (0.013)	41.864 (0.166)	58.415 (0.000)	64.211 (0.001)	63.115 (0.001)	24.296 (0.890)
With C	68.460 (0.000)	85.582 (0.000)	83.479 (0.000)	64.028 (0.001)	80.280 (0.000)	72.178 (0.000)	92.608 (0.000)	81.809 (0.000)	90.713 (0.000)	56.035 (0.010)
PP										
None	215.787 (0.000)	212.237 (0.000)	195.689 (0.000)	243.648 (0.000)	249.607 (0.000)	230.047 (0.000)	199.422 (0.000)	240.238 (0.000)	255.926 (0.000)	264.791 (0.000)
With C and T	138.195 (0.000)	152.903 (0.000)	115.148 (0.000)	180.423 (0.000)	164.142 (0.000)	192.369 (0.000)	146.950 (0.000)	197.930 (0.000)	267.203 (0.000)	299.427 (0.000)
With C	182.098 (0.000)	176.005 (0.000)	160.810 (0.000)	203.247 (0.000)	204.480 (0.000)	206.439 (0.000)	169.060 (0.000)	191.511 (0.000)	290.389 (0.000)	299.692 (0.000)

Source: developed by the authors with E-views 12.

4.3. Panel Least Squares Estimation Results

The findings of the panel least squares estimation with the cross-section random effect and fixed effect and without fixed and random effects are presented in Table 5. The ROE is the dependent variable in this situation, and there are four independent variables (CE, HC, RC, and SC), as well as three control variables for the GDP, leverage, and size. The results demonstrate that I.C significantly contributes to the enhancement of the bank's operational efficiency and the wealth creation and value of Indian banks. These outcomes support the results of [22,34,58,73].

Table 5. Panel least squared estimation using the cross-section random and fixed effects ROE.

	Without Fixed and Random Effects		Fixed Effect		With Cross-Section Random Effect	
	Coefficient	T Statistics	Coefficient	T Statistics	Coefficient	T Statistics
HC	2.010 *	5.902 (0.000)	1.993 *	5.554 (0.000)	2.010 *	5.671 (0.000)
CE	12.431 *	2.903 (0.004)	12.221 *	2.729 (0.007)	12.431 *	2.789 (0.005)
SC	−2.340	−0.172 (0.863)	−3.769	−0.264 (0.791)	−2.340	−0.165 (0.868)
RC	−1.328 **	−2.367 (0.019)	−1.389 **	−2.339 (0.020)	−1.328 **	−2.275 (0.024)
GDP	−0.448	−0.184 (0.854)	−0.771	−0.299 (0.764)	−0.448	−0.176 (0.859)
LEV	−0.643 **	−2.284 (0.023)	−0.654 **	−2.199 (0.029)	−0.643 **	−2.194 (0.029)
SIZE	−1.238	−0.832 (0.406)	−0.994	−0.625 (0.532)	−1.238	−0.799 (0.424)
C	−0.587	−1.020 (0.309)	−0.575	−0.959 (0.338)	−0.587	−0.980 (0.328)
R-squared	0.522		0.534		0.522	
Adjusted R-squared	0.501		0.460		0.501	
Durbin–Watson stat	2.668		2.737		2.668	
F-statistic	25.180 (0.000)		7.235 (0.000)		25.180 (0.000)	

* ($p \leq 0.01$), ** ($p \leq 0.05$). Source: developed by the authors with E-views 12.

The findings of the simple panel least squares analysis demonstrate that the HC and CE elements of I.C having significant and positive impacts on the ROE (p -value < 0.01). RC also exhibits a negative significant impact on the ROE (p -value < 0.05). Additionally, the leverage and size control variables also show significant negative impacts on the ROE. The R-squared and adjusted R-squared values are 0.522 and 0.501, respectively. This means that the different explanatory variables properly explain 52.20 percent of the variance in the dependent variable (ROE). Durbin–Watson was used to verify the autocorrelation or serial correlation of the model. Since the value of Durbin–Watson is 2.668, and this value is greater than 2 but less than 3, this means there is no serious problem of autocorrelation or serial correlation in the model. The F-statistic or ANOVA exhibits the overall good fitness of the model. For the present model, the F-statistic value is 29.039, and the associated p -value is less than 0.01, which means that the overall model is a good fit. The following is the equation of the model used to predict the ROE:

$$\text{ROE} = -0.587 + 12.431(\text{CE}) + 2.010(\text{HC}) - 1.328(\text{RC}) - 0.643(\text{LEV})$$

The panel least squares analysis with the fixed effect shows that CE, HC, and RC are the significant variables for the prediction of the ROE. CE and HC are found to be significant at the 1% level and RC is found to be significant at the 5 percent level, respectively. Leverage, as a control variable, also significantly impacts on the ROE. CE and HC show a positive association with the ROE, while RC and leverage show an inverse relationship with the ROE. Since the results of the fixed effect are similar to the simple panel least squares, this means that the heterogeneity of the banks does not affect the results. The following is the equation of the fixed effect mode:

$$\text{ROE} = -0.575 + 12.221(\text{CE}) + 1.993(\text{HC}) - 1.389(\text{RC}) - 0.654(\text{LEV})$$

The results of the cross-section random effect model are similar to those of the fixed effect model. Again, CE and HC show significant positive impacts on the ROE. In contrast, RC shows an inverse association with the ROE. In cross-section random effect analysis, the deviations between organizations are assumed to be accidental and uncorrelated with the explanatory or exogenous variables. A cross-section random effect model is also used to check the time-variant effect or random disturbances. In the present study, the findings of all three models were found to be similar. This means that the heterogeneity of the banks and the time-variant effect do not influence the results. The following is the equation of the cross-section random effect model:

$$\text{ROE} = -0.587 + 12.431(\text{CE}) + 2.010(\text{HC}) - 1.328(\text{RC}) - 0.643(\text{LEV})$$

Two out of the four elements of I.C, namely HC and CE, are significantly and positively associated with the ROE. On the other hand, RCE has a negative association with the ROE. An increase in relational capital leads to lower profitability. The findings are consistent with the results of [1,22,54,64]. Indian private sector banks can improve their profitability by increasing their investment in the knowledge and skills of the workforce (HCE) and balancing this with greater investment in tangible assets (CEE). However, these results are similar to those of previous studies, such as [5,22,54,64,73,86,87].

In this model (Table 6), the findings of the panel least squares analysis with the cross-section random effect and fixed random effect are reported. Here, the dependent variable is the ROCE. At the 1% level of significance, the components of I.C, namely RC and SC, are discovered to be significant. The link between the SCE and ROCE is positive. It indicates that private sector banks are effective in utilizing their internal intangible assets to increase the experience and abilities of their staff, therefore raising the productivity and profitability of PSBs [22,51,54,73], whereas few studies, such as [42,63], discovered a negative impact of SC on profitability. RCE also has a positive relationship with the ROCE. This demonstrates that increasing the capital invested in marketing and selling expenses and having a good relationship with stakeholders improve firm performance and facilitate the creation of a competitive edge. These results are in line with previous findings [1,20,86,87]. The two control variables, the GDP and leverage, are also found to be significant at the 1 percent level of significance. The control variable of GDP positively influences the ROCE, leverage, and size, showing a negative association with the dependent variable. The FR-squared and adjusted R-squared of the cross-section random effect value are 0.555 and 0.536. This indicates that all of the independent variables, taken together, may adequately explain the 55.54 and 53.60 variance in the ROCE. The *p*-value is less than 0.01, and the F-statistic is 28.73. Durbin–Watson’s ratio is 2.077, which means there is no serious problem of autocorrelation or serial correlation. The following is the equation of panel least squares with the cross-section random effect and without fixed and random effects:

$$\text{ROCE} = -0.027 + 0.253(\text{RC}) + 4.735(\text{SC}) + 0.396(\text{GDP}) - 0.049(\text{LEVERAGE})$$

Table 6. Panel least squares estimation using the cross-section random and fixed effect ROCE.

	Without Fixed and Random Effects		Fixed Effect		Cross-Section Random Effect	
	Coefficient	T Statistics	Coefficient	T Statistics	Coefficient	T Statistics
HC	0.021	1.379 (0.169)	0.020	1.236 (0.218)	0.021	1.326 (0.186)
CE	0.198	0.998 (0.319)	0.194	0.935 (0.350)	0.198	0.959 (0.338)
SC	4.735 *	7.505 (0.000)	4.801 *	7.241 (0.000)	4.735 *	7.215 (0.000)
RC	0.253 *	9.718 (0.000)	0.258 *	9.344 (0.000)	0.253 *	9.341 (0.000)
GDP	0.396 *	3.496 (0.000)	0.405 *	3.383 (0.000)	0.396 *	3.360 (0.001)
LEV	−0.049 *	−3.778 (0.000)	−0.047 *	−3.453 (0.000)	−0.049 *	−3.63 (0.000)
SIZE	−0.012	−0.183 (0.854)	−0.018	−0.252 (0.800)	−0.012	−0.176 (0.860)
C	−0.027	−1.023 (0.307)	−0.028	−1.014 (0.311)	−0.027	−0.983 (0.326)
R-squared	0.555		0.566		0.555	
Adjusted R-squared	0.536		0.497		0.536	
Durbin–Watson stat	2.077		2.109		2.077	
F-statistic	28.732 (0.000)		8.243 (0.000)		28.732 (0.000)	

* ($p \leq 0.01$). Source: developed by the authors with E-views 12.

The panel least squares analysis with the fixed effect shows that the RC, SC, GDP, and leverage are found to be significant at the 1 percent level of significance. In this model, the R-squared and adjusted R-squared values are 0.566 and 0.497, respectively. The value of the F-statistic or ANOVA value is 8.243. It is significant at 1 percent. The following is the equation:

$$\text{ROCE} = -0.028 + 0.258(\text{RC}) + 4.801(\text{SC}) + 0.405(\text{GDP}) - 0.047(\text{LEVERAGE})$$

Tables 7 and 8 represent the relationship between the overall intellectual capital (measured by the MVAIC model) and firm performance using the ROE and ROCE as dependent variables. There are three control variables, namely the GDP, leverage, and size. The model uses panel least squares estimation with the cross-section random and fixed effects and without the fixed and random effects. In Table 7, the overall I.C (measured by the MVAIC) is found to be significant at the 1 percent level of significance. The relationship between the MVAIC and ROE is negative. The control variables of the GDP and size are found to be significant at the 5 percent and 10 percent levels of significance. The GDP and leverage are negatively related to the ROE. The p -value is less than 0.001, and the F-statistic is 6.581. Durbin–Watson’s ratio is 2.101, which means there is no serious problem of autocorrelation.

Table 7. Panel least squares estimation using the cross-section random and fixed effect ROE.

Variables	Without Fixed and Random Effects		Fixed Effect		Cross-Section Random Effect	
	Coefficient	T Statistics	Coefficient	T Statistics	Coefficient	T Statistics
MVAIC	−0.858 *	−4.422 (0.000)	−0.810 *	−3.969 (0.000)	−0.858 *	−4.301 (0.000)
GDP	−8.708 *	−3.020 (0.002)	−8.917 *	−2.968 (0.003)	−8.708 *	−2.937 (0.003)
LEV	0.194	0.579 (0.563)	0.192	0.546 (0.585)	0.194	0.563 (0.574)
SIZE	2.886 ***	1.691 (0.092)	3.065 ***	1.700 (0.091)	2.886 ***	1.644 (0.102)
C	−0.549	−0.719 (0.472)	−0.558	−0.711 (0.477)	−0.549	−0.700 (0.484)
R-squared	0.138		0.177		0.138	
Adjusted R-squared	0.117		0.066		0.117	
Durbin–Watson stat	2.101		2.196		2.101	
F-statistic	6.581 (0.000)		1.600 (0.059)		6.581 (0.000)	

* ($p \leq 0.01$), ** ($p \leq 0.05$), *** ($p \leq 0.1$). Source: developed by the authors with E-views 12.**Table 8.** Panel least squares estimation using the cross-section random and fixed effect ROCE.

Variables	Without Fixed and Random Effects		Fixed Effect		Cross-Section Random Effect	
	Coefficient	T Statistics	Coefficient	T Statistics	Coefficient	T Statistics
MVAIC	0.066 *	8.538 (0.000)	0.066 *	8.025 (0.000)	0.066 *	8.175 (0.000)
GDP	0.302 *	2.606 (0.010)	0.312 *	2.548 (0.011)	0.302 *	2.495 (0.013)
LEV	−0.047 *	−3.542 (0.000)	−0.046 *	−3.212 (0.001)	−0.047 *	−3.392 (0.000)
SIZE	0.105 ***	1.541 (0.125)	0.101	1.375 (0.171)	0.105 ***	1.476 (0.141)
C	−0.015	−0.511 (0.610)	−0.016	−0.500 (0.617)	−0.015	−0.489 (0.625)
R-squared	0.400		0.410		0.400	
Adjusted R-squared	0.386		0.330		0.386	
Durbin–Watson stat	2.103		2.131		2.103	
F-statistic	27.428 (0.000)		5.148 (0.000)		27.428 (0.000)	

* ($p \leq 0.01$), ** ($p \leq 0.05$), *** ($p \leq 0.1$). Source: developed by the authors with E-views 12.

Table 8 shows that the total I.C (as determined by the MVAIC) is significant at the 1% level of significance. The ROCE is favorably impacted by the MVAIC in this model. At the 5% level of significance, the control variables GDP and leverage are determined to be significant. At the 10% level, the significance of size is discovered. ROCE has a positive relationship with the GDP and size. ROCE and leverage appear to be inversely related. The associated and adjusted R-square values are 0.400 and 0.386. This means that the one significant independent variable and control variable contribute 40 percent of the

variance in the dependent variable ROCE. The p -value is less than 0.01, and the F-statistic is 27.428. There are no significant issues with serial correlation or autocorrelation according to Durbin–Watson’s ratio, which is 2.03.

4.4. Hausman Test

The Hausman test results are shown in Table 9. The Hausman test is sometimes referred to as the model misspecification test. This test aids researchers in deciding whether or not to use a fixed effect model or a cross-section random model when analyzing panel data [22,42,54]. If the null hypothesis is accepted, the random model is the most appropriate one for the given data series. The acceptance of the alternative hypothesis reveals that the fixed effect model best fits the provided data series.

Table 9. Hausman Test.

Test Summary	Variables	Chi-Sq. Statistic	Chi-Sq d.f	Prob
Hausman Test	ROE	19.123	6	0.004
	ROCE	29.766	6	0.000
	ROE (MVAIC)	0.844	3	0.838
	ROCE (MVAIC)	9.839	3	0.020

Source: developed by the authors with E-views 12.

In the method used in the current investigation, the Hausman test is performed four times. First, the ROE is used as the dependent variable. In this instance, the related chi-square statistic value (19.123) is relatively high, and the p -value is less than 0.05, indicating that the null hypothesis is rejected and the alternative hypothesis is accepted. This indicates that the fixed effect model is a good fit model when using the ROE as the dependent variable and all the others as the independent variables (HC, SC, RC, and CE), together with two control variables. Secondly, the Hausman test is carried out using the return on capital employed (ROCE) as a dependent variable. Again, in this case, the associated chi-square value of the model is quite high, and the p -value is <0.05. This means that, again, in the case of the ROCE, the fixed effect model is the best-suited model as compared to the random model.

Thirdly, the Hausman test is carried out using the modified value added of the intellectual capital (MVAIC) as the independent variable, two control variables (leverage and size), and ROE as a dependent variable. Since the p -value of the associated chi-square test is greater than 0.05, this indicates the acceptance of the null hypothesis. It demonstrates that a random model is preferred over a fixed model in this case. Lastly, this test is conducted using the MVAIC as an independent variable, two control variables, and ROCE as a dependent variable. In this case, the p -value of the Hausman test is less than 0.05, and the associated chi-square test statistic is 9.839. This demonstrates that the null hypothesis is rejected and the alternate hypothesis is accepted, which further means that the fixed effect model is a good fit in the present case.

In the first, second, and fourth models, the heterogeneity of the banks is a major concern, as shown by the preference for the fixed effect model over the random model. The time-variant effect is the main issue with the third model, as shown by the preference of the random model over the fixed effect model.

5. Conclusions and Implications

The current study aimed to investigate intellectual capital (I.C) and the impact of its components on the sustainable financial performance (F.P) of private sector banks (PSBs) operating in India over an eleven-year period (2010–2021). For the period of 2010 to 2021, data from 17 PSBs currently operating in India were gathered. The modified value-added coefficient technique (MVAIC) was used to calculate the I.C of the banks. The two financial

ratios, namely the return on equity (ROE) and return on capital employed (ROCE), were used as dependent variables in depicting the sustainable financial performance of Indian PSBs. The I.C dimensions of human capital (HC), capital employed (CE), structural capital (SC), and relational capital (RC) were used as independent variables, and the GDP, size, and financial leverage were used as control variables. The data were arranged in balanced panel data form by retrieving the data for each dependent and independent variable over 11 years, including 17 PSBs. By using several unit root techniques, the stationarity of the dataset for the various variables was examined in the first stage. At a given level and the first difference, unit root tests were performed. All of the variable data series were discovered to be stationary at the first difference. As a result, all of the dependent and independent variable data series were changed into the first difference. Then, using two dependent variables (ROE and ROCE), a simple panel least squares analysis was performed using three alternative procedures (simple panel least squares, the fixed effect, and the cross-section random effect). The four models were developed to examine the impacts of the independent elements of intellectual capital (HC, CE, SC, and RC) on each dependent variable. In addition, the combined effect was studied using the above-mentioned variables (measured through the MVAIC). The study also used three control variables, namely the size, GDP, and leverage.

The empirical findings contribute to the body of research demonstrating that I.C plays a crucial role in providing private sector banks with a competitive edge and fostering value creation and sustainable financial performance (F.P). Our empirical findings revealed that the elements of I.C, the capital employed efficiency (CEE) and human capital efficiency (HCE), are positively and significantly related to the return on equity (ROE) [5,22,31,54,73,86,87], whereas the other two elements of I.C, the relational capital efficiency (RCE) and structural capital efficiency (SCE), also positively influence the return on capital employed (ROCE) [22,51,54,73,86,88]. However, the relational capital efficiency (RCE) shows a negative relationship with the ROE. The overall intellectual capital (I.C), as measured by the MVAIC, exhibits a positive and significant relationship with the ROCE and is negatively associated with the ROE. According to our findings, I.C plays a significant role in adding value to the banking industry. The elements of I.C all contribute significantly to the organization's increased productivity and profitability. These findings suggest that financial institutions that wish to boost their productivity and profitability should intensify their commitment to their HC, CE, SC, and RC. Through strategic planning, training, and development programs, HC may increase the staff's knowledge, talents, and skills. Since HC is the prime contributor to invention, creativity, and inspiration, it provides the company with a competitive advantage. By effectively and optimally using their physical assets and SC, which have a positive correlation with the ROCE, Indian private sector banks can also increase their profitability. This implies that the banks' profitability depends significantly on their investments in tangible and intangible assets, such as systems, databases, client relationships, and software.

Even though the empirical findings of this study show a favorable correlation between the sustainable financial performance of private sector banks and their I.C, thus far, the banks have invested a small amount of funds in the development of their I.C compared to other developing nations. Therefore, it is imperative that PSBs improve their investments by strengthening their IC. Examples of this include investments in technology, employee training, and development sessions and the improvement of client relationships by offering a better service. Therefore, this study may serve as a reference for executives and regulators in order to assess the effectiveness of the banks' I.C and to prioritize investing in its growth.

5.1. Implications of Findings

The results of this study have several practical and managerial implications for private sector banks. Indian banks can improve their productivity and profitability levels through the optimal use of their human capital (HC) and capital employed (CE), as these two factors have positive and significant relationships with the return on equity (ROE), and

the relational and structural capital (RC, SC) have a considerable positive link with the return on capital employed (ROCE). This implies that HC is a vital source of creativity and innovation, which aids in the achievement of inclusive and sustainable growth for both the bank and the country's economy. However, spending money on tangible and intangible resources such as software, systems, processes, procedures, and customer relationships are crucial for achieving profitability. Therefore, banks must have a robust infrastructure that promotes inclusive and sustainable economic growth.

Our study suggested that I.C can play an important role in enhancing the firm's performance. It is one of the valuable resources that provide a competitive edge to the firm in this knowledge-based world. Managers need to focus on the role of I.C and invest in various I.C components. The three elements of intellectual capital, the HC, CE, and SC, positively and significantly contribute to the bank's financial performance, and Indian private sector banks can enhance their profitability through the proper utilization and strengthening of the knowledge and skills of employees and by investing in physical assets and non-tangible assets. The least important component of intellectual capital is RC. As a result, we believe that private sector banks should place greater emphasis on relational capital in order to maintain regular contact with their stakeholders and create value. Even though the study's findings show a positive correlation between the I.C elements and financial indicators, thus far, Indian banks have invested less in I.C than banks in other emerging nations. As a result, it is important that private sector banks increase their investment by enhancing their I.C. This includes the building of strong customer relationships by providing better services, spending more on research, development, and technology, and the effective administration of training and development programs to improve the skills and knowledge of the workforce. In order to maintain a competitive edge in this information- and knowledge-based era, the policymakers of the private sector banks can use the information provided by this research to continuously improve these components of intellectual capital.

5.2. Limitations and Future Scope

Although every effort was made in this research to conduct a thorough investigation, it is impossible to take into account all the contributing aspects. In order to offer suggestions for future studies, it is necessary to acknowledge the current research paper's shortcomings. This study's primary goal was to determine how intellectual capital affects private sector banks' sustainable financial performance. To further understand how I.C affects the other pillars of the banks, a study could be conducted on the public sector, foreign sector, regional rural banks, small finance banks, and payments banks. Additionally, this study took into account solely Indian private sector banks. Additionally, the current work only examined issues pertaining to private banks in India; however, a comparative study should be performed to investigate how I.C affects the financial performance of banks in both the public and private sectors. Furthermore, future studies may take into account a sample of banks in various SAARC and ASEAN nations. Future studies could also consider other sectors in order to verify the influence of intellectual capital on the firm's performance. Another drawback is that this study did not take into account the Tobin-Q or other productivity and performance metrics that can have an impact on intellectual capital. Future studies could be undertaken using alternate methods, such as the national IC index and balance scorecard, to analyze the efficacy of I.C, since this study used the MVAIC approach. This study was entirely based on secondary data, but it could be further developed by asking upper-level bank personnel about their perceptions of the institution's financial performance. This would enable the investigator to pinpoint the variables that affect an institution's financial performance in different ways. Last but not least, the data for this study covered the years of 2010 to 2021, while future studies may potentially take the impact of COVID-19 on the banking sector into account (for pre-COVID and post-COVID analyses). As a result, as this study focused on the broader perspective of the private bank sector, it may serve as a foundation for subsequent research.

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Does intellectual capital impact the financial performance of Indian public sector banks? An empirical analysis using GMM

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This study examines the impact of intellectual capital (IC) on the financial performance (FP) of Indian public sector banks (IPSBs) between 2010 and 2021. This paper utilizes the modified value-added intellectual coefficient (MVAIC) approach to measure IC. It employs a panel data estimation approach, specifically the generalized method of moments (GMM), to investigate the connection between IC and the FP of public sector banks in India. The findings indicate that IC, along with its sub-elements of human capital (HC), capital employed (CE), structural capital (SC), and Relational capital (RC) have a notable positive or negative influence on various FP indicators, including return on assets (ROA), return on equity (ROE), return on capital employed (ROCE), earnings per share (EPS), and market performance (Tobin's Q). Furthermore, the combined IC, as evaluated through the modified value-added intellectual coefficient (MVAIC), has a notable and favorable impact on ROA and ROE. The leverage variable exhibits a negative and significant impact on the financial indicators, indicating that an increase in debt leads to a decrease in the bank's value. This study aims to assist stakeholders and policymakers in identifying the key elements of IC and determining an appropriate distribution among them to achieve sustainable FP and value generation in Indian IPSBs.

Introduction

Due to innovation, improvement, and a consistently changing business environment, the efficient and effective utilization of intangible and tangible assets is essential to organizations' success and sustainable growth (Khalique et al. 2019). Knowledge-intensive firms consider intellectual capital (IC) to be the most vital strategic asset for assessing and evaluating firm performance. The resource-based theory states that businesses that are in possession of "strategic resources" enjoy significant competitive advantages over those who are not in possession of such resources (Wernerfelt 1984). Currently, the scale of an organization is irrelevant, but effectively and efficiently making use of its resources can improve its profitability and sustainability. Particularly in the service sector, intangible assets such as IC have received immense support and emerged as one essential strategic assets for sustainable competitive advantage (Cohen et al. 2014; Janošević et al. 2013; Khalique et al. 2011). The banking sector is

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universally acknowledged as one of the country's most significant service sectors, and its role in economic growth is widely recognized. IC is recognized as one of the banking industry's most valuable and strategic assets (Mention and Bontis 2013). To understand and measure its impact on organizational success, market, and FP the topic has drawn the interest of both academics and professionals.

IC is often classified as non-tangible assets that have a positive impact on a company's performance but are not recorded on its balance sheet (Ozkan et al. 2017). The majority of academics acknowledge that evaluating IC pertains to measuring HC, CE, RC, and SC efficiencies when employing a monetary-based approach (Barak and Sharma 2023; Bayraktaroglu et al. 2019; Chowdhury et al. 2018; Kweh et al. 2022; Nazari and Herremans 2007; Pulic 1998, 2004; Smriti and Das 2018; Xu and Wang 2019). Researchers have demonstrated that IC contributes a significant part in improving the overall profitability of businesses. The management of a company will be able to increase the company's FP if they appropriately manage the IC of the company (Asare et al. 2021; Chowdhury et al. 2018; Inkien 2015; Khalique et al. 2019; Kweh et al. 2022; Le et al. 2022; Xu and Li 2019).

The transitions from an economy based on manufacturing to a knowledge and digital economy in developed countries highlight the benefits of IC (Forte et al. 2017). Developing nations like India need to draw attention to the vital role of the IC in revolutionizing their economies. This requirement can best be understood by first providing a concise overview of India. In just the past decade and a half, India's economy has risen from the 10th to the 5th largest on a global scale (Rao et al. 2023). Despite the world economy functioning in an exceedingly unfavorable macroeconomic climate and the COVID-19 effect, the Indian economy is predicted to increase by 7% year on year in the current fiscal 2023–2024. The union budget's initiatives to boost capital spending on infrastructure development, health, education, support for the green economy, and fortification of financial markets are anticipated to boost employment and speed growth in the economy, as highlighted in the budget 2023–2024. Due to the increasing adoption of digital devices, infrastructure changes, and India's history of frugal innovation, the speed of development in India's financial system can grow more rapidly than in other countries.

India is emerging as a South Asian nation with tremendous economic growth and development, with major trade engagements with SAARC nations such as the Preferential trading agreement in 1994 (SAFTA), the ASEAN-India Trade in goods agreement in 2009 (AITGA), the Indo-Sri Lanka free trade agreement in 1998 (ISFTA), and the South Asian free trade agreement in 2004 (SAFTA), the Indo Myanmar border trade agreement in 2009, India's economy is now highly intertwined with regional and global economies (Sahoo and Sethi 2023). According to the World Competitive Index 2022, India's economy has risen more dramatically than any other ASEAN member, moving up six places, from 43rd to 37th. India, ranked 7th, has retained its status as one of the top 10 countries worldwide for foreign direct investment, as stated in the World Investment Report released by the United Nations Conference on Trade and Development (UNCTAD) (Kanmony 2023).

India's banking industry contributes significantly to the country's overall economic expansion. In the year 2022, the overall value of all assets held within the banking industry reached a new high of 2.67 trillion US dollars. IC constitutes the most vital of all financial organizations. Financial institutions rely heavily on intangible assets like customer and employee connections and other forms of IC. Banks and other financial institutions are sometimes described as "knowledge-intensive" (Buallay et al. 2020). Both academics and industry professionals are particularly concerned about the strategic importance of IC, and they are unanimous in their belief that IC becomes an

essential bank asset that influences the long-term performance of banks (Mondal and Ghosh 2012). The academic community has a few studies on IC in the banking industry. As a result, it is essential to investigate the relationship between IC and banks' FP.

This research seeks to address the shortcomings in the existing literature about the ongoing discussions surrounding the impacts of MVAIC, its constituents, and FP, which have shown mixed results. We utilize the MVAIC model to assess the IC performance of 23 public sector banks operating in India from 2010 to 2021. Next, we analyze the linkage between IC and financial success to identify the components that have the greatest impact on profitability in India.

This study enhances the existing body of understanding by offering insights into the assessment of IC performance in the Indian banking industry. Additionally, it identifies the potential impact of IC on the FP of banks following the merger decisions made by the Indian government. This research further enhances the existing body of research on the factors that influence the profitability of banks. It not only enhances the profitability of banks but also aids policymakers in achieving their financial stability objectives. To address potential issues of endogeneity and account for the volatile nature of banking revenues, we utilize the generalized method of moments (GMM) model. This approach, which has not been extensively employed in previous studies, ensures the reliability and robustness of our estimation results.

With little prior research on the topic, this study fills a gap by analyzing the IC management and assessment practices of Indian public sector banks. The results of the unbalanced panel data analysis, conducted using the generalized method of moments (GMM), and accounting for potential heteroscedasticity and endogeneity difficulties in the variables, demonstrate that the combined intellectual capital (MVAIC) is positively and significantly associated with the financial performance indicators. Among the components of IC, human capital (HC) shows a particularly strong positive association. Therefore, it is essential to provide consideration to the HC through efficient management.

The subsequent sections of this work are organized as follows: following the introduction, the "Literature review" provides a comprehensive assessment of the intellectual literature. The "Research methodology" section outlines the research methodology. The "Empirical results and analysis" and "Discussion" sections, respectively, include information on the empirical findings, analysis, and discussion and encompass the consequences and limitations of the research.

Literature review

Understanding and assessing intellectual capital (IC). The ability of a company to develop, utilize, and evaluate its intangible resources to generate value is referred to as IC. This capability helps in the expansion of the company's operations and performance (Dean and Kretschmer 2007). Many academics agree that the term "intellectual capital" is utilized in a variety of contexts to denote intangible resources in a variety of ways. According to Ruckdeschel (1998), IC is an intangible value created for people and resources. The total amount of information a firm may utilize to run a business and generate value for itself is known as IC (Zeghal and Maaloul 2010).

IC is defined as "intellectual resources, knowledge, expertise, assets, and information that can be used to create value," according to (Dumay et al. 2015). The dynamic component of IC is reflected in the competitive advantages of the company that result either from the knowledge-based assets or the manner they are produced (Pirozzi and Ferulano 2016). The most revealing indicator of IC lies in the difference between a company's book value and its market value (Maditinos et al. 2011).

Intellectual capital and its elements. Clearly, IC is best understood as knowledge captured in an understandable form that can be used by organizations to generate value. IC is a collection of knowledge-based intangible resources that a company possesses and can manage effectively to gain a competitive advantage. Academicians typically divide the term “IC” into four categories: “human capital,” “capital employed,” “structural capital,” and “relational capital” to define it more clearly (Cohen et al. 2014; Kapoor and Saihjal 2022; Smriti and Das 2018; St-Pierre and Audet 2011; Weqar et al. 2020; Xu and Wang 2019).

Human capital (HC) is acknowledged as the key component of IC and consists of the knowledge, talent, expertise, abilities, education, and talents of an organization’s personnel that can enhance the performance of the organization (Cohen et al. 2014; Mention and Bontis 2013; Weqar et al. 2020; Zheng et al. 2022). IC relates to the capability to solve problems creatively, although a personnel education and skillset are the primary determinants of their competency (Meles et al. 2016). Employees contribute significantly to building and maintaining a competitive advantage (Rowlands 2018). Effective human resource management strategies directly impact HC development because they influence employee skill sets.

Structural capital (SC) supports human resources to leverage its knowledge. SC primarily encompasses organizational culture and infrastructure. SC is held by the corporation which includes strategies, information systems and datasets, structures, routines, methods, and procedures that support operations, innovation, and organizational efficiency (Cohen et al. 2014; Meles et al. 2016; Mention and Bontis 2013; Sardo and Serrasqueiro 2017). The capacity of an organization to communicate with its stakeholders (such as government, rival businesses, clients, trade groups, and suppliers) and the knowledge ingrained in these connections are referred to as relational capital (RC) (Cohen et al. 2014; Inkinen 2015; Mention and Bontis 2013; Sardo and Serrasqueiro 2017). In general, a corporation needs to maintain RC, over time to strengthen its connections with its stakeholders to approach new resources (Meles et al. 2016). The capital employed (CE) metric measures the output produced by a corporation for each monetary unit spent on manpower (Xu and Wang 2019). CE is referred to as the efficiency of both financial and physical resources (Poh et al. 2018).

Several models are created to assess IC. The following is a list of these techniques. Intangible Assets Monitor (Sveiby 1997), value-added intellectual coefficient (Pulic 1998, 2000), modified value-added intellectual coefficient (Ulm 2015), Tobin’s Q (Mourtsen et al. 2012), Balanced Scorecard (Kaplan et al. 1996), Skandia Navigator (Edvinsson and Malone 1997), Technology broker (Annie 1996), Economic value added and market value added (Chen Goh 2005a). The VAIC model is used by the majority of researchers in comparison to alternative IC assessments due to its accessibility, which enables efficient comparison across companies or nations (Chen Goh 2005a; Kapoor and Saihjal 2022; Kasoga 2020; Le et al. 2022; Phusavat et al. 2011; Poh et al. 2018; Pulic 2004; Sardo and Serrasqueiro 2017; Soewarno and Tjahjedi 2020; Tran and Vo 2020). The VAIC model has drawbacks, such as ignoring RC and innovation capital, major elements of IC. So, in this article, we employed the MVAIC methodology to evaluate the effectiveness of IC because it is essential for a corporation to have better stakeholder relations given the intense market competition (Aybars and Oner 2022; Buallay et al. 2019, 2020; Montequín et al. 2006; Pal and Soriya 2012; Tiwari and Vidyarthi 2018; Tran and Vo 2020; Weqar et al. 2020; Xu and Wang 2019).

Intellectual capital and firm’s performance. The performance of banks is crucial for the economy as it catalyzes economic growth (Mohapatra et al. 2019). Initially, research on the relationship

between IC and FP was primarily conducted in developed economies. However, there has been a significant increase in studies from emerging economies. Corporations now recognize the significance of investing in knowledge and IC to uphold and enhance their performance. Knowledge assets are crucial resources for achieving corporate success. The word “IC” commonly refers to intellectual assets, which are widely recognized as a crucial source of strategic advantage and value generation (Smriti and Das 2018).

Multiple empirical investigations have consistently found strong evidence of a positive relationship between IC and FP (Alhassan and Asare 2016; Anifowose et al. 2018; Dzenopoljac et al. 2017; Gupta and Raman 2021; Hamdan 2018; Innayah et al. 2020; Joshi et al. 2013; Meles et al. 2016; Nadeem et al. 2018; Oppong et al. 2019; Vishnu and Kumar Gupta 2014). Furthermore, other studies fail to demonstrate a significant association between the dependent and independent variables (Barathi Kamath 2007; Chu et al. 2011; Firer and Mitchell Williams 2003; Maditinos et al. 2011; Mehralian et al. 2012).

Additionally, it has been observed that not every aspect of IC holds the same level of importance in determining the organization’s performance (Bontis 1998). The studies conducted in different countries (Adesina 2019; Alipour 2012; Buallay et al. 2019; Chen Goh 2005a, b; Chen 2012; Forte et al. 2017; Hamdan 2018; Joshi et al. 2013; Le et al. 2022; Nadeem et al. 2018; Poh et al. 2018; Sardo and Serrasqueiro 2017; Ting et al. 2021; Tiwari and Vidyarthi 2018; Tran and Vo 2018; Vishnu and Kumar Gupta 2014; Weqar et al. 2020) demonstrate that HC and SC are the predominant and significant constituents of IC that impact FP.

Furthermore, additional studies investigating the impact of combined IC (MVAIC) on FP. Vishnu and Kumar Gupta (2014) and Maji and Goswami (2017) provide proof demonstrating a strong association between IC-MVAIC and firm performance in India. In their study, Farooque et al. (2023) investigated the association between IC-MVAIC and the FP of Islamic and conventional banks listed in GCC nations. They discovered that MVAIC is more effective in improving the profitability metrics of conventional banks compared to VAIC in Islamic banks. Xu and Liu (2020) and Tran and Vo (2020a) demonstrate that IC-MVAIC has a favorable impact on accounting-based firm performance in the South Korea and Vietnam markets, respectively. According to Bayraktaroglu et al. (2019), the different elements of IC efficiency play a moderating function in the connection between CE efficiency and profitability. Nimtrakoon (2015) demonstrates that IC-MVAIC has a favorable impact on business efficiency in various Asian nations. In a study conducted by Xu and Li (2019), it was found that there is a significant association between the IC-MVAIC and the accounting-based performance of both non-high-tech and high-tech companies in China. The study conducted by Zheng et al. (2022) suggests that enhancing IC efficiency has a beneficial impact on bank performance in Bangladesh.

It is recognized that there have been few studies conducted to investigate the impact of IC on the FP of the Indian banking industry. Many articles commonly employ a straightforward regression method to quantify the causal impact of IC on FP (Al-Musali and Ismail 2014; Weqar et al. 2021). Nevertheless, we employ an alternative methodology, namely GMM, to address the issues of endogeneity and account for the dynamic characteristics of bank earnings. This study has also encompassed the COVID-19 period, potentially shedding light on the impact of the pandemic on the FP of banks.

Research methodology

Data collection. The current research aims to explore the role of IC in the FP of Indian public sector banks (IPSBs). The data for

IPSBs was compiled using financial statements from their annual reports and ProwessIQ, a database maintained by the Centre for Monitoring the Indian Economy (CMIE). Unbalanced panel data for the period 2010–2021 was collected from 23 banks (before and after the merger of banks) of public sector banks. After extracting all necessary data from “ProwessIQ,” it was discovered that several observations were missing. The yearly reports of the banks were searched manually to find the missing data. Banks were removed from the dataset that had missing values that could not be located even from annual reports.

Research methodology. To assess the impact of IC on FP, some scholars (Kasoga 2020; Meles et al. 2016; Isanzu 2015; Nawaz and Haniffa 2017) have employed the value-added intellectual coefficient (HC, SC, and CE) as proposed by Pulic (1998). Nevertheless, the VAIC model does have certain limitations. To address these limitations, the researchers devised the MVAIC framework, which incorporates a supplementary component of IC, referred to as Relational Capital (RC). RC encompasses a company's interactions with various stakeholders, such as customers, vendor partners, creditors, shareholders, and marketing distributors. So in this research, the MVAIC technique (Bayraktaroglu et al. 2019; Buallay et al. 2020; Tran and Vo 2018; Weqar et al. 2020; Xu and Li 2019) is used to determine the effect of IC on FP. Capital employed efficiency (CEE), Human capital efficiency (HCE), relational capital efficiency (RCE), and structural capital efficiency (SCE) are the four independent variables used to describe the elements of IC and two control factors (firm size and leverage) have been used. Five dependent variables return on asset (ROA), return on equity (ROE), market performance (Tobin's Q) or (TQ), earnings per share (EPS), and return on capital employed (ROCE), are employed as indicators of FP. Data of different elements of IC, dependent variables, and control variables have been collected from 2010 to 2021. Data series of different aforesaid variables are arranged into a balanced panel data format. The first stage of the estimate examines how each dependent variable is affected by the different components of IC (HC, CE, SC, and RC). The different elements of IC have also been used to examine the combined effect of IC (measured through MVAIC) on the FP of IPSBs. Initially, the values from descriptive statistics and the matrix of correlation between variables are calculated to comprehend the relationship and nature among the variables. Later, to check the stationarity of data, various panel unit root techniques are employed. First, stationarity is checked at a level and then at first difference. The data series of multiple variables are stationary at first difference. Accordingly, we convert the data series of all the dependent, independent, and control variables into the first difference. The generalized method of moments (GMM) (Arellano and Bond 1991) is employed in this study to analyze how IC affects public sector banks' FP.

Measurement of variables

Classification of intellectual capital. This research employs the MVAIC approach, which has been extensively utilized in prior empirical investigations for evaluating IC (Aybars and Oner 2022; Buallay et al. 2019; Tran and Vo 2020; Vidyarthi 2019; Weqar et al. 2020; Xu and Wang 2019). MVAIC is a combination of four performance variables. MVAIC has been calculated using the formula:

$$\text{MVAIC} = \text{HCE} + \text{CEE} + \text{SCE} + \text{RCE}$$

where HCE is the marginal impact of every unit of HC to value-

added; SCE is the share of SC to generating value; CEE is the marginal contributions of every unit of monetary and physical capital to value-added; and RCE is the role of RC in generating value. The four elements of MVAIC have been calculated in the following order: HCE, SCE, CEE, and RCE:

$$\text{HCE} = \text{VA}/\text{HC}$$

$$\text{SCE} = \text{SC}/\text{VA} = (\text{VA} - \text{HC})/\text{VA}$$

$$\text{CEE} = \text{VA}/\text{CE}$$

$$\text{RCE} = \text{RC}/\text{VA}$$

where VA is the value-added. VA is classified as the Operating profit plus employees' cost, Depreciation, and Amortization. HC signifies total personnel expenditure. SC is computed by subtracting HC from VA. Both monetary and physical capital are denoted by CE. Marketing, sales, and advertising costs are used to calculate RC.

Dependent variables. This research applies return on assets (ROA), return on capital employed (ROCE), return on equity (ROE), market performance (Tobin's Q or TQ), and earnings price per share (EPS) as proxies for banks' financial performance indicators. To construct the model for this research, we first looked at other studies that had been done previously (Aybars and Oner 2022; Barak and Sharma 2023; Buallay et al. 2019; Kapoor and Saihjal 2022; Kasoga 2020; Tran and Vo 2020; Weqar et al. 2020; Xu et al. 2020; Zheng et al. 2022):

$$\text{ROA} = \text{Net income}/\text{Total assets}$$

$$\text{ROCE} = \text{Earnings before interest and tax}/\text{Capital employed}$$

$$\text{ROE} = \text{Profit available to equity shareholders}/\text{Shareholders' fund}$$

$$\text{TQ} = \frac{\text{Market value of equity} + \text{Book value of the short-term liabilities}}{\text{Book value of total assets}}$$

$$\text{EPS} = \text{Net income}/\text{Shares Outstanding}$$

Control variables. Leverage, which can be determined as the ratio of total outside liabilities to total assets, and Size, which can be approximated as the log of total assets, are used as proxies for bank characteristics. These two control factors were chosen because of their significant contributions to the company's overall performance (Aybars and Oner 2022; Buallay et al. 2019; Kapoor and Saihjal 2022; Weqar et al. 2020; Xu and Wang 2019).

Generalized method of moments (GMM) estimation. Regarding the valuation technique, most studies employ a straightforward regression technique to quantify the causal impact of IC on FP. For instance, Weqar et al. (2020) employ multiple linear regression analysis to examine the relationship between ROE, ROA, and ATO as dependent variables, and various components of VAIC. In a similar manner, Poh et al. (2018) utilize linear regression analysis to quantify the correlation between VAIC, its constituent elements, and FP. Nevertheless, the possible issue of endogeneity, as previously stated, might lead to biased and inconsistent estimation findings when using ordinary least squares (OLS). Therefore, Xu et al. (2023) employ a fixed-effects model to account for bank-specific variables at the individual level. While a fixed-effects model effectively manages unchanging unobserved traits, it is unable to account for variables that vary over time (Allison 2009). It is contended that this approach can generate a reliable estimation when we assume no association between unique errors and independent variables. Nevertheless, this assumption may be invalidated by time-varying unobservable factors (such as sudden

financial stress) or reverse causality (where MVAIC influences financial success). In this research, we utilized the two-step GMM estimation technique, considering potential endogeneity issues.

The OLS estimation method, which assumes n_i to be unrecognized and the existence of a correlation between predictor variables and unobservable characteristics (n_i), remained biased in the presence of firm-specific effects (Hsiao 1985). If an error term (ε_{it}) is serially uncorrelated then the instrumental variable estimate method gives reliable findings. Arellano and Bond (1991) suggest the generalized method of the moment (GMM), assuming that the error term is serially uncorrelated. Within the group of instrumental variable estimators, GMM is the most effective technique (Honore and Hu 2004). Numerous earlier studies have found that two-step GMM is more effective than one-step estimation when the disturbances are anticipated to exhibit heteroscedasticity in big sample data with a reasonably long period (Arellano and Bond 1991; Blundell and Bond 2023).

The success of GMM estimation, however, is dependent on a few presumptions, including the validity of the other predictor variables and the lagged value of the dependent variable, as well as the absence of autocorrelation in the model's error term. Arellano and Bond (1991) suggested three steps to achieve this. The first step is to determine whether the error component of the suggested model exhibits any autocorrelation. The test statistic has a conventional normal distribution under the null hypothesis that there is no serial connection. The second is to ensure that the error term in the GMM model is distributed as a standard normal under the null hypothesis of no serial correlation, and should not exhibit second-order autocorrelation. The third is the Sargan (1958) test for over-identifying limitations, sometimes known as J statistics. Under the null hypothesis of instrument validity, this evaluates the validity of the instruments and asymptotically distributed as Chi-square.

We propose five models to study the unique influence of each element of IC on each dependent variable. The following is the model equation:

$$\begin{aligned} \text{Model 1: } -\text{ROA}_{it} &= \alpha_0 + f(\text{ROA}_{it-1}, \text{CEE}_{it}, \text{HCE}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \\ \text{Model 2: } -\text{ROE}_{it} &= \alpha_0 + f(\text{ROE}_{it-1}, \text{CEE}_{it}, \text{HCE}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \\ \text{Model 3: } -\text{EPS}_{it} &= \alpha_0 + f(\text{EPS}_{it-1}, \text{CEE}_{it}, \text{HCE}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \\ \text{Model 4: } -\text{TQ}_{it} &= \alpha_0 + f(\text{TQ}_{it-1}, \text{CEE}_{it}, \text{HCE}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \\ \text{Model 5: } -\text{ROCE}_{it} &= \alpha_0 + f(\text{ROCE}_{it-1}, \text{CEE}_{it}, \text{HCE}_{it}, \text{SC}_{it}, \text{RC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \end{aligned}$$

The following are the GMM equations to investigate the combined effect of IC (MVAIC) on the FP of public sector banks:

$$\begin{aligned} \text{Model 6: } -\text{ROA}_{it} &= \alpha_0 + f(\text{ROA}_{it-1}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \\ \text{Model 7: } -\text{ROE}_{it} &= \alpha_0 + f(\text{ROE}_{it-1}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \\ \text{Model 8: } -\text{EPS}_{it} &= \alpha_0 + f(\text{EPS}_{it-1}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \\ \text{Model 9: } -\text{TQ}_{it} &= \alpha_0 + f(\text{TQ}_{it-1}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \\ \text{Model 10: } -\text{ROCE}_{it} &= \alpha_0 + f(\text{ROCE}_{it-1}, \text{MVAIC}_{it}, \text{LEVERAGE}_{it}, \text{SIZE}_{it}) \\ &\quad + n_i + n_t + \varepsilon_{it} \end{aligned}$$

where ROA_{it} , ROE_{it} , EPS_{it} , TQ_{it} , and ROCE_{it} are the different measures of profitability of IPSBs, it in year, ε_{it} is the error term, n_i is the unrecognized firm-specific effects and n_t is the time-specific effects. The variables remaining in the equations represent the various IC measures used as explanatory variables. MVAIC reflect the combined effect of different component of IC.

Empirical results and analysis

Table 1 summarizes the descriptive statistics for all dependent and independent variables. The value produced by HCE is 1.888 out of the four IC elements with the greatest mean value. When compared to the other components, the HCE makes up the majority of the average MVAIC value of 3.672. The average value of the three non-physical elements (HCE, RCE, and SCE) combined is 3.547, which is much higher than the average value of CEE, which is 0.128. This distinction suggests that non-physical assets create higher value creation for IPSBs than tangible ones. Similar outcomes were observed in earlier research (Ahmed et al. 2022; Alipour 2012; Kapoor and Saihijal 2022; Maditinos et al. 2011; Mehralian et al. 2012; Vergauwen et al. 2007). The dependent variable's EPS had a higher mean value, 18.919, indicating that banks are profitable and in a strong financial position. Following that, ROCE had a mean value of 1.391. Since TQ in this instance is less than 1, it can be assumed that the bank's market value is lower than its book value. As a result, if the stock market value of the capital is lower than the book value, then replacing the capital will not be a prudent step as it would only result in its deterioration. The results of the Kasoga (2020) investigation are similar to this finding. Following it was ROE, with an average of 0.645, and ROA, with a low average of 0.074, indicating more assets used to produce a profit.

Karl Pearson's method was adopted to perform correlation analysis shown in Table 2. None of the coefficients have a value of greater than 0.9, and significant association is absent in the sample (Field 2013; Hair et al. 2013; Pallant 2010; Tabachnick et al. 2013). Multicollinearity hence does not affect the estimation variables. The independent variables HCE, CEE, RCE, and MVAIC are positively correlated with the dependent variables ROA, TQ, and ROE. Whereas SCE has negatively correlated with ROA, ROE, TQ, and ROCE but is weakly positively related to EPS. The dependent variable ROCE is negatively correlated with the CEE, HCE, SCE, and MVAIC but positive association with RCE.

Unit root test. Using unit root tests we utilized the tests proposed by Levin et al. (2002) (LLC) in addition to two sets of Fisher-type tests employing ADF and Phillips-Perron (PP) as given by Choi (2001) and Maddala and Wu (1999).

Hypothesis (H0). There is a unit root, and the different variables' data series are not stationary.

Hypothesis (H1). There is no unit root, and the different variables' data series are stationary.

The results of a panel unit test with five dependent, five independent, and two control variables are displayed in Table 3. The findings show that every variable is stationary at the first difference. We accept the alternative hypothesis as all the variables are stationary at first difference. Therefore, the null hypothesis is rejected as the variables are not stationary.

Empirical results using the generalized moments method. The results of GMM estimation using the five dependent variables and different components of IC as independent variables are presented in Table 4. The outcome of ROA reflects that the lagged value of a dependent variable significantly affects the dependent variable. The components of IC, namely, capital employed efficiency (CEE), and structural capital Efficiency (SCE) are observed to be significant at a 1% level (p value < 0.05) and demonstrate a negative association with ROA (Mohapatra et al. 2019; Muhammad and Ismail 2009; Sardo and Serrasqueiro 2017; Ting et al. 2021). The leverage, a control variable, has shown a significant value. The negative association between CEE, SCE, and ROA indicates that IPSBs are not operating efficiently. However, human capital efficiency (HCE) and ROA reflect a positive significant relationship (Adesina 2019; Buallay et al. 2019; Forte et al. 2017; Le et al. 2022;

Table 1 Descriptive statistics.

	ROA	ROE	EPS	TQ	ROCE	CEE	HCE	RCE	SCE	MVAIC	LEV	SIZE
Mean	0.074	0.645	18.919	0.762	1.391	0.123	1.888	1.201	0.458	3.672	1.028	12.493
Std. Dev	0.855	19.590	46.561	0.837	0.685	1.239	11.737	8.239	2.753	14.732	0.481	0.893
Skewness	-1.656	-2.927	0.916	10.894	-0.957	-13.580	-12.755	3.038	-7.027	-8.926	0.277	0.829
Kurtosis	5.905	16.482	5.845	146.847	3.033	198.936	183.173	29.350	70.045	116.264	2.368	3.686
Jarque-Bera	187.659	2088.738	110.711	204,613.4	35.430	378,245	320,095.7	7068.918	45,362.78	127,092.4	6.827	31.146
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.000
Sum	17.310	149.750	4389.230	176.910	322.850	28.6836	438.100	278.850	106.343	851.977	238.585	2898.418
Sum Sq. Dev	169.204	88,656.30	500,804.6	161.980	108.535	354.784	31,824.20	15,683.30	1751.661	50,136.74	53.478	184.486
Observations	232	232	232	232	232	232	232	232	232	232	232	232

Source: Constructed with the E-views 12 by the authors.

Table 2 Correlation analysis.

Variable	ROA	ROE	TQ	ROCE	EPS	CEE	HCE	RCE	SCE	MVAIC	LEV	SIZE
ROA	1.000											
ROE	0.940	1.000										
TQ	0.115	0.077	1.000									
ROCE	0.064	0.043	0.147	1.000								
EPS	0.671	0.607	0.154	-0.056	1.000							
CEE	0.183	0.178	0.030	-0.059	0.142	1.000						
HCE	0.221	0.212	0.034	-0.058	0.189	0.991	1.000					
RCE	0.049	0.044	0.023	0.069	-0.012	0.022	0.019	1.000				
SCE	-0.066	-0.052	-0.038	-0.090	0.005	-0.014	0.000	-0.679	1.000			
MVAIC	0.207	0.199	0.036	-0.029	0.156	0.883	0.891	0.450	-0.193	1.000		
LEV	0.041	-0.023	0.113	0.044	0.112	0.068	0.009	-0.07	0.089	0.062	1.000	
SIZE	-0.036	-0.042	0.238	0.434	-0.079	0.013	0.013	0.033	-0.016	0.027	0.256	1.000

Source: Constructed with the E-views 12 by the authors.

Table 3 Panel unit root at the first difference.

Variable	ROA	ROE	EPS	TQ	ROCE	CEE	HCE	RCE	SCE	MVAIC	LEV	SIZE
LLC												
Without C&T	-12.842 (0.000)	-13.585 (0.000)	-16.696 (0.000)	-11.805 (0.000)	-15.607 (0.000)	-18.443 (0.000)	-17.460 (0.000)	-13.005 (0.000)	-13.324 (0.000)	-17.422 (0.000)	-62.076 (0.000)	-9.780 (0.000)
With C	0.699 (0.058)	4.972 (0.001)	-9.750 (0.000)	2.675 (0.996)	-7.7832 (0.000)	-8.577 (0.000)	-9.374 (0.000)	-5.891 (0.000)	-15.479 (0.000)	-9.317 (0.000)	-62.076 (0.000)	-4.931 (0.000)
With C&T	-0.306 (0.379)	5.573 (1.000)	-10.421 (0.000)	8.557 (1.000)	-6.801 (0.000)	-20.996 (0.000)	-21.179 (0.000)	-1.166 (0.121)	-3.856 (0.000)	-16.165 (0.000)	-5.458 (0.000)	-2.327 (0.010)
ADF												
Without C&T	168.137 (0.000)	170.482 (0.000)	205.411 (0.000)	133.729 (0.000)	177.215 (0.000)	169.788 (0.000)	166.064 (0.000)	227.473 (0.000)	225.996 (0.000)	190.214 (0.000)	221.899 (0.000)	144.191 (0.000)
With C	89.022 (0.000)	83.402 (0.000)	113.652 (0.000)	83.226 (0.000)	92.002 (0.000)	109.300 (0.000)	96.837 (0.000)	144.777 (0.000)	136.140 (0.000)	104.489 (0.000)	106.830 (0.000)	79.832 (0.000)
With C&T	50.908 (0.001)	44.023 (0.007)	53.730 (0.000)	36.296 (0.051)	50.736 (0.001)	58.670 (0.000)	57.101 (0.000)	75.024 (0.000)	65.164 (0.004)	58.915 (0.000)	61.974 (0.013)	48.835 (0.000)
PP												
Without C&T	334.276 (0.000)	330.416 (0.000)	340.588 (0.000)	310.767 (0.000)	306.115 (0.000)	309.601 (0.000)	325.651 (0.000)	316.211 (0.000)	325.236 (0.000)	336.322 (0.000)	335.616 (0.000)	267.674 (0.000)
With C	295.596 (0.000)	296.344 (0.000)	281.395 (0.000)	289.569 (0.000)	251.615 (0.000)	251.969 (0.000)	260.572 (0.000)	278.539 (0.000)	290.319 (0.000)	289.336 (0.000)	290.727 (0.000)	197.862 (0.000)
With C&T	191.019 (0.000)	183.568 (0.000)	163.119 (0.000)	185.319 (0.000)	163.006 (0.000)	192.157 (0.000)	187.044 (0.000)	163.126 (0.000)	170.578 (0.000)	183.527 (0.000)	201.323 (0.000)	160.014 (0.000)

Source: Constructed with the E-views 12 by the authors.

Sardo and Serrasqueiro 2017; Ting et al. 2021; Tran and Vo 2018; Weqar et al. 2020; Xu et al. 2020). The findings contradict those of Firer and Mitchell Williams (2003) and Kasoga (2020) who discovered that HCE had a negative effect on the FP of organizations. In this instance, the lagging value of the dependent variable is statistically significant. Significant first-order correlation indicates

serial correlation or autocorrelation in the model. However, second-order correlation is not substantial, indicating that autocorrelation is not a problem. The Sargan test (p value > 0.05) indicates the validity of instruments and they are uncorrelated with residual. The first model is a suitable fit for examining the effect of IC on ROA.

Table 4 GMM estimation.

Variables	ROA		ROE		EPS		TQ		ROCE	
	Coeff.	T-statistics	Coeff.	T-statistics	Coeff.	T-statistics	Coeff.	T-statistics	Coeff.	T-statistics
LAG (Δ)	-0.294*	-8.917 (0.000)	-0.316*	-14.675 (0.000)	-0.390*	-38.272 (0.000)	-0.474*	-664.156 (0.000)	-0.284*	-23.530 (0.000)
CEE	-1.054*	-2.966 (0.003)	-27.457*	-5.290 (0.000)	-73.937*	-6.858 (0.000)	0.315*	3.055 (0.002)	-0.101**	-2.502 (0.020)
HCE	0.116*	2.972 (0.003)	3.068*	5.111 (0.000)	8.140*	6.400 (0.000)	-0.033*	-3.893 (0.000)	0.010**	2.311 (0.030)
RCE	-0.002	-1.034 (0.302)	-0.051	-0.624 (0.538)	-0.764**	-1.996 (0.050)	-0.002	-1.270 (0.205)	0.000*	3.366 (0.002)
SCE	-0.037*	-3.850 (0.000)	-0.689***	-1.970 (0.061)	-3.483	-1.461 (0.158)	-0.003	-1.526 (0.128)	-0.006*	-5.438 (0.000)
LEV	-0.437*	-10.513 (0.000)	-14.234*	-13.251 (0.000)	-10.566*	-4.888 (0.000)	-0.258*	-22.523 (0.000)	-0.035*	-3.225 (0.003)
SIZE	-0.421	-1.031 (0.303)	2.382	0.638 (0.529)	-8.736	-0.410 (0.685)	-0.002	-0.167 (0.867)	0.006	1.612 (0.121)
Sargan test	15.544 (0.485)		19.515 (0.242)		14.117 (0.589)		21.227 (0.169)		17.564 (0.350)	
Correlation 1	0.007		0.188		NA		0.295		NA	
Correlation 2	0.226		NA		NA		0.329		0.999	

Source: Constructed with the E-views 12 by the authors.

* $p \leq 0.01$; ** $p \leq 0.05$ *** $p \leq 0.1$.

In the second model, ROE is a dependent variable. Just like the previous model, the lag value of ROE is found to be a significant determinant of ROE. The variables, namely, CEE, and SCE, the components of IC, exhibit a negative significant effect on ROE. Contrary, the HCE reflects a positive significant effect on ROE (Buallay et al. 2020; Sardo and Serrasqueiro 2017; Tran and Vo 2018; Xu et al. 2020; Xu and Wang 2019). The p value > 0.05 of the Sargan test reflects that the instruments used in the study are valid and uncorrelated with error terms. This model's first-order correlation indicates that autocorrelation is not an issue (p value > 0.05).

The third model deals with EPS as the dependent variable; the empirical findings of this model are like the earlier two models in that CEE and SCE reflect a substantial negative effect on EPS. The HCE depicts the positive significant effect on EPS. But then, relational capital efficiency (RCE) is a new significant determinant of EPS ($p \leq 0.05$). The lag value of EPS is also a significant determinant of EPS.

In the fourth model Tobin's Q (TQ), the variables CEE and HCE are the significant determinants of dependent variables along with the lag value of TQ. In this model, CEE has a positive association with TQ (Kapoor and Saihjal, 2022) but HCE has a negative correlation with TQ (Dzenopoljac et al. 2017; Kapoor and Saihjal 2022; Kasoga 2020). This suggests that the market value of the bank over time is favorably influenced by the CEE whereas, HCE influences negatively. In the last model, HCE and RCE demonstrate a positive significant effect on ROCE. In contrast, CEE, and SCE, along with the lag of ROCE, reflect a substantial negative effect on ROCE. Since the values of the Sargan test in both models are 21.227 and 17.564, respectively, and the p value is more than 0.05, we cannot reject the null hypothesis, showing that the instruments are valid and uncorrelated with residual. In the fourth model, the first-order and second-order correlations are insignificant, and serial correlation is not an issue. Similarly, the second-order correlation in the final model is not significant.

Table 5 displayed the combined effect of IC and lag of own dependent variables on the different dependent variables. Modified value-added intellectual capital (MVAIC) positively impacts ROA (Buallay et al. 2020; Weqar et al. 2020; Xu and Wang 2019), ROE (Buallay et al. 2020), EPS, and ROCE. This indicates that IC makes

an important contribution to the improvement of bank performance and the creation of value for IPSBs. In contrast, the MVAIC negatively affects TQ. Leverage of a control variable reflects the negative significant impact on all five dependent variables (ROA, ROE, EPS, TQ, and ROCE). In all five models, the p value associated with the Sargan test or J statistics is greater than 0.05. It means all five models meet the conditions over identified restrictions. This also means that all the variables, including the lag of their variables, are valid instruments and uncorrelated with the error term. As the corresponding p value is greater than 0.05, there is no issue with the first-order and second-order correlation in the case of TQ and ROCE. The first-order correlation in the case of ROA is serially correlated with the error term, however, the second-order correlation is not serially associated with the error term and there is no serial correlation. Similarly, in the case of ROE and EPS, there is no second-order serial. Overall, we can conclude that IC has a substantial positive influence on public sector banks and that all the generated models are accurate predictors of the FP of Indian PSBs.

Discussion

Underpinned by the GMM estimation the current study aims to examine the role of intellectual capital (IC) on the financial performance (FP) of Indian public sector banks (IPSBs). The study used the MVAIC model using four elements of IC, these elements are capital employed (CE), human capital (HC), structural capital (SC), and relational capital (RC). These proxies are employed to represent different elements of IC. The different indicators have been used to represent the financial performance. These five FP parameters are utilized as dependent variables, they are return on assets (ROA), return on equity (ROE), return on capital employed (ROCE), Tobin's Q (TQ), and Earning price per share (EPS). The study also used two control variables leverage and size. The data of all variables have been collected for the period 2010 to 2021. Initially, descriptive statistics and a matrix of correlation coefficients of different factors are computed to know the nature of the data and the existence of a problem of multicollinearity. Later stationarity of different variables is examined

Table 5 GMM estimation (MVAIC).

Variable	ROA		ROE		EPS		TQ		ROCE	
	Coeff.	T-statistics	Coeff.	T-statistics	Coeff.	T-statistics	Coeff.	T-statistics	Coeff.	T-statistics
LAG (Δ)	-0.327*	-12.915 (0.000)	-0.351*	-21.959 (0.000)	-0.413*	-54.722 (0.000)	-0.472*	-2800.923 (0.000)	-0.305*	-22.322 (0.000)
MVAIC	0.002**	2.379 (0.026)	0.074*	3.558 (0.001)	0.049	0.858 (0.400)	-0.000	-0.653 (0.520)	0.000	0.363 (0.719)
LEV	-0.503*	-10.951 (0.000)	-14.283*	-24.448 (0.000)	-10.986*	-10.248 (0.000)	-0.250*	-99.579 (0.000)	-0.046*	-6.523 (0.000)
SIZE	0.199	0.732 (0.471)	4.686	1.341 (0.193)	4.212	1.081 (0.291)	-0.019	-1.943 (0.064)	0.013	0.829 (0.415)
Sargan test	19.243 (0.441)		21.962 (0.286)		19.929 (0.398)		22.472 (0.261)		17.271 (0.436)	
Correlation 1	0.007		NA		0.015		0.296		0.952	
Correlation 2	0.449		0.452		0.613		0.331		0.966	

Source: Constructed with the E-views 12 by the authors.

* $p \leq 0.01$; ** $p \leq 0.05$.

using the unit root techniques. First, the stationarity of all variables is investigated at a level. Since none of the variables is observed to be stationary at level. So, on examining the first difference the data series of all the variables are found to be stationary. Accordingly, the data series of multiple variables are converted into the first difference. Later GMM technique is applied to examine the effect of IC on the FP of Indian public sector banks. GMM estimation is preferred over linear panel least square (Anifowose et al. 2018; Farooque et al. 2023; Tiwari and Vidyarthi 2018; Zheng et al. 2022). As GMM techniques remove the problem of endogeneity. In the GMM technique lag of the dependent variable is used as an independent variable along with other independent variables. According to the GMM technique, there is a need to fulfill certain assumptions. These assumptions are the lag of the dependent variable should be a significant variable along with other independent variables. All the instruments should be valid and should not be correlated with residuals. There should not be a problem of first-order and second-order autocorrelation.

The results of this study indicate that the HCE is the primary driver of financial performance in Indian public sector banks, which is consistent with other studies (Adesina 2019; Nadeem et al. 2018; Ting et al. 2021; Weqar et al. 2021) but not in line with the result (Rehman et al. 2022). This is because the nation is still developing and its banking system is not fully established. The finding demonstrates that the development of HC is essential to the banks' ability to expand sustainably. A corporation with strong human resources would perform better and be more creative and innovative. FP was negatively impacted by SCE and CEE, although market performance (TQ) showed a statistically significant and favorable association with CEE. According to studies by Ozkan et al. (2017) and Ginesti et al. (2018), there is a strong and negative relationship between CEE and SCE and financial performance metrics. However, market performance (TQ) has a statistically significant and positive association with CEE.

The inverse correlation between CEE and SCE and the financial performance metrics highlights the necessity for Indian public sector banks to prioritize the physical capital invested in the banks and strive to decrease their non-performing assets. Banks should also monitor their strategies, operations, procedures, and organizational efficiency to improve the bank's profitability. In contrast, RCE shows a negative and strong correlation with EPS and a negligible relationship with all other financial performance metrics, except for ROCE. Lastly, we examined the impact of the control variables on financial performance and discovered that financial

leverage has a considerable negative impact while size has a positive impact. As leverage or debt capital is increased it leads to a decline in the profitability of the public sector banks.

The overall impact of IC (MVAIC) has been shown to have a substantial positive influence on financial performance metrics, as evidenced by the studies conducted by Maji and Goswami (2017), Nimtrakoon (2015), Tran and Vo (2020), Vishnu and Kumar Gupta (2014), Xu et al. (2020) and Zheng et al. (2022). The results indicate that allocating resources to IC has a positive effect on the financial outcomes of Indian public sector banks. Leverage again shows a negative significant impact on financial performance. This may be due to the increase in debt enhancing the interest expenses. Moreover, financial risk also increases as we use more amount of debt capital. All the models developed using GMM reflect the good fit model. All the models fulfill the condition of a good fit model. J-statistic or Sargan test value is significant in all the cases which means all the models fulfill the over-identifying condition and the instruments used in the model are valid and not correlated with error terms.

Practical implications. The current study should have relevance for different stakeholders including the banking authorities, the government, society, and other stakeholders. Enhancing the profitability of IPSBs is a great challenge for banking authorities as well as for the government. This study highlights that CEE and SCE have a negative impact on profitability. There is a need to pay attention, to why CEE has a negative impact on profitability. It may be due to more proportion of debt capital in capital employed. There is a need to put a cap on debt capital to enhance financial performance. Similarly, the SCE also demonstrates the negative impact, there is also a need to reassess the investment made in infrastructure and cost involvement in strategy formulation.

The HCE has a substantial positive effect on FP. Government and banking authorities are urged to increase their investment in personnel training and development, skills, and expertise of their personnel to improve operational performance. The combined effect of IC shows a positive significant impact on different measures of FP metrics. It implies that policymakers are recommended to increase investment in the IC to maximize profits. The article also indicates that efficient administration of IC resources mitigates the adverse effects of detrimental shocks induced by crises such as the COVID-19 pandemic.

Societal implications. The study's conclusions provide significant advantages for society. When Indian banking institutions possess high-quality infrastructure and technology, society will experience several advantages such as superior financial services, innovative banking initiatives, reduced borrowing costs, efficient resource utilization, economic expansion, and enhanced quality of life.

Theoretical implications. An analysis was conducted to carefully examine the contribution of this research to the existing knowledge database. The aim was to determine the relationship between financial success and IC. This enabled the Indian public sector banks to boost their IC, serving as a benchmark for maintaining a competitive and knowledge-driven environment. Bank authorities should enhance their efforts to ensure the inclusion of banks' IC in their financial reports. This created knowledge is widely thought to assist academics and scholars in identifying the suitable measures of intellectual capital that serve as more accurate forecasters of value creation and an organization's growth.

Implications for future researchers. Despite making every effort to conduct a thorough investigation in this research, it is not practicable to evaluate all the contributing aspects. Recognizing the constraints of the present research is crucial to propose additional research. The primary objective of this study was to investigate the impact of intellectual capital on the financial performance of Indian public sector banks. Firstly, the investigation solely encompassed banks that are owned by the government. Subsequent investigation could prioritize the examination of international and local rural, cooperative banks, payment, and small finance institutions. Secondly, this study just focuses only on the banking sector. Further research can explore other industries as well to validate the impact of intellectual capital on a company's performance. Thirdly, future researchers may have the capability to integrate additional financial parameters that are pertinent to banks to undertake comprehensive analyses of intellectual capital and financial performance. Fourthly, this study employed the MVAIC approach to assess the efficacy of IC, thereby paving the way for future investigations to explore alternative methodologies such as the national IC index, the intangible assets monitor, the balanced scorecard, the technology broker, and the value-added intellectual coefficient (VAIC).

Data availability

The datasets used and analyzed in this study are disclosed in the paper.

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Author contributions

The first author was responsible for the conception, planning, and implementation of the study, as well as the statistical analysis. The interpretation of the results was assisted by the second author. All the authors have gone through the process of revising and reading the work and agreed on the current version of the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

This article contains no human participant investigations conducted by any of the authors.

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Additional information

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Analyzing the Impact of Intellectual Capital on the Financial Performance: A Comparative Study of Indian Public and Private Sector Banks

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Abstract

This paper explores the effect of intellectual capital (I.C) on the financial performance (F.P) of 12 public and 17 private sector banks in India. To get a comprehensive viewpoint, the study will try to answer the research question, i.e., *Does the intellectual capital affect the financial performance of the Indian banks with respect to their multidimensionality?* We used intellectual capital and financial performance as multidimensional constructs (human capital (H.C), capital employed (C.E), structural capital (S.C), and relational capital (R.C) for intellectual capital and return on assets (ROA), return on equity (ROE), return on capital employed (ROCE), and return on sales (ROS) for financial performance). Data were collected over 12 years, specifically from 2010 to 2022 from each bank. This study employed the modified value-added intellectual coefficient (MVAIC) measure as an alternative to the disputed value-added intellectual capital (VAIC) model to address the shortcomings of the previous research. The present study employed advanced longitudinal cointegration techniques to authenticate and validate the results. The fully modified ordinary least squares (FMOLS) method is employed to assess the effectiveness of the intellectual capital. The results suggest a positive relationship between human capital and all financial metrics, except for ROE, in the context of public sector banks. Further efficiency of capital employed and structural capital positively affects public sector bank financial performance indicators like ROA, ROE, ROCE, and ROS. Private sector banks have a negative correlation between relational capital and ROS whereas it demonstrates a positive association with ROCE. Similarly, there is a negative correlation between relational capital and both ROA and ROE in the case of public sector banks. For instance, the MVAIC model improves all financial performance measures except ROA, especially in private sector banking. The findings will assist executives, government officials, and policy-makers in quantifying the efficiency and discerning the essential intellectual elements that enhance their effectiveness. Additionally, these findings will aid in devising strategies to foster and enhance their intellectual capacity.

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JEL Classification C1 · J24 · L25 · G21

Introduction

In the context of the post-industrial and digital economy, the concept of efficiency must be reviewed from the standpoint of innovation (Taneja et al., 2024). Efficiency is measured in the current situations in ways other than just maximizing output while using the fewest resources possible. In the modern era, the evaluation of an organization's efficiency and effectiveness is predicated on the utilization of its intangible resources. The knowledge-based economy is characterized by its focus on the effective and innovative usage of intangible resources (Tiwari & Vidyarthi, 2018). In the present era of the digital and knowledge-based economy, there has been a significant shift in the primary factor that drives organizational efficiency, performance, and value creation. In the past, physical assets were largely recognized as the primary determinant. The knowledge that provides more value to the firm is known as I.C, though with the emergence of this new knowledge-based economy (Chen Goh & Pheng Lim, 2004; Soheli Rana & Hossain, 2023). Consequently, many enterprises in the modern economy, especially those in the service sector like banks, prioritize intellectual capital (I.C) over physical capital. Banks substantially depend on I.C, which they utilize strategically to achieve a competitive edge by optimizing output levels (Al-Azizah & Wibowo, 2023; Kamal et al., 2012; Kwaku Mensah Mawutor et al., 2023; Madani et al., 2015; Martens, 2023; Mollah & Rouf, 2022). According to the resource-based approach, both tangible and intangible resources are crucial for achieving success in a company (Barney, 1991).

The banking industry plays a crucial role in facilitating economic progress and wealth generation in every nation worldwide. A banking sector's stability and effectiveness are essential to the smooth operation of a financial system and the progressive development of an economy because they are crucial to the distribution of capital that promotes economic growth (Cao et al., 2021; Khaliq et al., 2013; Poh et al., 2018). India's economic growth has predominantly centered around the service sector since the implementation of economic liberalization in the early 1990s. In the second quarter of 2023–2024, India's economy grew by an astounding 7.6% of GDP, outpacing the growth of major global countries, according to data from the Ministry of Statistics and Programme Implementation. The nation's growth-oriented policies have demonstrated its continued commitment to a knowledge-based economy as opposed to a production-only one. Consequently, manual banking in India has been replaced by an increasing emphasis on the utilization of information technology-enabled financial services. This shift has resulted in the progressive transformation of Indian banks into universal banks (Tiwari & Vidyarthi, 2018).

The stability of a country's financial sector is essential to its sustainable growth and expansion. As a result of globalization and COVID-19, banks are confronted

with new challenges because of the escalating complexity of emerging technologies, the advancement of communication and information techniques, and the rise in consumer expectations, as well as regulatory constraints. The dynamic transformations occurring in the banking industry and the competitive landscape have compelled financial institutions to function as a sector that heavily relies on knowledge (Zheng et al., 2022). This further led financial institutions to prioritize the assessment of the I.C to achieve their long-term goals.

To gain a competitive edge and improve financial performance (F.P), banks in developed and developing countries are now focusing more on I.C due to significant advancements in the banking sector. Studies have revealed that intangible resources, such as I.C, hold equal importance in contemporary economies as financial and physical capital (Majumder et al., 2023; Nguyen, 2023; North & Kumta, 2018). The presence of intellectual capital (I.C) plays a crucial role in the financial performance (F.P) of banks and in generating value (Majumder et al., 2023; Nguyen, 2023; Sohel Rana & Hossain, 2023; Ullah et al., 2023; Weqar & Haque, 2020). Hence, the study intended to answer the research question, i.e., *Does intellectual capital affect the financial performance of the Indian banks with respect to their multidimensionality?*

It is again worth mentioning that the primary objective of this study is to examine the linkage between I.C and F.P to the Indian banking sector (both public and private, respectively). Moreover, to get a comprehensive result, this investigation used I.C and F.P as multidimensional constructs (human capital (H.C), capital employed (C.E), structural capital (S.C), and relational capital (R.C) for I.C and ROA, ROE, ROCE, and ROS for F.P). Hence, the present study aims to broaden the investigation on the effectiveness of I.C as the primary driver of competitive edge and ascertain the extent to which I.C enhances the performance of Indian banks. Furthermore, this work intends to augment the existing knowledge base by addressing multiple research gaps utilizing the dataset that is now available. Since the current study is intended to function as a single, comprehensive article, it has examined the I.C and F.P in the Indian sector, taking into account both of them as multidimensional constructs. This research aims to enhance the current knowledge based on I.C and F.P by examining a period that encompasses two significant economic events in India: demonetization and COVID-19. Moreover, it is worth mentioning that the current study's outcome will bridge the gap by providing a holistic comparative analysis of both public and private sector banks to I.C and F.P and their respective elements. The MVAIC model is employed as a means of quantifying the efficiency of I.C (Sardo & Serrasqueiro, 2017; Vishnu & Kumar Gupta, 2014). This model is known for its enhanced accuracy and consistency compared to the conventional VAIC model. Our study aimed to employ an appropriate econometric method for analyzing longitudinal data, specifically focusing on the 12-year period (2010–2022) that includes the consequences of demonetization and COVID-19. This distinguishes our research from previous studies. We conducted panel data analysis using the fully modified ordinary least squares method (FMOLS) to investigate the influence of intellectual capital (I.C) on the financial performance (F.P) of Indian banks.

The following are the main objectives of the study:

- (i) To investigate the degree of relationship among the different components of the intellectual capital of the Indian public and private sector banks
- (ii) To examine the individual impact of different components of intellectual capital on the financial performance of Indian banks
- (iii) To compare the combined effect of intellectual capital on the financial performance of Indian public and private sector banks

The subsequent sections of the study are organized in the following manner: the “[Literature Review](#)” section provides a comprehensive theoretical framework and literature review. The “[Research Methodology](#)” section provides an overview of the data and methodology implemented in the study. The “[Empirical Results](#)” section provides an in-depth analysis and presentation of the empirical findings. The “[Discussion](#)” section provides a comprehensive summary of the discussion, implications, conclusion, limitations, and recommendations for future research.

Literature Review

Theories Concerning I.C and Firm Performance

Resource-Based View

The relationship between I.C and firm performance is commonly explained by the resource-based hypothesis (Kamaluddin & Rahman, 2013). Company assets are thought to be the primary factor influencing company performance (Barney, 1991). According to Riahi-Belkaoui (2003), these resources include both tangible and intangible assets that businesses use to maintain their profitability and competitiveness. In today’s digital and knowledge-driven economy, there is a growing demand for organizations to give priority to intangible assets rather than the tangible ones (Wernerfelt, 1995). It is also critical to remember that, in terms of performance, tangible and intangible assets depend on one another. Since competitors cannot simply duplicate I.C, unlike other physical assets, it increases the likelihood of a sustained competitive advantage (Kamaluddin & Rahman, 2013; Nadeem et al., 2018). Previous researchers, Rehman et al. (2022), Faruq et al. (2023), Kawaku Mensah Mawutor et al. (2023), and Asutay (2023), employed the resource-based view theory. The reason the RBV is important to this study is that a bank’s competitive edge and overall efficiency in India can be greatly impacted by its distinct and well-known H.C, S.C, C.E, and R.C resources. Through efficient utilization of these resources, banks may set themselves apart from rivals and maintain long-term prosperity in demanding competitive surroundings.

Stakeholder Theory

Obtaining external resources is essential for the long-term viability of any organization, as it is always uncertain and presents a potential concern. Organizations require continuous access to external resources to preserve their strategic significance.

Corporations should prioritize delivering value to all stakeholders, rather than exclusively concentrating on shareholders. However, creating a link between the external forces and the corporate boards could potentially mitigate this problem (Freeman et al., 2010). Relational capital (R.C) is an essential element of I.C, which pertains to how a firm manages its relationships with stakeholders. R.C incorporates not just the loyalty and strength of a client relationship but also qualities such as understanding and trust (Kannan & Aulbur, 2004). According to the research conducted by Soewarno and Tjahjadi (2020), the term R.C denotes the information that a company has regarding individuals who are not employed by the company nor are they, its clients.

Definition and Review of the Components of I.C

I.C refers to the firm's total hidden assets, which account for the difference between the market value of its stock and the replacement cost of its tangible assets (Sardo & Serrasqueiro, 2017; Vishnu & Kumar Gupta, 2014). Intellectual capital (I.C) refers to the valuable knowledge assets possessed by a company and has drawn considerable academic interest (Bayraktaroglu et al., 2019). The main components of I.C, as identified by scholars, are human capital (H.C), structural capital (S.C), relational capital (R.C), and capital employed (C.E) (Cabrita & Bontis, 2008; Chowdhury et al., 2018; Kujansivu & Lönnqvist, 2007; Nazari & Herremans, 2007; Ozkan et al., 2017; Petty & Guthrie, 2000; Pulic, 1998, 2004; Stewart, 1997; Ulum et al., 2017; Zheng et al., 2022). This categorization is crucial for comprehending and examining the various knowledge resources of organizations, recognizing them as important assets in particular areas. These four elements of I.C have been shown to significantly improve firm performance in a growing body of research on the practical application of knowledge within businesses (Martens, 2023; Nguyen, 2023; Ullah et al., 2023; Zheng et al., 2022). Their vital contribution to the achievement of an organization's goals is emphasized (Farooque et al., 2023; Faruq et al., 2023; Youndt et al., 2004).

Human capital (H.C) is an inherent part of individuals, encompassing their skills, education, knowledge, expertise, and capability. It is closely tied to the person and cannot be owned or controlled by the company (Alhassan & Asare, 2016; Al-Musali & Ismail, 2014; Edvinsson, 1997; Hamdan, 2018; Kianto et al., 2010; Pulic, 1998; Weqar & Haque, 2022). It is widely accepted that investing in H.C can improve the quality of the workforce, increase national income, and spur growth in the economy (Eniola et al., 2015). The efficient use and administration of an organization's tangible and intangible resources, including procedures, technology, organizational information systems, data, strategies, routines, infrastructure, patents, and organizational culture, is known as structural capital efficiency, or SCE (Ismail & Kareem, 2011). It is about creating a welcoming atmosphere that promotes learning, experimentation, and knowledge integration. To increase the value of the company, S.C influences H.C to create and use knowledge.

All intellectual resources used to manage and control an organization's external interactions, including ties with stakeholders, suppliers, consumers, and marketing

channels, are collectively referred to as R.C (Bollen et al., 2005; Cabrita & Bontis, 2008; Meles et al., 2016). It may foster confidence in the organization and affect the perceptions of the stakeholders (Liu, 2017; Ting et al., 2021). By providing the necessary infrastructure and resources, RCE enables HCE and SCE to maximize their resource utilization which leads to an overall enhancement in the efficiency of the company (Widowati & Pradono, 2017). One important indicator that puts a company's value creation in context with its capital investments is capital employed efficiency (CEE). This metric incorporates both the physical and financial aspects of I.C (Smriti & Das, 2018). Physical assets are essential in enhancing the organization's profitability and productivity (Nadeem et al., 2018). It affects an organization's capacity to produce income, and C.E can boost profitability and productivity (Bayraktaroglu et al., 2019; Kweh et al., 2022; Nadeem et al., 2018; Nimtrakoon, 2015; Ozkan et al., 2017; Xu & Wang, 2019).

Relationship Between I.C and Firm Performance

As a driver of economic expansion, bank performance plays a significant role in the economy (Mohapatra et al., 2019). I.C plays a crucial function in the growth and development of the organization. Several empirical investigations on the relationship between the I.C and the firm's F.P indicators have discovered a positive correlation (Anifowose et al., 2018; Asutay & Ubaidillah, 2023; Bayraktaroglu et al., 2019; Buallay et al., 2020; Farooque et al., 2023; Gupta & Raman, 2021; Innayah et al., 2020; Martens, 2023; Nguyen, 2023; Ousama et al., 2019; Prasojo et al., 2022; Xu & Zhang, 2021; Xu et al., 2022; Zheng et al., 2022).

The studies utilized the VAIC and MVAIC techniques to assess the efficacy of financial indicators, including ROA, ROE, Tobin's Q , ATO, EPS, ROS, and ROCE. The findings indicate that I.C significantly influences firm performance (Barak & Sharma, 2023; Bayraktaroglu et al., 2019; Farooque et al., 2023; Faruq et al., 2023; Kweh et al., 2022; Mollah & Rouf, 2022; Nguyen, 2023; Nimtrakoon, 2015; Prasojo et al., 2022; Smriti & Das, 2018; Soewarno & Tjahjadi, 2020; Wang, 2011; Xu et al., 2022, 2023; Zheng et al., 2022). In their study, Martens (2023) examined the impact of technical efficiency and MVAIC on the performance of Taiwanese banks between 2010 and 2023. The results demonstrate that I.C improves efficiency and increases revenue growth, yet its impact on profitability is complex. Challenges were identified with RCE and HCE, both of which showed a negative correlation with ROE. CEE has a dual impact, enhancing the operational ratio while diminishing the profit margin.

Mawutor et al. (2023) conducted a study on sub-Saharan African banks to investigate the correlation between I.C and their performance. The study utilized a panel regression methodology to analyze the performance of 80 banks across 21 countries from 2000 to 2020. The study found that the VAIC, HCE, and SCE positively and significantly influence the performance of banks. However, CEE negatively and significantly affects the profitability of banks, specifically ROA. In addition, Xu et al. (2023) investigated the influence of COVID-19 on the I.C performance of banks in China and Pakistan from 2019 to 2020. The study

demonstrates an insignificant, however, adverse impact of COVID-19 on the I.C efficiency of the banking industry in both economies. Results reveal that while I.C components have been slightly affected by the COVID-19 pandemic, they are resilient against it.

In a study conducted by Nguyen et al. (2023), it was found that I.C had a notable positive influence on the performance of Vietnamese commercial banks from 2007 to 2020. The findings suggest that the VAIC and its components, HCE, CEE, and SCE, have a favorable impact on bank performance. The study also analyzed the impact of income diversification (ID) on bank performance and found a significant and negative correlation. Additionally, Faruq et al. (2023) look into the connection between the performance of Bangladesh's listed banks from 2015 to 2021 and metrics of I.C efficiency. The results indicate that ROA is favorably correlated with the elements of MVAIC, HCE, SCE, RCE, and CEE.

A study conducted by Awwad and Qtaishat (2023) examined the performance of 13 Jordanian commercial banks listed on the Amman Stock Exchange from 2009 to 2018. The study found a positive relationship between competitive advantage, I.C, and F.P in commercial banks. Prasojo et al. (2022) examined the efficacy of Islamic banking institutions over 10 years from 2009 to 2019. The findings indicate that the use of VAIC has a significant positive impact on the performance of Islamic banks, as measured by both ROA and income. SCE is associated with ROA but not with IFIB, whereas HCE and CEE exhibit a positive correlation with both ROA and IFIB.

Tiwari et al. (2023) conducted a study on 39 Indian banks spanning the years 2005–2019. The findings revealed a significant positive influence of the I.C and its two subcomponents, namely, H.C and C.E, on bank productivity. Duho (2020) employs the slack-based technical efficiency method to examine the banking sector in Ghana from 2012 to 2017. The study reveals that H.C plays a crucial role in determining banking efficiency. In their study, Al-Azizah and Wibowo (2023) examined how I.C influenced the F.P of Indonesian banks between 2017 and 2021. The results indicate that the VAIC has a considerable impact on F.P, specifically on ROA, ROE, and ATO. The different elements of VAIC have no impact on F.P.

The results of multiple studies have shown that the individual elements of I.C have diverse impacts on the financial sector. Therefore, it would be highly beneficial to identify the subdimensions (H.C, S.C, C.E, R.C) of the I.C that have the most significant influence on the efficiency and profitability of the Indian public and private sector banks. Their long-term competitive advantage can be significantly increased by this understanding. To improve the existing body of knowledge on I.C and F.P, this study looks at a time that includes two important economic events that happened in India: COVID-19 and demonetization. This study seeks to fill the research void regarding I.C in the Indian banking sector. To examine the effect of I.C on the F.P, the study used the cointegration regression technique (FMOLS). The assessment will quantify the existing utilization of I.C by banks and identify areas where they might concentrate their efforts to improve the effectiveness of their intellectual operations.

Research Methodology

Conceptual Framework

The main focus of this study was to understand the impact of subdimensions of intellectual capital (I.C) on the financial performance (F.P) of both public and private sector banks in India. This study applied the conceptions of I.C and F.P as multidimensional factors. I.C was measured using human capital (H.C), capital employed (C.E), structural capital (S.C), and relational capital (R.C). Financial performance was assessed using return on assets (ROA), return on equity (ROE), return on capital employed (ROCE), and return on sales (ROS). All four of the I.C components are shown in Fig. 1, and their effects on the F.P are displayed.

Data Collection

The data for banks was compiled using financial statements from their annual reports and ProwessIQ, a database maintained by the Centre for Monitoring Indian Economy (CMIE). Data for 29 banks out of 33 banks were collected between 2010 and 2022. After extracting all necessary data from “ProwessIQ,” it was discovered that several observations were missing. The yearly reports of the banks were searched manually to find the missing data. Banks were removed from the dataset that had missing values that could not be located even from annual reports.

Research Methodology

Multiple techniques exist for measuring I.C. The value-added intellectual coefficient (VAIC), developed by Pulic (1998), is widely utilized and endorsed by certain academics as a means of evaluating I.C. Furthermore, VAIC is unbiased, measurable, easy to understand, and comparable because it uses data from audited financial statements that are accessible (Nimtrakoon, 2015). In addition, Ulum et al. (2014) introduced the concept of relational capital as an element to enhance the modified VAIC (MVAIC), which is utilized in this work. MVAIC is an organized method that enables all pertinent stakeholders, ranging from executives to

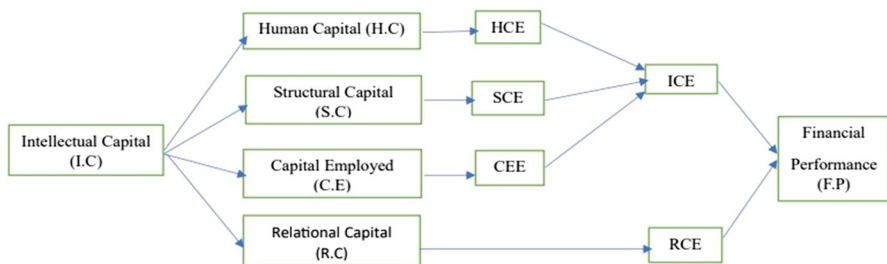


Fig. 1 I.C components and their effects on the F.P

investors, to assess and oversee the I.C efficiency of companies. This assessment reflects their capacity to generate more value by utilizing their assets.

In the current study, the MVAIC technique (Ahmad et al., 2023; Asutay & Ubaidillah, 2023; Bayraktaroglu et al., 2019; Buallay et al., 2020; Farooque et al., 2023; Faruq et al., 2023; Sohail Rana & Hossain, 2023; D. B. Tran & Vo, 2018; Umar & Dandago, 2023; Weqar et al., 2020; Xu & Li, 2019) is used to assess the effect of I.C on F.P. HCE, CEE, SCE, and RCE are the four independent variables used to describe the elements of I.C, and two control factors (firm size and leverage) have been used. Four dependent variables, return on asset (ROA), return on equity (ROE), return on capital employed (ROCE), and return on sales (ROS), are employed as indicators of F.P. Data series of different aforesaid variables are arranged into a balanced panel data format. The first stage of the estimate examines how each dependent variable is affected by the different components of I.C (HCE, CEE, SCE, and RCE). The different elements of I.C have also been used to examine the combined effect of I.C (measured through MVAIC) on the F.P of Indian scheduled commercial banks. Initially, the values from the descriptive statistics and the matrix of correlation between variables are calculated to comprehend the relationship and nature among the variables. Later, to check the stationarity of data, various panel unit root techniques are employed. First, stationarity is checked at a level and then at first difference. The data series of multiple variables are stationary at first difference. Accordingly, we convert the data series of all the dependent, independent, and control variables into the first difference. The fully modified ordinary least squares (FMOLS) is employed in this study to analyze how I.C affects the 29 scheduled commercial banks' F.P.

Measurement of Variables

Classification of Intellectual Capital

This research employs the MVAIC approach, which has been extensively utilized in prior empirical investigations for evaluating I.C (Ahlawat et al., 2023; Ahmed et al., 2022; Asutay & Ubaidillah, 2023; Aybars & Oner, 2022; Buallay et al., 2019; Farooque et al., 2023; Faruq et al., 2023; N. P. Tran & Vo, 2020; Vidyarthi, 2019; Weqar et al., 2020; Xu & Wang, 2019). MVAIC is a composite metric derived from the aggregation of four distinct performance variables. The calculation of MVAIC has been performed utilizing the following designated formula:

$$\text{MVAIC} = \text{HCE} + \text{CEE} + \text{SCE} + \text{RCE}$$

where HCE is the marginal impact of every unit of H.C to value-added, SCE is the share of S.C to generating value, CEE is the marginal contributions of every unit of monetary and physical capital to value-added, and RCE is the role of R.C in generating value. The four elements of MVAIC have been calculated in the following order, HCE, SCE, CEE, and RCE:

$$\begin{aligned} \text{HCE} &= \text{V.A}/\text{H.C} \\ \text{SCE} &= \text{S.C}/\text{V.A} = (\text{V.A} - \text{H.C})/\text{V.A} \\ \text{CEE} &= \text{V.A}/\text{C.E} \\ \text{RCE} &= \text{R.C}/\text{V.A} \end{aligned}$$

where V.A is the value-added; V.A is classified as the operating profit plus employees' cost, depreciation, and amortization; H.C signifies total personnel expenditure; and S.C is computed by subtracting H.C from V.A. Both monetary and physical capital are denoted by C.E. Marketing, sales, and advertising costs are used to calculate R.C.

Dependent Variables

The present research utilizes return on assets (ROA), return on capital employed (ROCE), return on equity (ROE), and return on sales (ROS) as indicators to assess the financial performance of banks. To establish the framework for this research, an analysis of prior studies was conducted (Al-Azizah & Wibowo, 2023; Asutay & Ubaidillah, 2023; Aybars & Oner, 2022; Barak & Sharma, 2023; Buallay et al., 2019; Farooque et al., 2023; Faruq et al., 2023; Kapoor & Saihjpal, 2022; Kasoga, 2020; Kim & Tran, 2023; Nguyen, 2023; Prasajo et al., 2022; Rehman et al., 2022; N. P. Tran & Vo, 2020; Weqar et al., 2020; Weqar & Haque, 2022; Xu et al., 2020; Zheng et al., 2022).

$$\begin{aligned} \text{ROA} &= \text{net income}/\text{total assets} \\ \text{ROCE} &= \text{earnings before interest and tax}/\text{capital employed} \\ \text{ROE} &= \text{profit available to equity shareholders}/\text{shareholders' fund} \\ \text{ROS} &= \text{earnings before interest and tax}/\text{net sales} \end{aligned}$$

Control Variables

Leverage, which can be determined as the ratio of total outside liabilities to total assets, and size, which can be approximated as the log of total assets, are used as proxies for bank characteristics. These two control factors were chosen because of the significant contributions they make to the overall performance of the company (Aybars & Oner, 2022; Buallay et al., 2019; Farooque et al., 2023; Kapoor & Saihjpal, 2022; Kim & Tran, 2023; Nguyen, 2023; Prasajo et al., 2022; Weqar et al., 2020; Xu & Wang, 2019).

Statistical Model Briefing

With the study spanning from 2010 to 2022, our objective was to utilize a suitable econometric method for longitudinal analysis. Most of the prior research relies on panel data and employs either a static or dynamic model, which effectively addresses both firm heterogeneity and time effects (Faruq et al., 2023; Kwaku Mensah Mawutor et al., 2023; Prasajo et al., 2022; Sohel Rana & Hossain, 2023; Weqar & Haque, 2022; Zheng et al., 2022). Several techniques have been used to estimate the models,

including pooled OLS, fixed effects, random effects, and generalized method of moments (GMM). These techniques address the issue of simultaneity bias by utilizing instrumental variables and accounting for unobserved firm-specific factors. Nevertheless, they disregard the integration qualities of the data. Thus, it remains uncertain from these research whether they establish a stable and lasting connection between I.C, its constituents, and F.P, or if they merely demonstrate a misleading correlation that could result in erroneous conclusions. This work utilizes advanced econometric approaches, specifically panel cointegration and panel estimation using the fully modified OLS (FMOLS) method, to address the limitations noted earlier. The objective is to gain a deeper understanding of how I.C impacts the financial performance of banks.

Models

This article aims to conduct an analysis and investigation into the impact of I.C on the F.P of the 29 Indian scheduled commercial banks from 2010 to 2022. The utilization of MVAIC and its constituent elements served as alternate indicators of I.C inside the models. The empirical models are depicted in Table 1.

Empirical Results

Table 2 displays the descriptive statistics for both private and public sector institutions. The average returns indicate that private sector banks' financial performance measures (ROA, ROE, and ROCE) are considerably greater than those of public sector banks. This suggests that private sector banks have successfully and proficiently utilized their assets and equity. Public sector banks have a significantly unfavorable return on sales (ROS) compared to private sector banks. Compared to other subcomponents of I.C, HCE contributes the highest amount of 7.739 in private sector banks and 6.131 in public sector banks (Al-Azizah & Wibowo, 2023; Asutay & Ubaidillah, 2023; Faruq et al., 2023; Le et al., 2022; Nguyen, 2023; Ozkan et al., 2017; Sohail Rana & Hossain, 2023; Weqar & Haque, 2022; Xu & Wang, 2019). Both sector banks exhibited low CEE values, suggesting that they faced challenges in generating value from the capital they used during the research period. The mean value of MVAIC is higher in public sector banks (12.627) compared to private sector banks (9.038), indicating that both types of banks successfully utilize I.C. The standard deviation and coefficient

Table 1 Representations of the model

Model	Functional representations
$\text{Perf} = f(\text{HCE}, \text{CEE}, \text{SCE}, \text{RCE}, \text{LEV}, \text{SIZE})$	$\beta_0 + \beta_1 (\text{HCE}_{it}) + \beta_2 (\text{CEE}_{it}) + \beta_3 (\text{SCE}_{it}) + \beta_4 (\text{RCE}_{it}) + \beta_5 (\text{SIZE}_{it}) + \beta_6 (\text{LEV}_{it}) + e_{it}$
$\text{Perf} = f(\text{MVAIC}, \text{LEV}, \text{SIZE})$	$\beta_0 + \beta_1 (\text{MVAIC}_{it}) + \beta_2 (\text{SIZE}_{it}) + \beta_3 (\text{LEV}_{it}) + e_{it}$

Source: constructed by the authors

Table 2 Descriptive statistics

Private sector banks											
Variable	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
Mean	1.079	7.679	2.131	-6.611	7.739	0.487	0.153	0.646	9.038	10.908	11.519
Std. dev	4.903	13.010	0.857	13.805	3.052	0.285	0.141	3.310	4.209	3.558	1.370
Skewness	13.748	-3.163	-0.415	-3.840	0.494	0.949	8.090	12.618	3.561	0.511	0.124
Kurtosis	199.918	15.576	3.215	24.343	3.938	3.657	107.82	182.539	45.310	3.034	2.322
Jarque-Bera	364,034.2	1824.935	6.780	4738.131	17.109	37.182	103,594.7	301,320.6	16,874.63	9.648	4.804
Probability	0.000	0.000	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.090
Sum	238.670	1697.110	471.150	-1461.210	1710.388	107.789	34.020	142.312	1988.416	2410.803	2545.85
Sum sq. dev	5288.781	37,241.67	161.717	41,930.81	2050.440	17,956	4.403	2400.000	3879.784	2785.982	413.188
Observations	221	221	221	221	221	221	221	221	221	221	221
Public sector banks											
Variable	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
Mean	0.099	0.983	1.625	-11.915	6.131	0.556	0.814	0.803	8.306	15.887	12.896
Std. dev	0.824	17.395	0.412	13.379	1.873	0.551	0.094	1.656	2.420	2.607	0.932
Skewness	-1.598	-2.539	-0.295	-1.473	0.134	10.825	-4.500	9.742	5.011	0.145	0.489
Kurtosis	5.848	13.467	3.987	5.700	2.878	128.972	31.874	109.224	45.334	5.548	3.139
Jarque-Bera	119.214	879.851	8.633	103.850	0.563	10,695.8	5945.996	75,811.38	12,302.36	42.773	6.344
Probability	0.000	0.013	0.000	0.000	0.754	0.000	0.000	0.000	0.000	0.000	0.041
Sum	15.530	253.510	-1858.820	153.420	956.546	86.879	127.069	125.295	1295.791	2478.520	2011.873
Sum sq. dev	105.294	26.339	27746.65	46903.78	544.087	47.108	1.385	425.366	907.804	1053.451	134.669
Observations	156	156	156	156	156	156	156	156	156	156	156

Source: the authors created the data using E-views 12

of variation indicate that the ROA, ROE, ROS, RCE, and SCE of private sector banks exhibit significant volatility. Using a control variable demonstrates that the percentage of debt in public sector banks is greater than that in private sector banks. The average size of both sector banks is equivalent, with a slight disparity.

The correlation matrix of private and public sector banks is displayed in Table 3. Four endogenous variables, five exogenous variables, and two control variables are utilized. ROE is highly negatively correlated with SCE (-0.476) and then RCE (-0.422) in the private sector. There is a minimum correlation between ROE and the remaining variables (Asutay & Ubaidillah, 2023). ROCE is highly negatively correlated with CEE (-0.491) and positively with MVAIC (0.450). The association between leverage (-0.654) and size (0.633) with ROCE is extremely negative and positive, respectively. ROS has a negative relationship with SCE (-0.432) and RCE (-0.475), followed by a positive relationship with HCE (0.398), whereas I.C element HCE has a substantial positive correlation with MVAIC (0.597), ROE (0.527), ROCE (0.404), and ROS (0.398). While CEE demonstrates a strong correlation with control variables, SCE demonstrates a strong positive correlation with RCE (0.896) and MVAIC (0.417). R.C indicates a positive association with MVAIC (0.713) and SCE (0.896).

In the case of public sector banks, HCE is an independent variable that positively correlates with ROA (0.447), ROE (0.445), and ROS (0.554). S.C has a strong positive correlation with ROA (0.438), ROE (0.478), and ROS (0.497). The correlation between ROCE, ROS, and independent and control variables is weak. RCE has a strong correlation with the MVAIC (0.588). The present study reveals that HCE has the most robust correlation with all F.P metrics. Nevertheless, no evidence of multicollinearity is shown in the model. Concisely, the findings suggest that I.C is considered significant and highly correlated with the financial outcomes.

Before estimating our model with fully modified ordinary least squares (FMOLS), we examine the stationarity and cointegration of various exogenous and endogenous variables in a panel framework. We employ the LLC test proposed by Levin et al. (2002) and in addition to two sets of Fisher-type tests utilizing ADF and Phillips–Perron (PP) as proposed by Choi (2001) and Maddala and Wu (1999). In the beginning, several different panel unit root tests are carried out on a level for different factors, since none of the variables was discovered to be constant at a level. Therefore, these tests are carried out at the first difference. The results of the panel unit root at the first difference of both private and public sector banks are reported in Tables 4 and 5, respectively.

The cointegration test results are shown in Table 6. Due to the non-stationarity of the series, panel cointegration analyses are required to infer the long-term relationship between the variables. Among the available panel cointegration tests, we consider Kao's (1999) test. The results demonstrate that in the case of ROA, ROE, ROCE, and ROS for private and public sector banks, there is a cointegration in the models as the p -value is less than 0.05. It means we accept the alternate hypothesis which means there is cointegration in the model. Furthermore, a cointegration test has been conducted by using MVAIC as the independent variable and leverage and size as a control variable. Again ROA, ROE, ROCE, and ROS are used as dependent

Table 3 Correlation matrix

Private sector banks											
ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE	
ROA	1.000										
ROE	0.123	1.000									
ROCE	0.199	0.357	1.000								
ROS	0.181	0.881	0.120	1.000							
HCE	0.144	0.527	0.404	0.398	1.000						
CEE	-0.079	0.040	-0.491	0.209	-0.148	1.000					
SCE	-0.122	-0.476	-0.023	-0.432	-0.445	0.037	1.000				
RCE	-0.087	-0.422	0.243	-0.475	-0.131	-0.121	0.896	1.000			
MVAIC	0.026	0.037	0.450	-0.084	0.597	-0.134	0.417	0.713	1.000		
LEV	-0.102	-0.254	-0.654	-0.091	-0.086	0.664	0.099	0.001	-0.013	1.000	
SIZE	0.161	0.096	0.633	-0.057	0.356	-0.601	-0.154	0.071	0.269	-0.438	1.000
Public sector banks											
ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE	
ROA	1.000										
ROE	0.948	1.000									
ROCE	0.474	0.434	1.000								
ROS	0.942	0.895	0.277	1.000							
HCE	0.447	0.445	0.048	0.554	1.000						
CEE	0.133	0.131	-0.003	0.156	-0.079	1.000					
SCE	0.438	0.478	0.074	0.497	0.779	-0.052	1.000				
RCE	-0.291	-0.311	-0.126	-0.270	-0.106	-0.028	-0.175	1.000			
MVAIC	0.193	0.180	-0.047	0.299	0.713	0.125	0.403	0.588	1.000		
LEV	-0.269	-0.293	-0.247	-0.143	0.163	-0.096	0.042	0.095	0.171	1.000	
SIZE	0.134	0.125	0.200	-0.008	-0.077	-0.177	0.066	-0.170	-0.214	-0.085	1.000

Source: the authors created the data using E-views 12

Table 4 Panel unit root at the first difference (public sector banks)

	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
LLC											
Without C&T	-9.648 (0.000)	-9.963 (0.000)	-11.146 (0.000)	-7.245 (0.000)	-10.907 (0.000)	-9.819 (0.000)	-10.029 (0.000)	-9.872 (0.000)	-10.684 (0.000)	-11.544 (0.000)	-3.792 (0.000)
With C&T	-1.139 (0.000)	-1.140 (0.126)	-5.658 (0.000)	-0.361 (0.058)	-7.910 (0.000)	-5.493 (0.000)	-3.808 (0.000)	-2.384 (0.008)	-8.931 (0.000)	-7.381 (0.000)	-6.114 (0.000)
With C	-2.127 (0.000)	-1.561 (0.042)	-5.795 (0.000)	-0.131 (0.047)	-7.140 (0.000)	-5.678 (0.000)	-4.593 (0.000)	-4.067 (0.000)	-8.629 (0.000)	-8.533 (0.000)	85.892 (0.000)
ADF-Fisher chi-square											
Without C&T	121.852 (0.000)	131.272 (0.000)	150.752 (0.000)	101.571 (0.000)	145.326 (0.000)	131.709 (0.000)	142.722 (0.000)	133.186 (0.000)	151.153 (0.000)	156.838 (0.000)	68.867 (0.000)
With C&T	32.225 (0.054)	40.784 (0.096)	65.312 (0.001)	31.547 (0.088)	63.087 (0.001)	50.773 (0.032)	52.491 (0.022)	43.667 (0.123)	68.583 (0.000)	61.108 (0.002)	57.941 (0.006)
With C	53.429 (0.018)	61.279 (0.002)	86.950 (0.000)	44.140 (0.014)	96.317 (0.000)	77.421 (0.000)	86.245 (0.000)	78.0125 (0.000)	100.635 (0.000)	95.288 (0.000)	54.756 (0.013)
PP-Fisher chi-square											
Without C&T	201.934 (0.000)	228.206 (0.000)	230.687 (0.000)	190.294 (0.000)	200.859 (0.000)	212.871 (0.000)	225.637 (0.000)	235.784 (0.000)	208.769 (0.000)	215.710 (0.000)	100.266 (0.000)
With C&T	108.128 (0.000)	136.751 (0.000)	174.761 (0.000)	108.441 (0.000)	132.847 (0.000)	153.851 (0.000)	52.491 (0.022)	153.491 (0.000)	161.422 (0.000)	173.238 (0.000)	117.904 (0.000)
With C	121.294 (0.000)	150.007 (0.000)	180.138 (0.000)	114.732 (0.000)	156.971 (0.000)	161.089 (0.000)	187.838 (0.000)	201.182 (0.000)	175.782 (0.000)	205.867 (0.000)	85.892 (0.000)

Source: the authors created the data using E-views 12

Table 5 Panel unit root at the first difference (private sector banks)

	ROA	ROE	ROCE	ROS	HCE	CEE	SCE	RCE	MVAIC	LEV	SIZE
LLC											
Without C&T	-6.369 (0.000)	-7.302 (0.000)	-8.544 (0.000)	-5.281 (0.000)	-9.446 (0.000)	-8.714 (0.000)	-10.099 (0.000)	-10.729 (0.000)	-12.554 (0.000)	-9.037 (0.000)	-4.928 (0.000)
With C&T	0.579 (0.019)	-0.490 (0.011)	-4.607 (0.000)	3.315 (0.995)	-4.864 (0.000)	1.729 (0.958)	-7.831 (0.000)	-9.293 (0.000)	-22.381 (0.000)	-4.080 (0.000)	-2.398 (0.008)
With C	0.873 (0.808)	0.100 (0.540)	-3.756 (0.000)	3.921 (0.000)	-4.164 (0.000)	0.408 (0.658)	-4.804 (0.000)	-7.066 (0.000)	-12.561 (0.000)	-4.257 (0.000)	-3.661 (0.000)
ADF-Fisher chi-square											
Without C&T	67.182 (0.000)	75.325 (0.000)	96.316 (0.000)	56.459 (0.000)	104.544 (0.000)	95.140 (0.000)	113.130 (0.000)	105.948 (0.000)	134.240 (0.000)	97.232 (0.000)	54.751 (0.000)
With C&T	28.874 (0.024)	32.937 (0.010)	41.726 (0.013)	20.047 (0.522)	36.085 (0.050)	31.550 (0.013)	48.811 (0.002)	43.472 (0.008)	67.560 (0.000)	38.515 (0.030)	19.001 (0.751)
With C	26.924 (0.308)	29.699 (0.194)	46.415 (0.003)	21.209 (0.026)	60.923 (0.000)	46.622 (0.003)	62.146 (0.000)	55.659 (0.000)	95.371 (0.000)	54.056 (0.000)	79.847 (0.000)
PP-Fisher chi-square											
Without C&T	158.181 (0.000)	175.345 (0.000)	160.857 (0.000)	147.972 (0.000)	183.668 (0.000)	199.800 (0.000)	200.482 (0.000)	177.455 (0.000)	191.093 (0.000)	164.359 (0.000)	80.458 (0.000)
With C&T	107.957 (0.000)	128.170 (0.000)	145.106 (0.000)	85.186 (0.000)	113.463 (0.000)	149.634 (0.000)	125.157 (0.000)	116.136 (0.000)	134.111 (0.000)	120.982 (0.000)	75.144 (0.000)
With C	89.715 (0.000)	104.017 (0.000)	123.944 (0.000)	83.240 (0.000)	138.775 (0.000)	157.796 (0.000)	165.302 (0.000)	119.716 (0.000)	166.419 (0.000)	123.251 (0.000)	79.847 (0.000)

Source: the authors created the data using E-views 12

Table 6 Results of the cointegration test

Models	Private sector banks							
	Individual effect				Combined effect			
	ROA	ROE	ROCE	ROS	ROA	ROE	ROCE	ROS
ADF test	-4.537 (0.000)	-2.804 (0.000)	-1.618 (0.000)	-5.642 (0.000)	0.664 (0.253)	-7.068 (0.000)	-2.916 (0.000)	-1.640 (0.005)
Remarks	Cointegration	Cointegration	Cointegration	Cointegration	No cointegration	Cointegration	Cointegration	Cointegration
Public sector banks								
Models	Individual effect							
	ROA	ROE	ROCE	ROS	ROA	ROE	ROCE	ROS
	ADF test	-1.515 (0.041)	-12.607 (0.000)	-5.960 (0.000)	-7.670 (0.000)	-2.550 (0.005)	-9.993 (0.000)	-6.050 (0.000)
Remarks	Cointegration	Cointegration	Cointegration	Cointegration	Cointegration	Cointegration	Cointegration	Cointegration

Source: The authors created the data using E-views 12

variables. The null hypothesis of “no cointegration” appears to be rejected for all models except in the case of private sector banks combined I.C (ROA).

The results of the fully modified ordinary least squares (FMOLS) model with four dependent variables and two control variables, leverage and size of private and public sector institutions, are presented in Table 7. For private sector banks, there was a notable and positive correlation between HCE and all performance measures. However, when it comes to public sector banks, there is a clear positive correlation between HCE and key financial performance indicators such as ROA, ROCE, and ROS. Increased investment in staff has improved the performance of Indian banks. The findings align with the previous research conducted by Asutay and Ubaidillah (2023), Nguyen (2023), Sohel Rana and Hossain (2023), and Weqar and Haque (2022). Nevertheless, numerous studies have found that HCE has a minimal impact on financial performance indicators, as indicated by research conducted by Al-Azizah and Wibowo (2023), Barathi Kamath (2007), and Dzenopoljac et al. (2017).

In the case of public sector banks, there is a significant positive association between CEE and all performance measures (Asutay & Ubaidillah, 2023; Faruq et al., 2023; Nguyen, 2023; Sohel Rana & Hossain, 2023; Weqar & Haque, 2022). These findings indicate that CEE has a substantial influence on measures of productivity and profitability. In contrast, private sector banks experience a noteworthy favorable influence of CEE just on their ROE and ROS. SCE has a positive impact on ROA, ROE, and ROS in public sector banks (Al-Azizah & Wibowo, 2023; Faruq et al., 2023). However, it is only positively linked to ROCE in private sector banks. But it contradicts some investigations, including those by Asutay and Ubaidillah (2023) and Sohel Rana and Hossain (2023). RCE adversely affects the ROCE and ROS in private sector banks. Conversely, in public sector banks, RCE is negatively correlated with ROA and ROE. The findings indicate that higher expenditures on advertisement, marketing, selling, and third-party operations are associated with reduced financial profitability and company performance, and vice versa. Furthermore, leverage has a negative impact on F.P indicators. The size of the bank had a positive impact on the F.P of both sector banks.

Table 8 shows the FMOLS results, while MVAIC serves as the independent variable. In public sector banks, the estimated MVAIC coefficients were found to be positively significant when ROA, ROCE, and ROS were used as F.P indicators. We observe a positive association, as indicated by earlier studies conducted by Asutay and Ubaidillah (2023), Sohel Rana and Hossain (2023), and Faruq et al. (2023). In the case of private sector banks, the MVAIC coefficients were positively and significantly related to ROCE, whereas they had a negative influence on ROE and ROS. Furthermore, the utilization of leverage has an adverse impact on all financial performance measures for banks in the public sector, whereas it only has an adverse impact on the return on capital employed (ROCE) for banks in the private sector. The size of public banks had a favorable effect on both ROA and ROE, while the size of private sector banks had a positive effect on both ROE and ROS. The association between MVAIC and financial performance measures is positive and significant, suggesting that investing in I.C is crucial in creating value for banks. This is particularly important for banks to remain competitive and thrive in the present era, which is heavily reliant on knowledge.

Table 7 Fully modified ordinary least squares (FMOLS) estimation results

Vari- ables	Private sector banks						Public sector banks									
	ROA		ROE		ROCE		ROS		ROA		ROE		ROCE		ROS	
	Coeff	<i>T</i> -statis- tics	Coeff	<i>T</i> -statis- tics	Coeff	<i>T</i> -statis- tics	Coeff	<i>T</i> -statis- tics	Coeff	<i>T</i> -statis- tics	Coeff	<i>T</i> -statis- tics	Coeff	<i>T</i> -statis- tics	Coeff	<i>T</i> -statis- tics
CEE	0.342	0.107 (0.914)	12.599*	3.216 (0.001)	-0.012	-0.074 (0.940)	12.640*	3.191 (0.001)	0.756*	11.252 (0.000)	14.577*	9.944 (0.000)	0.122**	2.193 (0.030)	11.538*	11.002 (0.000)
HCE	0.745*	2.855 (0.004)	2.803*	8.712 (0.000)	0.037*	2.654 (0.008)	3.380*	10.388 (0.000)	0.102**	2.376 (0.019)	0.458	0.487 (0.627)	0.602**	1.746 (0.080)	1.912*	2.843 (0.005)
RCE	0.300	0.762 (0.447)	-0.402	-0.826 (0.409)	0.227*	10.716 (0.000)	-1.284*	-2.611 (0.001)	-0.019***	-1.669 (0.098)	-0.459***	-1.821 (0.071)	0.009	0.954 (0.341)	-0.255	-1.413 (0.160)
SCE	-8.715	-0.875 (0.382)	-18.556	-1.512 (0.132)	-4.180*	-7.811 (0.000)	-0.219	-0.017 (0.985)	5.135*	7.209 (0.000)	114.301*	7.358 (0.000)	0.370	0.625 (0.533)	78.572*	7.070 (0.000)
LEV	-0.039	-0.187 (0.851)	-0.828*	-3.159 (0.001)	-0.040*	-3.501 (0.006)	-0.098	-0.369 (0.712)	-0.027**	-1.677 (0.096)	-3.021*	-8.412 (0.000)	-0.012	-0.896 (0.372)	-0.245	-0.954 (0.342)
SIZE	-1.145	-0.223 (0.823)	8.226	1.300 (0.195)	-0.468*	-1.696 (0.001)	13.177**	2.060 (0.041)	0.257**	2.997 (0.034)	6.654*	3.553 (0.006)	-0.011	-0.156 (0.876)	4.088*	3.051 (0.002)
<i>R</i> ²	0.351		0.623		0.668		0.716		0.685		0.742		0.489		0.720	
Adj. <i>R</i> ²	0.312		0.522		0.579		0.640		0.595		0.669		0.386		0.641	

Source: the authors created the data using E-views 12

* $p \leq 0.01$; ** $p \leq 0.05$; *** $p \leq 0.1$

Table 8 Fully modified ordinary least squares results (MVAIC)

Variables	Private sector banks						Public sector banks					
	ROA		ROE		ROCE		ROA		ROE		ROCE	
	Coeff	<i>T</i> -statistics	Coeff	<i>T</i> -statistics	Coeff	<i>T</i> -statistics	Coeff	<i>T</i> -statistics	Coeff	<i>T</i> -statistics	Coeff	<i>T</i> -statistics
MVAIC	-0.051 (0.449)	-0.758 (0.449)	-1.096* (0.000)	-8.157 (0.000)	0.062* (0.000)	14.187 (0.000)	-1.260* (0.000)	-8.275 (0.000)	0.031** (0.040)	1.999 (0.040)	0.300 (0.352)	0.934 (0.352)
LEV	0.029 (0.878)	0.153 (0.878)	-0.472 (0.224)	-1.221 (0.224)	-0.050* (0.000)	-3.932 (0.000)	0.311 (0.000)	0.710 (0.478)	-0.169* (0.000)	-8.651 (0.000)	-5.747* (0.000)	-14.222 (0.000)
SIZE	0.969 (0.770)	0.292 (0.770)	20.118** (0.030)	2.182 (0.030)	-0.544** (0.000)	-1.792 (0.045)	26.742** (0.000)	2.559 (0.011)	0.419* (0.001)	3.329 (0.001)	9.775* (0.000)	3.760 (0.000)
R^2	0.289		0.358		0.563		0.420		0.322		0.524	
Adj. R^2	0.241		0.203		0.457		0.280		0.155		0.352	
											0.481	
											0.330	
											0.164	

Source: the authors created the data using E-views 12

* $p \leq 0.01$; ** $p \leq 0.05$

Discussion

The current study assessed the intellectual capital performance of public and private sector banks in India. The MVAIC technique was used on a sample of 12 public and 17 private sector banks across 12 years, spanning from 2010 to 2022. The significance of I.C to a company's success has been extensively acknowledged in numerous nations (Adesina, 2019; Al-Azizah & Wibowo, 2023; Asutay & Ubaidillah, 2023; Buallay et al., 2020; Farooque et al., 2023; Faruq et al., 2023; Le et al., 2022; Rehman et al., 2022; Soheli Rana & Hossain, 2023; Weqar & Haque, 2022; Zheng et al., 2022). However, in the context of an emerging market such as India, this issue has been largely neglected, particularly in the banking sector. The findings indicate that in the case of public sector banks, I.C has a positive and significant relationship with F.P indicators such as ROA, ROCE, and ROS, whereas in the case of private sector banks, I.C has a positive impact only on ROCE and a negative significant impact on ROE and ROS.

We discovered that the impact of I.C is greater in public sector banks than in private sector banks. It indicates that I.C performs an essential role in enhancing the profitability of Indian public sector banks, whereas the private sector banks must pay close attention to how I.C can be utilized to boost their profitability and productivity. According to Sardo and Serrasqueiro (2017) and Smriti and Das (2018), I.C can enhance F.P and generate more wealth if used effectively and efficiently.

Concerning the components of I.C, HCE is the most important contributor, as it positively and significantly affects private sector and public sector banks' F.P indicators except ROE in the case of public sector banks. The results are identical to those of Chowdhury et al. (2018), Mollah and Rouf (2022), Sardo and Serrasqueiro (2017), Weqar et al. (2020), Xu et al. (2022), Faruq et al. (2023), and Soheli Rana and Hossain (2023). Thus, this result suggests that banks interested in achieving greater levels of efficiency and profitability should increase their commitment to their H.C by initiating the appropriate training and development programs. CEE has a positive and significant impact on all financial performance metrics for public sector banks. The outcome lines up with Mollah and Rouf (2022), Dzenopoljac et al. (2017), Faruq et al. (2023), Soheli Rana and Hossain (2023), and Sardo and Serrasqueiro (2018) findings. Additionally, SCE has a positive and substantial effect on ROA, ROE, and ROS (Bayraktaroglu et al., 2019; Chen Goh, 2005; Dzenopoljac et al., 2017; Faruq et al., 2023). The findings demonstrate that Indian banks can improve their efficiency and profitability by making more efficient use of their physical and structural capital.

RCE has a considerable negative impact on the ROA and ROE of public sector banks, as well as the ROS of private sector banks. The results corroborate with the findings of Bayraktaroglu et al. (2019), Soheli Rana and Hossain (2023), Weqar et al. (2020), Xu and Li (2019), and Xu and Wang (2019). However, it has a positive significant impact on ROCE for private sector banks (Barak & Sharma, 2023). The influence of MVAIC on banks' financial performance is positive and significant, indicating that institutions that effectively utilize their

intangible assets tend to perform better. This finding aligns with the basic concept of resource-based theory. The F.P measures of Indian sector banks were negatively influenced by control variables, specifically leverage. It indicates that debt proportion is a matter of concern in both sector banks. The influence of size in both sector banks is the same. However, public sector banks have a greater positive impact on I.C elements.

Theoretical Contribution of the Study

This research provides empirical evidence of I.C and its impact on the F.P of Indian institutions from a theoretical standpoint. In place of VAIC, the comprehensive method of MVAIC has been implemented. Therefore, the current study offers a more in-depth analysis of the importance of the I.C and its constituents to the F.P of the Indian public and private sector banks. Indian commercial banks were able to improve their intellectual property, which served as a measure of their ability to maintain a high level of financial performance.

Researchers and experts need to identify the relevant indicators of I.C that can serve as more accurate forecasters for an organization's success in competitive markets, as well as contribute to evaluation and advancement. The present results broaden our comprehension of the essential changes and methods required to enhance intellectual capital within the framework of Indian commercial banks. This study can serve as the foundation for future research on the state of I.C and their impact on the performance of cooperative banks, non-banking financial services firms, and insurance companies.

Empirical Contribution of the Study

The empirical findings contribute to an ongoing study by demonstrating that I.C plays a substantial role in generating value for Indian banks. The empirical investigation affirms that the proper and effective utilization of I.C improves a bank's profitability. Regarding the assessment of the influence of individual components of MVAIC, the results indicate a robust correlation between all four components (H.C, C.E, S.C, R.C) and financial performance metrics of the firm (ROA, ROE, ROCE, ROS). Indian banks have the requirement to consistently enhance and improve these types of intellectual assets to ensure ongoing success in the future.

Practical Contribution of the Study

According to a point of view of practicality, business managers need to investigate and assess the functions that I.C plays in their organizations. In this age of the digital and knowledge-based economy, administrators are required to have an in-depth awareness of the crucial role that I.C plays in the improvement of F.P. According to the findings of this study, Indian financial institutions need to ensure that they effectively manage the efficiency of each component of their I.C, which includes their capital employed, human capital, structural capital, and innovation capital. It

has been demonstrated that I.C plays a crucial role in the achievement of financial success as well as a sustainable competitive advantage in the banking industry. To enhance economic performance and growth, Indian banks should therefore encourage I.C investment. Thus, policymakers can use this research as a reference when formulating future, I.C development policies in the banking sector.

Contribution to the Advancement of Society

This research increases the understanding of how better I.C in banking organizations could bring greater benefits to a society's overall quality of life. The role of I.C becomes an increasingly essential factor in the knowledge-driven economy. The banking industries offer societally useful financial services to people through their operations. When the Indian banking system has access to high-quality I.C, the Indian society will reap greater benefits, including improved quality of life, increased economic growth, lower costs of money, and innovation in banking operations.

Conclusion

This current research makes several contributions to the existing literature. First, we have used an alternative measure of intellectual capital rather than the disputed VAIC model, which is MVAIC, to overcome the limitations of past studies. Second, we address the major research gap, which is that all the papers conducted in India used simple regression techniques to determine the link between intellectual capital and financial performance, so we have employed fully modified ordinary least squares (FMOLS). Third, this paper shall be unique in addressing the role of intellectual capital and comparing them for two separate groups of banks together. Finally, it uses an extensive individual bank-wise database up to 2022 including the COVID-19 and demonetization period for measuring the impact of intellectual capital on the financial performance of the banks.

Researchers and academicians worldwide are becoming more and more aware of the indisputable impact that I.C has on an organization's financial performance. It is now challenging to deny that intellectual capital contributes to the firm's value creation. This article attempts to investigate the association between intellectual capital and its subdimensions using data from 12 public and 17 private sector banks spanning from 2010 to 2022. The authors utilized the MVAIC approach as a substitute indicator of intellectual capital to test the hypotheses about intellectual capital and the financial performance of banks. HCE is identified as the most effective predictor out of all the subdimensions of I.C. This finding implies that banks that are interested in achieving strong F.P ought to devote more attention to their H.C assets by effectively managing training and development initiatives that enhance and fortify employees' competencies.

The effective and optimal use of physical (C.E) and structural (S.C) capital by Indian public sector banks can also improve their financial performance, as these two factors positively correlate with the banks' ROA and ROE. It implies that the

bank's financial performance depends significantly on investments in both tangible and intangible resources, such as databases, software, systems, and client connections. The outcomes of MVAIC positively affect the financial performance parameters of public sector banks.

Though this research's empirical findings show a positive correlation between Indian banks' financial performance and their intellectual capital, Indian banks still invest a small amount in the growth of their intellectual capital when compared to other developing nations. Indian banks must prioritize increasing their investment in developing intellectual capital through research and development activities, training for staff programs, advances in technology, and enhancing customer relationships by offering excellent services with reasonable service charges.

Limitations and Future Research

The recently conducted research does have a few shortcomings; however, they could be overcome in subsequent research. First, the empirical findings are restricted to the banking industry; however, future studies may broaden the scope of the investigation to include other types of financial institutions or banks that operate in South Asian nations. Second, it would be beneficial to determine the effect of corporate governance factors like the number of males and females in a bank board and how many family members are involved in key managerial positions. Third, the size of the sample can be increased by including different kinds of banks in the sample, such as cooperative, regional rural, and differentiated banks. Fourth, in the future, studies can use primary data to figure out how I.C affects a company's financial success. Fifth, for secondary data, future studies should focus on developing new ways to measure each part of I.C.

Author Contribution The first author assumed responsibility for the conceptualization, design, and execution of the research project, in addition to doing the statistical analysis. The second author aided in the interpretation of the results. The authors have collectively engaged in an ongoing cycle of rewriting and reviewing the paper, ultimately reaching a consensus on the current version.

Data Availability The datasets used and analyzed during this study are available upon reasonable request from the corresponding author.

Declarations

Ethics Approval This article contains no human participant investigations conducted by any of the authors.

Conflict of Interest The authors declare no competing interests.

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