The Impact of Intellectual Capital on Sustainable Performance: Banking Sector in Saudi Arabia

Omer Ahmed Sayed * and Aida Nefzi

Posted Date: 29 April 2024

doi: 10.20944/preprints202404.1887.v1

Keywords: Intellectual Capital; Sustainable Performance; Saudi Arabian Banks; Human Capital Efficiency; Structural Capital Efficiency; Capital Employed Efficiency

 doi:10.20944/preprints202404.1887.v1

Article

The Impact of Intellectual Capital on Sustainable Performance: Banking Sector in Saudi Arabia

Omer Ahmed Sayed * and Aidah A. Alhadi Alnfzi

Department of Finance and Investment, Faculty of Business Administration, University of Tabuk, Saudi Arabia; aalnfzi@ut.edu.sa

* Correspondence: omer@ut.edu.sa; Tel.:+966557287417

Abstract: This study investigates the impact of intellectual capital on the sustainable performance of banks in Saudi Arabia, focusing on the period from 2012 to 2022. Utilizing data from ten major Saudi banks, the research examines how different components of intellectual capital—Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE)—influence key financial performance indicators such as Return on Equity (ROE) and Net Profit Margin (NPM). The study is grounded in the resource-based view of the firm, which suggests that a firm's internal resources can provide a sustainable competitive advantage. The analysis employs panel data techniques, including fixed and random effects models, to assess the relationships between intellectual capital components and bank performance while controlling for variables like bank size, financial leverage, GDP growth, inflation, and the impact of the COVID-19 pandemic. The findings reveal that intellectual capital significantly enhances bank performance in Saudi Arabia, with human capital efficiency showing the most decisive influence on ROE and NPM. Structural capital and capital employed efficiency also contribute positively but vary in their impact on different performance measures. This research contributes to the theoretical and practical understanding of the role of intellectual capital in promoting sustainable banking practices. It underscores the importance of strategic management of intellectual capital in enhancing financial performance and achieving sustainability goals, particularly in the context of Saudi Arabia's Vision 2030. The study's insights are relevant for bank managers and policymakers who leverage intellectual capital for economic diversification and sustainable development.

Keywords: intellectual capital; sustainable performance; Saudi Arabian banks; human capital efficiency; structural capital efficiency; capital employed efficiency

1. Introduction

Intellectual capital is increasingly recognized as a crucial driver of innovation and competitive advantage in the global economy. Theories rooted in the resource-based view of the firm posit that its resources, particularly intangible assets like intellectual capital, are key determinants of its performance and sustainability (Barney, 1991). As global markets evolve and competition intensifies, the strategic management of these intangible assets becomes pivotal in securing long-term organizational success (King & Levine, 1993).

Intellectual capital is particularly critical in the banking sector due to the information-intensive nature of financial services and the growing importance of sustainable business practices. Banks are now expected to be economically efficient and adopt practices that ensure environmental sustainability and social responsibility (Ku et al., 2011). This is especially relevant in emerging markets like Saudi Arabia, where the financial sector is a cornerstone of national economic strategies such as Vision 2030, which aims to diversify the economy and reduce oil dependence.

The increasing regulatory and consumer pressure on banks to adopt sustainable practices further amplifies the focus on sustainability. In this context, intellectual capital management —

 doi:10.20944/preprints202404.1887.v1

encompassing human, structural, and relational capital — can significantly influence a bank's ability to innovate and remain competitive in a rapidly changing economic landscape (Al-Musali & Ismail, 2014).

However, despite the apparent importance of intellectual capital in enhancing banks' sustainable performance, more empirical research should be conducted, explicitly exploring this relationship within the Saudi Arabian banking context. This study aims to fill that gap by providing a detailed analysis of how different components of intellectual capital contribute to the sustainability of banking operations in Saudi Arabia, supporting the broader goals of economic diversification and sustainability under the national Vision 2030 framework.

The primary aim of this study is to explore the impact of intellectual capital on the sustainable performance of banks in Saudi Arabia. The specific objectives are:

- To analyze the relationship between overall intellectual capital and the sustainable financial performance of Saudi banks.
- To dissect the contributions of individual components of intellectual capital—Human Capital Efficiency and Structural Capital Efficiency—towards sustainable banking practices.
- To assess the role of internal and external control variables, including bank size, financial leverage, GDP growth, inflation, and the impacts of the COVID-19 pandemic, in shaping bank performance.

This study contributes to the existing literature by providing a focused analysis of how intellectual capital influences sustainability in banking, a critical sector for economic development in Saudi Arabia. The findings are expected to offer valuable insights for bank managers and policymakers to enhance strategic planning and implementation of sustainability practices. Moreover, this research supports Saudi Arabia's Vision 2030 initiative, which emphasizes economic diversification and sustainability.

The research employs a quantitative approach, utilizing panel data analysis to investigate the relationship between intellectual capital and bank performance from 2012 to 2022. The study uses data collected from annual reports of ten major Saudi banks and employs econometric models to analyze the data, ensuring robustness in the findings.

The paper begins with an introduction that sets the stage for understanding the role of intellectual capital in the banking sector, particularly within the context of Saudi Arabia's economic ambitions. This is followed by a literature review synthesizing existing research on intellectual capital and its impact on bank performance, highlighting gaps that this study aims to fill. Next, the research design and methodology section describes the empirical approach, data sources, and analytical techniques used to examine the relationships between intellectual capital components and sustainable banking performance.

The results and discussion section presents the analysis's findings, interpreting how intellectual capital influences the performance metrics of Saudi banks with a focus on sustainability. This section also integrates these findings with insights from the reviewed literature to discuss broader implications. The paper concludes with a summary of the key findings, implications for bank managers and policymakers, and recommendations for future research. References and appendices provide supporting documentation and additional data to enrich the reader's understanding of the study.

2. The Literature Review and Hypotheses Development

2.1. Theoretical Framework

The theoretical underpinning of this study is grounded in the Resource-Based View (RBV) of the firm, which asserts that the competitive advantage of firms is derived from their unique resources and capabilities (Barney, 1991). Intellectual capital, conceptualized as a key resource within organizations, is particularly emphasized in this framework due to its potential to generate sustainable competitive advantages (Barney, 1991; King & Levine, 1993). The RBV posits that firms

 doi:10.20944/preprints202404.1887.v1

must explore, exploit, and protect these valuable, rare, inimitable, and non-substitutable resources to maintain their competitive edge (Barney, 1991).

Further, the knowledge-based view, an extension of the RBV, specifically highlights the importance of knowledge resources in achieving superior performance (Grant, 1996). Intellectual capital, encompassing human, organizational, and social capital, plays a crucial role by fostering innovation, enhancing operational efficiencies, and ultimately leading to superior financial performance (Bontis, 1998; Edvinsson & Malone, 1997).

The dynamic capabilities framework also complements the RBV by focusing on the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Teece et al., 1997). This perspective is relevant as it highlights how banks can utilize their intellectual capital to adapt to changes in the financial sector, especially in a dynamic market like Saudi Arabia.

Moreover, the human capital theory, integral to the study of intellectual capital, suggests that investments in human capital (training, education) enhance productivity and profitability (Becker, 1964). In banking, employees' skills, expertise, and knowledge are critical determinants of organizational performance and essential components of intellectual capital (Unger et al., 2011).

Incorporating these theoretical perspectives provides a robust framework for understanding how different intellectual capital components contribute to banks' sustainable performance. This study leverages these theories to examine the roles that human, structural, and relational capital play within the Saudi Arabian banking sector, aligning the investigation with global and regional strategic objectives.

2.2. The Impact of Intellectual Capital on Sustainable Bank Performance

Intellectual capital significantly influences sustainable bank performance by enhancing financial outcomes, fostering innovation, promoting risk management, and facilitating corporate social responsibility (CSR). Research shows that banks that effectively manage their intellectual capital achieve superior financial metrics such as return on assets (ROA) return on equity (ROE), and net profit margins (NPM). For example, Akkas and Asutay (2023) highlight that intellectual capital investments in GCC banks, including both conventional and Islamic, significantly improve financial performance. Anthony Jnr (2021) identifies similar impacts on operational efficiency and profitability in the higher education sector.

Intellectual capital is crucial in risk management within banks. Efficient handling of intellectual resources can substantially reduce operational and credit risks, leading to more stable financial performances. Alrashidi and Alarfaj (2020) support this, noting the importance of intellectual capital in managing risks in the Saudi banking industry. This aspect is particularly vital as banks face increasingly volatile financial markets.

From an innovation perspective, intellectual capital drives the development of new financial products and services, adapting to changing consumer demands and regulatory landscapes. Bhattacharjee (2023) suggests that banks with robust intellectual capital frameworks are more innovative, enhancing their competitive edge. This is supported by research from Alshadadi and Deshmukh (2023), who note the role of intellectual capital in sustaining competitive advantages through innovation.

Moreover, intellectual capital impacts non-financial aspects such as employee well-being and organizational culture, which are crucial for long-term sustainability. Banks with significant intellectual capital investments typically exhibit solid organizational cultures that promote employee satisfaction and retention, enhancing overall performance, as Haris et al. (2019) documented.

Al Issa et al.'s (2023) research examines green intellectual capital in healthcare. It extends its implications to broader sectors, including banking, suggesting that environmentally focused intellectual capital practices can significantly enhance sustainability outcomes. Similarly, Asutay and Ubaidillah (2023) explore intellectual capital performance in Islamic banks, identifying its pivotal role in enhancing financial performance, an essential aspect of sustainable operational practices.

 doi:10.20944/preprints202404.1887.v1

Studies such as those by Bhatti et al. (2023) and Rundengan and Tjahjadi (2023) introduce green intellectual capital and its influence on leadership and organizational sustainability practices. These insights are critical as they link intellectual capital management directly with sustainable performance outcomes, emphasizing the transformative potential of intellectual capital in driving environmental and economic sustainability within educational and financial institutions.

Habtamu (2023) and Majumder et al. (2023) provide empirical evidence from Ethiopia and Bangladesh, respectively, demonstrating that intellectual capital efficiency significantly affects the financial performance of commercial banks. This correlation underscores intellectual capital management principles' universal applicability and effectiveness across different banking environments and market conditions.

Furthermore, Nguyen et al. (2023) investigate the moderating role of income diversification in the relationship between intellectual capital and bank performance in Vietnam, highlighting the importance of strategic asset management in leveraging intellectual capital for enhanced market performance. This is complemented by Ul Rehman et al. (2023) work, who delve into the dynamics of intellectual capital and financial performance in ASEAN banks, reinforcing that effective intellectual capital management is integral to achieving superior financial metrics.

Vale et al. (2022) and Jordão et al. (2022) focus on creating value through sustainable intellectual capital, illustrating how intellectual capital supports sustainable economic and financial performance and fosters long-term value creation in emerging markets like Brazil.

2.3. Intellectual Capital Components and Its Impact on Sustainable Bank Performance

Intellectual capital is broadly segmented into three core components—Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE)—each contributing uniquely to the sustainable performance of banks. Human capital, encompassing employees' skills, knowledge, and competencies, fosters innovation and enhances decision-making capabilities. Studies by Mondal and Ghosh (2012) and Singh et al. (2016) have shown that banks with higher levels of human capital exhibit superior financial performance. This is supported by the work of Al-Musali and Ismail (2014), who found that in Saudi Arabia, banks investing in human capital achieve better operational efficiencies and financial outcomes.

Structural capital, which includes the organizational processes, culture, and databases that retain knowledge within the bank, supports the effective utilization of human capital. According to Pham & Dut (2022) and Asiaei et al. (2022), structural capital can significantly enhance organizational efficiency, facilitating improved service delivery and innovation. Ermawati et al. (2023) further suggest that substantial structural capital is linked to enhanced firm value by promoting operational efficiency and service innovation, particularly in complex sectors like banking. Structural Capital Efficiency (SCE) pertains to the systems and processes that support the utilization of human capital. This includes technologies, organizational structures, and corporate culture that enable the practical application of human skills and knowledge. Adequate structural capital ensures that intellectual resources are appropriately leveraged, improving operational performance and sustainability. The role of green intellectual capital, as discussed by Abdelwahed, Al Doghan, and Soomro (2022), emphasizes the growing importance of sustainability-oriented processes and systems in enhancing environmental performance and supporting long-term sustainability goals.

Human Capital Efficiency (HCE) is often cited as a fundamental element in enhancing organizational performance. A bank's workforce's knowledge, skills, and competencies directly influence its ability to innovate and respond to competitive challenges. Studies like those by Rehman, Aslam, and Iqbal (2022) and Jawad et al. (2022) have highlighted the significant impact of HCE on the performance of Islamic banks, underscoring the value of skilled personnel in driving operational efficiency and financial success.

The research underscores the importance of CEE in promoting sustainable banking practices. For instance, efficient capital utilization allows banks to invest more strategically in sustainable technologies and processes, thus contributing to broader environmental and social goals (Abdelwahed, Al Doghan, & Soomro, 2022). This alignment of financial management with

 doi:10.20944/preprints202404.1887.v1

sustainability objectives is crucial in today's regulatory and economic landscape, where banks are increasingly held accountable for their environmental and social impacts.

Moreover, the relationship between CEE and bank performance extends to risk management. Studies suggest that banks with higher CEE perform better financially and exhibit more prudent risk management behaviours, which is vital for long-term sustainability (Zheng et al., 2022). This efficient capital management indicates a bank's overall managerial competence and strategic execution, essential for navigating the complex dynamics of the global financial market.

Moreover, integrating intellectual capital into sustainability practices is becoming increasingly important. Paramba et al. (2023) provide a bibliometric analysis of how intellectual capital influences sustainable startup performance, suggesting that these dynamics apply to more established entities like banks.

The synergy among these intellectual capital components drives financial success and promotes sustainability and corporate responsibility, aligning with global sustainability goals and local economic visions such as Saudi Arabia's Vision 2030. This is echoed by Barak & Sharma (2023) and Anthony Jnr (2021), who emphasize the importance of intellectual capital in achieving sustainable competitive advantages. The literature thus highlights the indispensable role of effectively managing human, structural, and relational capital for banks, particularly in regions like Saudi Arabia, where the economic and regulatory landscape is rapidly evolving.

2.4. Internal Control Variables, Macroeconomic Indicators and COVID-19

This study includes several internal control variables and macroeconomic indicators to ensure a thorough understanding of factors impacting bank performance beyond intellectual capital influences.

Bank Size (SIZE) is recognized as a significant control variable. Larger banks might benefit from economies of scale, enhancing profitability and operational efficiencies. Conversely, larger sizes could also introduce inefficiencies related to more complex operational structures. This variable's dual impact on performance is substantiated by research showing that while size can provide advantages in terms of market reach and resource allocation, it can also lead to bureaucratic inefficiencies that may dampen expected positive impacts (Al-Musali & Ismail, 2014; Alturiqi & Halioui, 2020).

Financial Leverage (LEV) is another crucial variable that measures how much a bank uses borrowed funds. While leverage can amplify returns by increasing the resources available for investment, it also elevates financial risk. Empirical research supports a generally positive, though complex, relationship between leverage and bank profitability, indicating that careful leverage management is essential to avoid excessive risk (Alshadadi & Deshmukh, 2023; Alrashidi & Alarfaj, 2020).

Macroeconomic Indicators such as GDP growth (GGDP) and inflation (INF) are included to provide a backdrop against which the bank's performance is evaluated. GDP growth is often linked with enhanced banking performance due to increased business activities, whereas inflation can negatively impact profitability by inflating costs and reducing the actual value of earnings (Akbar & Heryani, 2020; Asiaei & Jusoh, 2022).

The impact of COVID-19 (COV) is also considered when assessing recent economic disruptions. The pandemic's varying impact across banks highlights differences in operational resilience and strategic response capabilities. Including this variable is crucial for understanding the effects of global crises on financial stability and performance (Marcu, 2021; Maria et al., 2022).

These control variables and indicators are vital for a comprehensive analysis. They allow for a more nuanced understanding of how internal strategies and external economic conditions collectively shape bank performance, ensuring the analysis accurately reflects the complex dynamics driving sustainable performance in the banking sector.

 doi:10.20944/preprints202404.1887.v1

2.5. The Impact of Intellectual Capital on Sustainable Bank Performance in the Context of Saudi Arabia

The impact of intellectual capital on sustainable bank performance is increasingly significant, particularly within the unique economic and regulatory landscape of Saudi Arabia. This literature review synthesizes findings from a range of studies to illuminate how various dimensions of intellectual capital contribute to the performance and sustainability of Saudi banks.

Intellectual capital in Saudi Arabia, encompassing human, structural, and relational capital, has been a focal point of academic inquiry, given its crucial role in driving organizational success and adaptation in a rapidly changing economic environment. Abdelwahed, Al Doghan and Soomro (2022) discuss the concept of green intellectual capital and its relevance to sustainability within the manufacturing sectors, suggesting implications for its application in the banking sector to enhance environmental and economic sustainability.

Al-Musali and Ismail (2014) provide empirical evidence on the positive effects of intellectual capital on the financial performance of banks in Saudi Arabia, highlighting that efficient management of intellectual resources significantly correlates with enhanced profitability. Similarly, Alharbi (2023) extends this analysis by showing that intellectual capital significantly impacts firm performance across various sectors in Saudi Arabia, supporting the broader application of these findings in the banking sector.

The research by Alrashidi and Alarfaj (2020) explicitly addresses the banking industry, illustrating how intellectual capital efficiency influences bank risks, indicating that higher intellectual capital efficiency can mitigate risks and contribute to bank stability. This is corroborated by studies such as those by Alshadadi and Deshmukh (2023), which link systemic risks and stability in the banking sector, suggesting that intellectual capital could be a crucial factor in enhancing stability.

Alturiqi and Halioui (2020) further affirm the importance of intellectual capital in improving firm performance in Saudi Arabia, arguing for its critical role in fostering innovation and competitiveness. Hamdan, Buallay, and Alareeni (2017) explore the moderating role of corporate governance in this relationship, indicating that effective governance mechanisms enhance the positive impact of intellectual capital on performance.

Alghamdi et al. (2016) discuss the conceptual frameworks and mechanisms for investing in intellectual capital in Saudi educational institutions, emphasizing the importance of knowledge and skill development as fundamental components of intellectual capital. This emphasis is equally critical in the banking sector, where sophisticated knowledge management systems are essential for innovation and competitive advantage.

Sulphey and Naushad (2019) specifically examine the position of intellectual capital among Saudi banks, illustrating its role in enhancing financial performance and market competitiveness. Their findings suggest that Saudi banks that effectively manage their intellectual capital enjoy superior market positions and better financial outcomes, which are critical indicators of sustainable performance.

Moreover, Bengana et al. (2023) explore the broader economic impacts of human capital development through artificial intelligence in Saudi Arabia, demonstrating that strategic investments in human capital significantly contribute to economic performance. This perspective reinforces the importance of intellectual capital in banking, where technological advancements and human capital development are crucial for sustaining growth and adapting to market changes.

These studies collectively point to a significant gap in the literature. While the impact of intellectual capital on financial performance is well-documented, more is needed to know about how these capabilities specifically contribute to sustainable practices within banks. This gap is especially pertinent as Saudi Arabia pushes towards sustainability and economic diversification, where the strategic management of intellectual capital could play a transformative role in aligning bank operations with national sustainability goals.

2.6. Research Gap

While substantial literature explores the impact of intellectual capital on organizational performance, specific investigations focusing on its effects on the sustainable performance of banks

 doi:10.20944/preprints202404.1887.v1

in Saudi Arabia are relatively sparse. Existing studies typically discuss the broader sector, adopt a global view, and often overlook the nuances of the Saudi Arabian banking environment. For example, research by Al-Musali and Ismail (2014) touches upon intellectual capital in Saudi banks but needs to address the sustainability aspects within the banking sector specifically. Likewise, Akkas and Asutay (2023) examine intellectual capital in GCC banks primarily from a financial performance perspective, rather than focusing on sustainability.

The studies also frequently ignore the unique market conditions and regulatory frameworks in Saudi Arabia that could influence these relationships. For instance, although Alharbi (2023) and Alrashidi and Alarfaj (2020) provide valuable insights into intellectual capital within the Saudi context, they do not concentrate on sustainable performance, which is becoming increasingly crucial under Saudi Arabia's Vision 2030 and its growing emphasis on sustainability in the financial sector.

Additionally, while the literature acknowledges the importance of control variables such as bank size and financial leverage in promoting sustainable banking performance, their specific interactions with intellectual capital have yet to be thoroughly investigated within the Saudi Arabian context. This oversight represents a significant gap, as understanding these interactions can offer crucial insights for policymakers and bank managers aiming to enhance both financial and environmental performance.

Moreover, the advent of the COVID-19 pandemic has introduced complexity and urgency to this domain. The pandemic has drastically affected global and local economies, significantly impacting banking operations and financial stability. However, the specific impacts of the pandemic on the relationship between intellectual capital and sustainable bank performance in Saudi Arabia have yet to be deeply explored. This study aims to address this gap by analyzing how COVID-19 has influenced these dynamics, providing a more contemporary understanding that reflects the challenges and adaptations faced by banks during the pandemic.

This research aims to fill these gaps by delivering a detailed analysis of how intellectual capital and its components influence the sustainable performance of banks, specifically in Saudi Arabia. It considers unique local factors, global economic conditions, and the recent impacts of the COVID-19 pandemic. Through this, it intends to contribute valuable insights to the existing body of knowledge and support the strategic goals of Saudi Arabian banks in achieving sustainability and resilience.

2.7. Hypotheses Development

Based on the literature review and the objectives aimed at exploring the impact of Intellectual Capital (VAIC) and its components(Human et al. (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE)) on bank sustainable performance of banks in Saudi Arabia, namely the Profitability and the operational efficiency of banks (as indicators of achievement of Goals 8 and 9 of Sustainable Goals) within the Saudi Arabian banking sector, the following hypotheses are proposed.

Hypothesis 1 (H1): The overall Value-Added Intellectual Coefficient (VAIC) positively impacts the Return on Equity (ROE) for banks in Saudi Arabia.

Hypothesis 1a (H1a): Human Capital Efficiency (HCE) positively affects the Return on Equity (ROE) of banks in Saudi Arabia.

Hypothesis 1b (H1b): Structural Capital Efficiency (SCE) positively affects the Return on Equity (ROE) of banks in Saudi Arabia.

Hypothesis 1c (H1c): Capital Employed Efficiency (CEE) positively affects the Return on Equity (ROE) of banks in Saudi Arabia.

Hypothesis 2 (H2): The overall Value-Added Intellectual Coefficient (VAIC) positively impacts the Net Profit Margin (NPM) of banks in Saudi Arabia.

Hypothesis 2a (H2a): Human Capital Efficiency (HCE) positively affects the Net Profit Margin (NPM) of banks in Saudi Arabia.

Hypothesis 2b (H2b): Structural Capital Efficiency (SCE) positively affects the Net Profit Margin (NPM) of banks in Saudi Arabia.

 doi:10.20944/preprints202404.1887.v1

Hypothesis 2c (H2c): Capital Employed Efficiency (CEE) positively affects the Net Profit Margin (NPM) of banks in Saudi Arabia.

These hypotheses specifically aim to test the impacts of VAIC and its components (human, structural, and capital-employed efficiencies) on key financial performance metrics such as ROE and bank operational efficiency, thereby improving their profit margins and NPM as indicators of sustainable performance. The confirmation or refutation of these hypotheses through empirical testing will add to the understanding of intellectual capital's role in Saudi banks' financial performance.

3. Research Design and Methodology

This section outlines the comprehensive research design and methodology employed to explore the impact of intellectual capital on the sustainable financial performance of banks in Saudi Arabia. Intellectual capital is represented through the Value-Added Intellectual Coefficient (VAIC), a holistic measure encompassing Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE). The investigation focuses on how these components influence key financial performance indicators, specifically Return on Equity (ROE) and Net Profit Margin (NPM).

The methodology section provides a clear and systematic exploration of the research framework, detailing the data collection processes, the econometric methods applied, the operationalization of variables, and the statistical models developed to analyze the data. This structure is intended to ensure that the study is replicable and that the findings are robust and applicable to the broader context of banking sector performance, particularly in relation to achieving Sustainable Goals 8 (Decent Work and Economic Growth) and 9 (Industry, Innovation, and Infrastructure).

This section details each component of the research design to illuminate the intricacies of measuring and evaluating the contributions of intellectual capital to banks' financial sustainability. This approach enhances the understanding of intellectual capital's role and aligns with global efforts to integrate sustainability into core business strategies.

3.1. The Research Framework

This study's research framework is anchored in the firm's resource-based view (RBV), which highlights the strategic significance of leveraging unique organizational resources and capabilities to achieve competitive advantage. Intellectual capital, comprising human, structural, and employed capital efficiencies, is a pivotal intangible asset banks can utilize to enhance their efficiency and competitiveness. Sustainability theories further support this approach, emphasizing size-efficient resource management as essential for achieving economic, social, and environmental goals.

In this framework, Human Capital Efficiency (HCE) is valued for its role in driving profitability through employees' skills and knowledge, aligning with findings from Al-Musali & Ismail (2014), who underscored the importance of human capital in the financial performance of Saudi banks. Similarly, Capital Employed Efficiency (CEE) reflects the effective use of financial and physical resources to generate revenue. This relationship has been supported by research like that of Alturiqi and Halioui (2020), demonstrating the positive impact of capital management on firm performance in Saudi Arabia.

However, the impact of Structural Capital Efficiency (SCE) is more complex, as evidenced by its varied effects on Net Profit Margin (NPM) in the models used. This mirrors insights from Pham and Dut (2022), who discussed how structural capital, while crucial, might have long-term benefits that are not immediately apparent in short-term financial metrics.

Control variables such as bank size and leverage, along with macroeconomic factors like GDP growth and inflation, are integrated into the models to understand the comprehensive impact of external and internal factors on bank performance. This holistic approach helps isolate the specific contributions of intellectual capital components to financial outcomes, highlighting the nuanced ways these assets drive sustainable performance in line with Sustainable Development Goals 8 and 9, which focus on promoting sustained economic growth and building resilient infrastructure.

 doi:10.20944/preprints202404.1887.v1

By systematically examining these relationships within the Saudi banking sector, this study not only seeks to validate the RBV's theoretical propositions in a specific industrial context but also aims to offer practical insights that can guide strategic decisions in resource management. This contributes to a broader understanding of how intellectual capital influences sustainable financial performance, providing a valuable reference for both academic research and practical application in the banking industry.

3.2. Data Collection

The data collection for this study was carried out meticulously to ensure the reliability and relevance of the data used to examine the impact of intellectual capital on the sustainable financial performance of banks in Saudi Arabia. The primary data source involved the annual financial reports of 10 major Saudi banks from 2012 to 2022. These reports are essential for accessing detailed financial information, such as profits, assets, and equity.

Secondary data were sourced from the Saudi Arabian Monetary Authority (SAMA) and Tadawul (Saudi Financial Markets). SAMA provided crucial macroeconomic indicators like inflation rates and GDP growth, while Tadawul offered market-related data, including stock prices and capitalization.

Data collection methods included detailed document analysis to extract specific data from financial reports and structured database queries to retrieve historical macroeconomic and market data. All data underwent rigorous verification, validation, and cleaning processes to ensure accuracy and consistency, addressing issues like missing values or outliers.

Regarding data handling, all procedures complied with ethical research standards, focusing on confidentiality and integrity. Data were securely stored with backups and restricted access to minimize risks of breaches and ensure future research availability. This comprehensive approach to data collection enhances the study's credibility, providing a strong empirical basis for analyzing the contributions of intellectual capital to the financial performance of banks within Saudi Arabia's economic context.

3.3. Methodology

The methodology for this study employs a quantitative approach to explore the relationships between intellectual capital, measured by the Value-Added Intellectual Coefficient (VAIC), and its impact on the sustainable financial performance of Saudi banks. Specifically, the focus is on how the components of VAIC—Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE)—affect two critical financial performance indicators: Return on Equity (ROE) and Net Profit Margin (NPM). This section outlines the panel data analysis techniques used to handle the data, the rationale behind the chosen econometric models, and the procedure for testing the hypotheses.

3.3.1. Panel Data Analysis

Panel data analysis was selected due to its capacity data, which involves multiple observations over various time periods for the same firms. This type of data allows for controlling both cross-sectional and time-series variabilities, providing a more detailed and accurate analysis than pure cross-sectional or time-series data could offer.

The econometric analysis begins with the formulation of models that incorporate both fixed and random effects in addition to without fixed and random models:

Fixed-effects model: This model is used to study the impact of variables that vary over time but are constant across individuals or entities. The fixed-effects model is beneficial for controlling time-invariant characteristics of the individual banks, allowing the model to focus on the variables that change over time. It effectively handles omitted variable bias by assuming unobserved variables do not correlate with the observed variables over time.

 doi:10.20944/preprints202404.1887.v1

Random Effects Model: This model is chosen when the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model. If the random effects assumption holds, it is more efficient than the fixed-effects model, as it considers differences between entities, generalizing the inferences beyond the sample used in the study.

3.3.2. Model Specification

Each of the components of VAIC (HCE, SCE, and CEE) and overall VAIC are included as independent variables in the regression models to determine their individual effects on ROE and NPM. Control variables such as bank size (SIZE), leverage ratio (LEV), and macroeconomic indicators (GDP growth - GGDP and inflation - INF) are also included to adjust for their potential impacts on the dependent variables, constituting four different models:

3.3.2.1. Model 1: ROE with VAIC and Control Variables

This model assesses the impact of the overall VAIC on Return on Equity (ROE), including control variables such as size, leverage, GDP growth, and inflation:

$$\mathrm{ROE}_{it} = \beta_0 + \beta_1 \mathrm{VAIC}_{it} + \beta_2 \mathrm{SIZE}_{it} + \beta_3 \mathrm{LEV}_{it} + \beta_4 \mathrm{GGDP}_t + \beta_5 \mathrm{INF}_t + \beta_6 \mathrm{COV}_t + \epsilon_{it} \quad (1)$$

3.3.2.2. Model 2: ROE with VAIC Components and Control Variables

This model explores the individual effects of the components of VAIC (HCE, SCE, CEE) on ROE, along with the same control variables:

$$\mathrm{ROE}it = \beta 0 + \beta 1 \mathrm{HCE}it + \beta 2 \mathrm{SCE}it + \beta 3 \mathrm{CEE}it + \beta 4 \mathrm{SIZE}it + \beta 5 \mathrm{LEV}it + \beta 6 \mathrm{GGDP}t + \beta 7 \mathrm{INF}t + \beta 7 \mathrm{COV}t + \epsilon it \quad (2)$$

3.3.2.3. Model 3: NPM with VAIC and Control Variables

This model assesses the impact of the overall VAIC on Net Profit Margin (NPM), considering the same control variables to evaluate how intellectual capital influences profitability:

$$\mathrm{NPM}_{it} = \beta_0 + \beta_1 \mathrm{VAIC}_{it} + \beta_2 \mathrm{SIZE}_{it} + \beta_3 \mathrm{LEV}_{it} + \beta_4 \mathrm{GGDP}_t + \beta_5 \mathrm{INF}_t + \beta_6 \mathrm{COV}_t + \epsilon_{it} \quad (3)$$

3.3.2.4. Model 4: NPM with VAIC Components and Control Variables

This model delves into how individual components of VAIC (HCE, SCE, CEE) affect NPM, along with the control variables, to provide detailed insights into the profitability impacts:

$$\mathrm{NPM}it = \beta 0 + \beta 1 \mathrm{HCE}it + \beta 2 \mathrm{SCE}it + \beta 3 \mathrm{CEE}it + \beta 4 \mathrm{SIZE}it + \beta 5 \mathrm{LEV}it + \beta 6 \mathrm{GGDP}t + \beta 7 \mathrm{INF}t + \beta 7 \mathrm{COV}t + \epsilon it \quad (4)$$

These equations systematically lay out the impacts of intellectual capital measures on financial performance outcomes, using a structured approach to evaluate the impacts across different facets of bank operations quantitatively.

3.3.3. Hypothesis Testing

To assess the validity of the proposed hypotheses regarding the relationships between VAIC components and bank performance measures, the study employs:

T-statistics: To determine the significance of the regression coefficients, which helps understand the relationships' strength and direction.

F-statistics: To test the regression models' overall fit and ensure the model variables' joint significance.

Hausman Test: This test is conducted to decide between fixed-effects and random-effects models based on whether the unique errors correlate with the model's regressors. It helps choose the most appropriate model for the data.

The analysis involves careful data handling procedures, including cleaning, missing data imputation, and preliminary descriptive statistics to ensure the quality and reliability of the results.

 doi:10.20944/preprints202404.1887.v1

Robust standard errors are calculated to control for potential heteroscedasticity and autocorrelation within the dataset.

By applying these comprehensive methodologies, the study aims to robustly quantify and elucidate the impacts of intellectual capital on the financial sustainability of banks in Saudi Arabia. This will offer valuable insights for industry stakeholders and contribute to the broader discourse on sustainable economic development.

3.4. Measurement of Variables

The Measurement of Variables section is a crucial cornerstone of this study, translating theoretical concepts of intellectual capital into quantifiable terms. It meticulously defines each variable analyzed, ensuring that the investigation into the sustainable performance of Saudi banks is grounded in empirical evidence. This section aligns academic rigour with practical analysis, preparing a robust examination of how intellectual capital influences key financial metrics.

Table 1. Measurement of Variables.

S. No	Variables	Sign	Description of Variables	Citations
1	Capital Employed Efficiency	CEE	The ratio of value added to capital employed includes equity and long-term borrowings.	Al-Musali & Ismail (2014), Alturiqi & Halioui (2020)
2	Human Capital Efficiency	HCE	The ratio of value added to human capital, where human capital is the total employee expenditure.	Mondal & Ghosh (2012). Singh et al. (2016)
3	Structural Capital Efficiency	SCE	The ratio of structural capital to value-added, where structural capital is the difference between value-added and human capital.	Pham & Dut (2022). Asiaei et al. (2022)
4	Value-Added Intellectual Coefficient	VAIC	A measure of the efficiency of value addition by the company's intellectual capital.	Ku Ismail & Abdul Karem (2011). Meles et al. (2016)
5	Return on Equity	ROE	Net income attributable to equity shareholders divided by total equity.	Barak & Sharma (2023). Singh et al. (2016)
6	Net Profit Margin	NPM	Net income is divided by total revenues, reflecting the company's efficiency in generating profit from its revenues.	Alturiqi & Halioui (2020), Akkas & Asutay (2022)
7	Financial Leverage	LEV	The ratio of debt to shareholder's equity, indicating the bank's financial structure.	Ousama et al. (2020), Akkas & Asutay (2022)
8	Size	Size	The natural logarithm of total assets, indicating the scale of the bank's operations.	Al-Musali & Ismail (2014), Akkas & Asutay (2022)
9	GDP Growth	GGDP	The growth rate of the country's total economic output represents the economic environment in which the banks operate.	Akbar & Heryani (2020), Yusliza et al. (2020)
10	Impact of COVID-19	COV	A variable to measure the impact of the COVID-19 pandemic on the bank's performance.	Marcu (2021), Pham & Dut (2022)

Source: Developed from this study.

 doi:10.20944/preprints202404.1887.v1

4. Results and Discussion

4.1. Descriptive Statistics and Correlation Analysis

The descriptive statistics of the study in Table 2 reveal that Human Capital Efficiency (HCE) is the most significant component of Intellectual Capital (VAIC) in terms of its mean value, analysing the sustainable financial performance of Saudi banks. This finding indicates a broader trend observed in the literature where HCE is often highlighted as a critical driver of value-creation organisations. It aligns with the results of Pulic's 2000 study. It is corroborated by research such as that by Mondal & Ghosh (2012) and Singh et al. (2016), which emphasise the pivotal role of human capital in enhancing firm performance.

Table 2. The descriptive statistics.

Statistical Measure	ROE	NPM	VAIC	LSCE	HCE	CEE	SIZE	LEV	GGDP	INF	COV
Mean	0.1189	0.4572	4.5158	0.0000	3.4892	0.0266	18.9268	0.8502	0.0284	0.0240	0.1818
Median	0.1184	0.4870	4.6420	0.0000	3.6172	0.0266	18.9985	0.8550	0.0285	0.0250	0.0000
Maximum	0.2191	0.6623	7.4720	0.0000	6.4433	0.0520	20.6672	0.9075	0.0874	0.0350	1.0000
Minimum	-0.0743	-0.4651	0.1042	0.0000	-0.8896	-0.0062	17.2093	0.6915	-0.0434	0.0080	0.0000
Std. Dev.	0.0456	0.1425	1.0389	0.0000	1.0359	0.0066	0.7107	0.0322	0.0320	0.0082	0.3875
Skewness	-0.5553	-2.9135	-0.5032	-1.0531	-0.4937	-0.6210	0.0585	-1.6149	-0.4762	-0.4537	1.6499
Kurtosis	5.2041	18.0949	5.3266	4.1764	5.2802	9.1701	2.6822	8.4073	3.5322	2.3856	3.7222
Jarque-Bera	27.9191	1199.9520	29.4529	26.6732	28.2990	181.5571	0.5259	181.8197	5.4552	5.5047	52.2981
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7688	0.0000	0.0654	0.0638	0.0000
Sum	13.0821	50.2944	496.7378	0.0000	383.8143	2.9236	2081.9510	93.5273	3.1200	2.6400	20.0000
Sum Sq. Dev.	0.2267	2.2127	117.6377	0.0000	116.9721	0.0047	55.0539	0.1129	0.1118	0.0074	16.3636
Observations	110	110	110	110	110	110	110	110	110	110	110

In stark contrast, the mean values of other components of VAIC, such as Capital Employed Efficiency (CEE) and Structural Capital Efficiency (SCE), are relatively lower. This distinction parallels studies like those by Alturiqi and Halioui (2020) and Al-Musali and Ismail (2014), which found that VAIC contributes more significantly to organisational performance than physical assets. The variance in the mean values of leverage, GDP, and size observed in the current study is consistent with the findings from Akbar & Heryani (2020) and Ousama et al. (2020), reflecting a nuanced understanding of how different dimensions of VAIC and various internal and external factors can influence the financial outcomes of firms.

The high standard deviation and coefficient of variation for the independent and dependent variables underscore high volatility in the VAIC components and profitability indicators. Such volatility is indicative of a dynamic business environment. Akkas and Asutay (2022) explore this

 doi:10.20944/preprints202404.1887.v1

theme in their research on intellectual capital, also underscoring the complexities of VAIC components in contributing to financial performance.

The Jarque–Bera statistics from this study point to a non-normal distribution for most variables, a condition that resonates with findings from the broader VAIC literature, as seen in the work of Pham & Dut (2022), where the distribution of VAIC indicators often deviates from normality. This has significant methodological implications, as it necessitates using non-parametric statistical methods or transforming data to meet the assumptions of parametric tests.

The current study's findings on the disproportionate value added by HCE compared to other VAIC components add to the growing body of evidence, as seen in the works within the references, that human capital is a cornerstone of intellectual capital that can substantially organisation financial sustainability. Moreover, the impact of macroeconomic factors and internal controls like size and leverage mirrors the importance of such variables highlighted in the works of Alharbi and Asiaei et al. (2022), suggesting that these factors play a crucial role in shaping the financial outcomes associated with intellectual capital investment.

The correlation matrix presented in Table 3 provides an insightful perspective on the relationships between various measures of financial performance and intellectual capital (VAIC) components within the Saudi banking sector. Notably, the strong positive correlation between Net Profit Margin (NPM) and Human Capital Efficiency (HCE) at 0.8602 suggests that HCE plays a critical role in the profitability of these banks, a finding that is consistent with the research by Mondal & Ghosh (2012), which observed a positive impact of intellectual capital on the financial performance of Indian banks.

Table 3. The correlation matrix of all variables.

	ROE	NPM	VAIC	LSCE	HCE	CEE	SIZE	LEV	GGDP	INF	COV
ROE	1										
NPM	0.7118	1									
VAIC	0.6384	0.8616	1								
LSCE	0.3474	0.1352	0.4008	1							
HCE	0.6348	0.8602	0.99998	0.4008	1						
CEE	0.8467	0.6102	0.4502	0.1739	0.4451	1					
SIZE	0.2938	0.308	0.6477	0.8495	0.6495	0.0071	1				
LEV	0.5071	0.0643	-0.0281	0.1353	-0.0296	0.23	-0.0266	1			
GGDP	0.2385	0.3617	0.2653	-0.0668	0.2648	0.2074	0.0046	0.046	1		
INF	-0.1315	-0.1991	-0.0575	-0.0662	-0.0562	-0.2246	0.0349	-0.0043	-0.0803	1	
COV	-0.3265	-0.3856	-0.1737	0.1556	-0.1717	-0.3884	0.1748	-0.0576	-0.4504	0.5173	1

Moreover, the Value Added Intellectual Coefficient (VAIC) shows a strong correlation with NPM at 0.8616, underscoring the integral part that VAIC plays in the financial success of banks, as also noted in the study by Alturiqi & Halioui (2020) within the Saudi context. The high correlation between HCE and VAIC at 0.99998 further reinforces the centrality of human capital in the constitution of overall VAIC, resonating with findings from Ousama et al. (2020), which highlighted a significant association between VAIC and financial performance in the GCC Islamic banking industry.

The correlations involving Leverage (LEV) show a more nuanced relationship with financial performance metrics. While a moderate positive correlation exists between LEV and Return on Equity (ROE) at 0.5071, indicating that leverage might play a role in equity returns, it is negatively correlated with NPM, albeit weakly. This might suggest that higher leverage does not necessarily contribute to profit margins, a result that echoes the study by Al-Musali & Ismail (20), emphasizing the complex effects of financial structure on performance.

The negative correlation between the impact of COVID-19 (COV) and both ROE (-0.3265) and NPM (-0.3856) suggests that the pandemic has had a detrimental effect on banks' financial performance. This aligns with the broader impacts of COVID-19 on financial sectors globally, as

 doi:10.20944/preprints202404.1887.v1

illustrated in various studies by Akkas and Asutay (2022). Additionally, the negative correlation with CEE (-0.3884) might indicate that the pandemic has disrupted the efficient use of capital employed within these banks.

Interestingly, SIZE shows a strong correlation with LSCE (0.8495). However, its correlation with ROE and NPM could be more robust, indicating that the size of the bank does not directly translate to higher profitability or returns on equity. This supports the findings by Barak & Sharma (2023), who investigated the sustainable financial performance of banks in India and suggested that larger size only sometimes leads to better financial outcomes.

Inflation (INF) shows a generally weak correlation with financial performance indicators, suggesting that it might not be a significant factor in banks' short-term performance. This perspective can be paralleled with the research by Githaiga et al. (2023), which focuses on the internal factors of financial institutions rather than external economic conditions.

This comprehensive correlation analysis sheds light on the intricate relationships between VAIC and financial performance in Saudi banking. The study's findings contribute to the growing body of literature that seeks to understand the multifaceted nature of VAIC's influence on firm performance, particularly in the context of the financial sector.

4.2. Unit Root Test

The panel unit root tests, as presented in Tables 4 and 5, provide valuable insights into the stationarity of the variables under consideration. The Phillips-Perron (PP) tests at this level indicate that most variables are non-stationary, except for LSCE and CEE, which are at certain specifications where the t-statistics are significant. This suggests that for most variables, their means, variances, and covariances are not constant over time, indicating the presence of unit roots at the level.

Table 4. Panel unit root (The Phillips-Perron -PP).

PP At Level											
		ROE	NPM	VAIC	LSCE	HCE	CEE	SIZE	LEV	GGDP	INF
With Constant	t-Statistic	0.2543	0.2441	0.3056	0.0027	0.3071	0.1018	0.0005	0.2237	0.6883	0.2067
	Prob.	0.3668	0.2403	0.157	0.0001	0.1578	0.0611	0.6587	0.6389	0.6883	0.2067
		n0	n0	n0	***	n0	*	n0	n0	n0	n0
With Constant & Trend	t-Statistic	0.0384	0.0957	0.229	0.0002	0.2294	0.106	0.0001	0.0001	0.9979	0.4368
	Prob.	0.3035	0.1778	0.0386	0.2154	0.0395	0.1497	0.6553	0.8362	0.9979	0.4368
		n0	n0	**	n0	**	n0	n0	n0	n0	n0
Without Constant & Trend	t-Statistic	0.5033	0.4638	0.4329	0.0083	0.422	0.5711	0.9775	0.6958	0.2779	0.4087
	Prob.	0.1903	0.2452	0.1742	0.0036	0.1762	0.4683	0.9709	0.4523	0.2779	0.4087
		n0	n0	n0	***	n0	n0	n0	n0	n0	n0
PP At First Difference											
		d(ROE)	d(NPM)	d(VAIC)	d(LSCE)	d(HCE)	d(CEE)	d(SIZE)	d(LEV)	d(GGDP)	d(INF)
With Constant	t-Statistic	0.0007	0.0012	0.0042	0.0155	0.0043	0.001	0.0002	0.0003	0.1318	0.0093
	Prob.	0.0121	0.0056	0.0021	0.1122	0.0021	0.0003	0.1086	0.1954	0.1318	0.0093
		**	***	***	n0	***	***	n0	n0	n0	***
With Constant & Trend	t-Statistic	0.0021	0.0021	0.0035	0.8259	0.0035	0.0018	0.001	0.0192	0.1248	0.02
	Prob.	0.0367	0.0335	0.0152	0.06	0.0153	0.0004	0.3271	0.4709	0.1248	0.02
		**	**	**	*	**	***	n0	n0	n0	**
Without Constant & Trend	t-Statistic	0.0001	0.0002	0.0006	0.0023	0.0006	0	0.0001	0.001	0.0115	0.0004
	Prob.	0.001	0.0003	0.0001	0.0406	0.0001	0	0.027	0.028	0.0115	0.0004
		***	***	***	**	***	***	**	**	**	***

Key: *p < 0.1, **p < 0.05, ***p < 0.01, n0: not significant.

 doi:10.20944/preprints202404.1887.v1

Table 5. Unit Root Test Table (The Augmented Dickey-Fuller-ADF).

ADF At Level											
		ROE	NPM	VAIC	LSCE	HCE	CEE	SIZE	LEV	GGDP	INF
With Constant	t-Statistic	0.2543	0.2364	0.265	0.0031	0.2662	0.0985	0.0003	0.2643	0.1924	0.1963
	Prob.	0.3691	0.2373	0.157	0.0203	0.1578	0.0611	0.6711	0.6529	0.1924	0.1963
		n0	n0	n0	**	n0	*	n0	n0	n0	n0
With Constant & Trend	t-Statistic	0.1577	0.2179	0.3176	0.0471	0.3168	0.2198	0.0709	0.1312	0.0586	0.4368
	Prob.	0.14	0.2342	0.2021	0.6141	0.205	0.1583	0.6553	0.6555	0.0586	0.4368
		n0	n0	n0	n0	n0	n0	n0	n0	*	n0
Without Constant & Trend	t-Statistic	0.4027	0.3935	0.4828	0.2973	0.4469	0.5018	0.8806	0.6872	0.1881	0.3586
	Prob.	0.323	0.3595	0.5103	0.0051	0.497	0.6326	0.9699	0.448	0.1881	0.3586
		n0	n0	n0	***	n0	n0	n0	n0	n0	n0
ADF At First Difference											
		d(ROE)	d(NPM)	d(VAIC)	d(LSCE)	d(HCE)	d(CEE)	d(SIZE)	d(LEV)	d(GGDP)	d(INF)
With Constant	t-Statistic	0.0141	0.0167	0.0284	0.1825	0.0285	0.0151	0.0046	0.1088	0.0043	0.0081
	Prob.	0.0671	0.0092	0.1018	0.1111	0.1032	0.0052	0.1074	0.1971	0.0043	0.0081
		*	***	n0	n0	n0	***	n0	n0	***	***
With Constant & Trend	t-Statistic	0.0646	0.0664	0.0947	0.7331	0.2302	0.0596	0.1706	0.2109	0.0172	0.02
	Prob.	0.2513	0.0496	0.0307	0.06	0.0307	0.1298	0.3194	0.4514	0.0172	0.02
		n0	**	**	*	**	n0	n0	n0	**	**
Without Constant & Trend	t-Statistic	0.0007	0.0008	0.0017	0.0181	0.0017	0.0006	0.0002	0.0121	0.0005	0.0003
	Prob.	0.0014	0.0004	0.0002	0.1019	0.0002	0.0002	0.0248	0.028	0.0005	0.0003
		***	***	***	n0	***	***	**	**	***	***

Key: *p < 0.1, **p < 0.05, ***p < 0.01, n0: not significant.

However, when first differences are considered, the significance improves dramatically, with most variables showing significance at the 1% and 5% levels, implying that they become stationary after differencing. This is an indication that the variables are integrated of order one, I(1), and suitable for subsequent cointegration analysis to examine long-term relationships, a procedure echoed in the work by Al-Musali & Ismail (2014) on Saudi Arabian banks and Mondal & Ghosh (2012) on Indian banks.

The Augmented Dickey-Fuller (ADF) tests corroborate the PP tests' findings, with non-stationarity evident at level but stationarity achieved upon first differencing. The ADF test is particularly stringent, including a constant and a trend. However, the results after differencing still indicate stationarity for most variables, aligning with the rigorous approach to examining financial performance in studies like those by Akkas and Asutay (2022) on Islamic and conventional banks.

The persistence of non-stationarity in some variables at the level could reflect structural instabilities and dynamic changes within the financial sector, particularly in light of external shocks such as the economic effects of COVID-19, which studies like Alrabei et al. (2023) have noted for Jordanian firms.

The stationarity of the differenced variables lays the groundwork for further econometric modelling, which is employed in examining the nexus between intellectual capital and financial performance, as seen in the work of Barak & Sharma (2023) on Indian banks and Singh et al. (2016) for a sectoral comparison in India.

In essence, the unit root tests in the study reveal the dynamic nature of the variables, akin to those observed in other emerging markets, emphasizing the need for robust time series analysis to understand banks' financial performance in relation to their intellectual capital.

4.3. Panel Least Squares Estimation Results

The results from the panel least squares estimation significantly highlight the role of the Value-Added Intellectual Coefficient (VAIC) in enhancing the Return on Equity (ROE) across different

 doi:10.20944/preprints202404.1887.v1

modelling scenarios, strongly supporting Hypothesis 1 (H1). The robust positive coefficients of VAIC in all models underline the importance of intellectual capital as a determinant of financial performance, resonating with the findings from Al-Musali & Ismail (2014), who identified similar impacts within Saudi Arabian banks.

The SIZE variable consistently demonstrates a negative relationship with ROE across all models, indicating potential inefficiencies or challenges larger banks face. This aligns with insights from international studies, such as Barak and Sharma (2023), which explored how scale impacts bank performance. They suggest that operational complexities increase with size, thereby diluting efficiency.

Leverage (LEV) exhibits a positive relationship with ROE, implying that Saudi banks effectively use debt to enhance equity returns. This finding aligns with broader financial theories and is corroborated by studies like those by Akkas and Asutay (2022), which noted the strategic use of leverage to boost profitability in Islamic banks.

Interestingly, macroeconomic factors such as Gross Domestic Product growth (GGDP) and inflation (INF) do not consistently impact ROE, suggesting that internal strategies and intellectual capital management more directly influence bank performance than external economic conditions. This observation is echoed in the literature, for instance, in the work of Singh et al. (2016), which suggests that the robust management of intellectual resources can shield banks from adverse economic conditions.

The relatively insignificant impact of COVID-19 (COV) on ROE suggests that either effective bank strategies mitigated the pandemic's financial impacts or that the banks possessed inherent resilience, similar to observations in broader studies on pandemic resilience, such as those by Githaiga et al. (2023).

The high R-squared values, particularly in the fixed effects model, indicate explanatory solid power, showing that the models effectively capture critical drivers of ROE.

Overall, the empirical evidence robustly affirms the significant role of intellectual capital in enhancing the financial performance of Saudi banks, reinforcing its strategic importance in achieving sustainability goals related to innovation and efficient resource utilisation within the banking sector. This comprehensive analysis supports the formulated hypotheses and enriches the dialogue on optimal strategies for banking growth and efficiency in the context of global financial practices and sustainable development objectives.

Table 6. Model 1: Panel least squared estimation using the cross-section random and fixed effects using ROE and VAIC.

Variable	Without Fixed or Random Effects		Fixed Effect		With Cross-Section Random Effect	
	Coefficient	T Statistics	Coefficient	T Statistics	Coefficient	T Statistics
Constant (C)			0.4163 **	3.5322	0.1578	1.5068
VAIC	0.0387***	11.9971	0.0291 ***	12.7305	0.0307 ***	13.7640
SIZE	-0.0258 ***	-7.8675	-0.0537 ***	-8.4669	-0.0381 ***	-7.1112
LEV	0.5209 ***	8.1024	0.6996 ***	10.3763	0.6469 ***	10.1718
GGDP	-0.0854	-0.9048	0.0668	1.2310	0.0129	0.2448
INF	-0.2190	-0.5882	-0.3805 *	-1.8332	-0.2360	-1.1512
COV	-0.0107	-1.1693	0.0024	0.4095	-0.0057	-1.0286
R-squared	0.6670		0.9143		0.8060	
Adjusted R-squared	0.6510		0.9007		0.7947	
Root MSE	0.0262		0.0133		0.0152	
Durbin-Watson stat	0.3987		1.4353		1.1221	
Prob(F-statistic)	N/A		0.0000 ***		0.0000 ***	

 doi:10.20944/preprints202404.1887.v1

The Hausman test, with a Chi-Square statistic of 0 and a probability of 1, supports using the random effects model. This result suggests no correlation between the unique errors and the regressors in the fixed effects model, making the random effects model more appropriate and efficient for this analysis. This finding is crucial as it aligns with the recommendations in the systematic reviews of intellectual capital's impact on firm performance, like those by Alvino et al. (20), emphasising the need for modelling choices that accurately reflect the underlying data structure.

Table 7. Model 1: Husman Test.

Test Summary Model	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0	6	1

The panel least squares estimation results from Model 2 (Table 8) clearly illustrate how various components of intellectual capital, namely Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE), impact Return on Equity (ROE) in Saudi Arabian banks. These components show differing degrees of influence across various models, offering a detailed perspective on intellectual capital's contribution to bank performance.

Table 8. Model 2: Panel least squared estimation using the cross-section random and fixed effects using ROE and VAIC- Components.

Variable	Without Fixed or Random Effects		Fixed Effects		Cross-Section Random Effects	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
C	N/A	N/A	-0.7145 **	-2.9801	-0.9915 ***	-7.2244
HCE	0.0226 ***	11.9356	0.0043	1.2262	0.0056 **	2.2846
LSCE	67524.76 ***	9.4872	-31553.0400	-1.4371	-42100.95 **	-2.6687
CEE	3.3170 ***	12.6708	4.7806 ***	9.5689	5.0075 ***	16.2979
SIZE	-0.0217 ***	-12.0391	0.0040	0.3484	0.0231 **	3.5956
LEV	0.4485 ***	11.0819	0.7041 ***	14.9258	0.5877 ***	16.1806
GGDP	-0.0210	-0.4402	0.0595	1.6931	0.0000	0.0010
INF	0.3786 *	1.9605	0.0989	0.6956	0.2308 *	1.7199
COV	-0.0080	-1.6482	0.0010	0.2610	-0.0063 *	-1.8795
R-squared	0.9167		0.9656		0.9348	
Adjusted R-squared	0.9110		0.9593		0.9296	
Root MSE	0.0131		0.0084		0.0098	
Durbin-Watson stat	0.8765		1.2855		1.0825	
Prob(F-statistic)	N/A		0.0000 ***		0.0000 ***	

Human Capital Efficiency (HCE) demonstrates a consistently positive effect on ROE in most models, supporting Hypothesis 1a (H1a) that HCE enhances bank profitability. This aligns with the findings from global research by Mondal and Ghosh (20), emphasising the crucial role of human capital in banking sector profitability. Similarly, studies by Singh et al. (2016) have shown that effective management of human resources is a key determinant of financial success, particularly in knowledge-intensive sectors like banking, confirming the importance of HCE in the Saudi context.

Structural Capital Efficiency (SCE) exhibits a complex relationship with ROE. While significantly positive in the model without fixed or random effects, it impacts ROE negatively under fixed and random effects models. This variance might indicate that the utility of structural capital is not universalized in all banks, possibly due to differences in implementation utilisation. This complexity mirrors findings from Yusliza et al. (2020), who noted that structural capital could have diverse effects

 doi:10.20944/preprints202404.1887.v1

depending on organisational context. The mixed results suggest a need for banks to adapt their structural capital strategies to their specific operational frameworks.

Capital Employed Efficiency (CEE) consistently shows a strong positive impact across all models, confirming Hypothesis 1c (H1c) and underscoring the importance of efficiently managed capital in enhancing profitability. This observation is supported by the broader literature, as seen in studies by Alturiqi and Halioui (2020), who highlight how well-managed capital resources significantly contribute to financial performance across various industries.

The effects observed with bank size (SIZE) and macroeconomic indicators like GDP growth (GGDP), inflation (INF) and COVID-19 (COV) indicate the complex interplay between internal bank characteristics and external economic conditions. The variable impacts observed align with studies by Akkas and Asutay (2022), which explore how external economic environments and internal bank features can intricately affect bank profitability.

Leverage (LEV) has a consistently positive relationship with ROE across all models, suggesting the effective utilization of financial leverage to enhance profitability in Saudi banks. This mirrors findings in the literature, where leverage is often seen as a tool to amplify financial performance when used judiciously, as discussed in the work by Ousama et al. (2020).

Overall, the empirical testing robustly supports the hypotheses regarding the positive impacts of VAIC and its components on ROE. The significant coefficients for intellectual capital variables across the models highlight these elements as vital for enhancing bank performance, directly contributing to sustainable financial success, and aligning with Sustainable Goals 8 and 9. This comprehensive analysis affirms the critical role of intellectual capital in Saudi banks and enriches the broader discourse, optimizing bank performance through strategic management of intellectual resources.

The Hausman test results (Table 9) suggest no significant difference between the fixed-effects and random-effects models. This result indicates that the unique errors are uncorrelated with the regressors, validating the use of random-effects models for this analysis. This finding is crucial as it supports the model selection, providing confidence in the robustness of the results.

Table 9. Model 2: Husman Test.

Test Summary Model	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0	8	1

The panel least squares estimation results for Model 3 provide a comprehensive assessment of the influence of the Value-Added Intellectual Coefficient (VAIC) and other variables on Saudi banks' Net Profit Margin (NPM). VAIC consistently demonstrates a strong positive impact on NPM across various models, with significant coefficients, indicating that effective intellectual capital management markedly enhances bank profitability. This finding aligns with the broader literature, such as the study by Al-Musali and Ismail (2014); we emphasize the significant role of intellectual capital in enhancing the financial performance of banks in Saudi Arabia, thus supporting Hypothesis 2 (H2) that VAIC positively impacts NPM.

The size of banks negatively affects NPM in all models, suggesting that larger banks may face challenges that hinder their efficiency and profitability. This observation is consistent with findings in other sectors where larger size does not necessarily equate to increased efficiency or profitability, as shown in the research by Naushad and Faisal (2023) on SMEs. The negative impact on NPM indicates that scaling up operations could introduce complexities that outweigh the benefits of increased capacity, supporting a nuanced view of bank scalability and operational efficiency.

Leverage shows a positive effect on NPM across the models, albeit with a diminishing impact on models without fixed effects compared to those with cross-section random effects. This suggests that while leverage can enhance profitability, its utility is context-dependent, possibly influenced by the bank's overall strategy and market conditions. This finding resonates with the positive role of financial leverage in enhancing profitability in other contexts, such as in the work of Akkas and

 doi:10.20944/preprints202404.1887.v1

Asutay (2022) on GCC banks, where strategic use of debt is highlighted as a key factor in financial performance.

Macroeconomic factors like GGDP and inflation exhibit mixed effects on NPM. While GGDP can sometimes boost profitability, reflecting a favorable economic environment, as seen in broader economic studies like those by Xu and Liu (2021), inflation generally deleteriously impacts bank profitability. This aligns with global financial trends where inflation often erodes real earnings and profitability, as evidenced in broader economic research, supporting a complex view of macroeconomic impacts on bank performance.

The influence of COVID-19 is mixed, with generally adverse but insignificant effects, suggesting that banks have varied in their resilience to the pandemic's challenges. This reflects findings from other studies like those by Githaiga et al. (2023), which examine the differential impact of global crises on financial institutions, showing that the degree of impact can vary widely depending on specific institutional circumstances and responses.

In conclusion, these results not only confirm the significant role of intellectual capital in enhancing bank profitability and operational efficiency but also illustrate the complex interplay of bank size, leverage, and economic conditions in shaping financial outcomes.

Table 10. Model 3: Panel least squared estimation using the cross-section random and fixed effects using NPM and VAIC.

	Without Fixed or Random Effects		Fixed Effects		Cross-Section Random Effects	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
C	N/A	N/A	2.3439 ***	6.5943	1.3214 ***	5.4399
VAIC	0.1342 ***	20.0065	0.1504 ***	21.7581	0.1534 ***	24.1887
SIZE	-0.0407 ***	-5.9619	-0.1576 ***	-8.2346	-0.0954 ***	-8.3976
LEV	0.7623 ***	5.7071	0.5378 **	2.6447	0.3361 *	2.0484
GGDP	0.1749	0.8920	0.3661 *	2.2371	0.1758	1.1411
INF	-1.0235	-1.3229	-2.2288 ***	-3.5607	-1.6570 **	-2.7202
COV	-0.0442 *	-2.3237	0.0195	1.1044	-0.0134	-0.8523
R-squared	0.8527		0.9202		0.8784	
Adjusted R-squared	0.8456		0.9075		0.8713	
Root MSE	0.0544		0.0401		0.0451	
Durbin-Watson stat	1.3927		1.8866		1.4924	
Prob(F-statistic)	N/A		0.0000 ***		0.0000 ***	

The Hausman test results (Table 11) suggest no significant difference between the fixed effects and random effects models. This result indicates that the unique errors are uncorrelated with the regressors, validating the use of random effects models for this analysis. This finding is crucial as it supports the model selection, providing confidence in the robustness of the results.

Table 11. Model 3: Husman Test.

Test Summary Model	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0	6	1

The significant positive influence of Human Capital Efficiency (HCE) on Net Profit Margin (NPM) across all models confirms Hypothesis 2a. It illustrates the critical role of human capital in enhancing bank profitability. This aligns with findings from studies such as those by Mondal and Ghosh (2012), which emphasize the importance of human capital in driving financial outcomes in the banking sector. Such consistency across different geographical contexts highlights the universal value

 doi:10.20944/preprints202404.1887.v1

of investing in human resources as a key strategy for enhancing bank performance and supporting broader sustainability goals related to decent work and economic growth (Sustainable Goal 8).

The negative coefficient of Structural Capital Efficiency (SCE) in some model's challenges Hypothesis 2b, suggesting that investments in structural capital do not uniformly translate into immediate profit margins. This contrasts with positive impacts noted in broader studies, such as Al-Musali and Ismail (2014), which found structural capital to significantly contribute to bank performance. The divergence might be explained by regional differences in how structural capital is implemented or the types of structural capital investments made, suggesting a need for context-specific strategies that consider local operational realities.

Capital Employed Efficiency (CEE) showing a consistently positive and significant impact across models supports Hypothesis 2c, reinforcing that efficiently employed capital contributes significantly to profitability. This finding aligns with the work of Akkas and Asutay (2022), who observed similar benefits in GCC banks, indicating that effective capital management is critical to financial success in banking. The consistent results across different studies affirm the importance of CEE in achieving operational efficiency and financial sustainability, directly contributing to the industry, innovation, and infrastructure goals (Sustainable Goal 9).

The negative impact of SIZE on NPM suggests that larger banks may struggle with inefficiencies, supporting the literature that sometimes questions the scalability benefits in the banking sector. For instance, studies by Barak and Sharma (2023) have also identified challenges associated with managing larger banks, where increased size can lead to diminishing returns. This observation is critical for policymakers and bank managers, emphasizing the need to carefully manage growth strategies to avoid efficiency losses, particularly in a sector where sustainable development is increasingly prioritized.

The varied impact of macroeconomic indicators like GGDP and INF on NPM underscores the complex interplay between economic conditions and bank performance. While GGDP's inconsistent influence suggests that broader economic growth does not always directly correlate with bank profitability, the consistently negative impact of inflation aligns with global financial trends, where higher inflation typically increases operational costs and compresses margins. Studies such as those by Alrabei et al. (2023) also reflect these dynamics, showing how external economic conditions can significantly influence financial performance.

The influence of COVID-19 is generally adverse but not significant, suggesting that banks have varied in their resilience to the pandemic's challenges. This reflects findings from other studies, like those by Githaiga et al. (2023), which examine the differential impact of global crises on financial institutions. These studies show that the degree of impact can vary widely depending on specific institutional circumstances and responses.

Overall, the analysis provides robust empirical support for the significant role of intellectual capital in enhancing the financial performance of banks in Saudi Arabia. The results contribute to a deeper understanding of how different components of intellectual capital influence profitability and operational efficiency, offering valuable insights for achieving sustainable development goals in the banking sector.

Table 12. Model 4: Panel least squared estimation using the cross-section random and fixed effects using NPM and VAIC-Components.

	Without Fixed or Random Effects		Fixed Effects		Cross-Section Random Effects	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
C	N/A	N/A	1.1234	1.1375	0.8410	1.2687
HCE	0.1229 ***	17.3106	0.1126 ***	7.7806	0.1234 ***	10.9437
LSCE	-116834.2 ***	-4.3780	30485.4	0.3371	-9904.047	-0.1362
CEE	3.9163 ***	3.9900	8.0527 ***	3.9129	6.1668 ***	4.2542
SIZE	-0.0198 **	-2.9500	-0.0868	-1.8292	-0.0640 **	-2.0704
LEV	0.3389 *	2.2336	0.4671 *	2.4039	0.2959	1.7882

 doi:10.20944/preprints202404.1887.v1

GGDP	0.1990	1.1102	0.3728 *	2.5773	0.2624	1.9197
INF	-1.5002 *	-2.0718	-1.1871 *	-2.0277	-1.2452 *	-2.2215
COV	-0.0174	-0.9592	0.0174	1.1219	0.0017	0.1225
R-squared	0.8800		0.9402		0.9028	
Adjusted R-squared	0.8718		0.9292		0.8951	
Root MSE	0.0491		0.0347		0.0396	
Durbin-Watson stat	1.2434		1.6442		1.3744	
Prob(F-statistic)	N/A		0.0000 ***		0.0000 ***	

The Hausman test results (Table 13) suggest no significant difference between the fixed-effects and random-effects models. This result indicates that the unique errors are uncorrelated with the regressors, validating the use of random-effects models for this analysis. This finding is crucial as it supports the model selection, providing confidence in the robustness of the results.

Table 13. Model 4: Husman Test.

Test Summary Model	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0	8	1

The analysis of the Value-Added Intellectual Coefficient (VAIC) and its components provides clear evidence of their impact on the financial performance metrics of Return on Equity (ROE) and Net Profit Margin (NPM) in Saudi Arabian banks. VAIC significantly enhances ROE, affirming the pivotal role of intellectual capital in improving shareholder value. Human Capital Efficiency (HCE) positively influences both ROE and NPM, highlighting the crucial role of employee skills and knowledge in driving bank efficiency and profitability. Conversely, Structural Capital Efficiency (SCE) has a mixed impact, suggesting that while important, the benefits might be offset by upfront costs or longer-term returns. Capital Employed Efficiency (CEE) strongly affects ROE and NPM, indicating that efficient asset management is key to enhancing profitability and operational efficiency. Collectively, these emphasize the importance of optimizing intellectual capital to achieve sustainable performance, aligning with Sustainable Goals 8 and 9 and ensuring competitive and sustainable growth in the banking sector.

5. Conclusion and Recommendations

This study conclusively establishes the vital role of intellectual capital in enhancing the sustainable performance of banks in Saudi Arabia. Through rigorous empirical analysis, it has been demonstrated that components such as human, structural, and capital-employed efficiencies significantly impact key performance indicators like Return on Equity (ROE) and Net Profit Margin (NPM). Human capital efficiency, in particular, stands out as a critical driver, emphasizing the importance of investing in employee skills and knowledge to boost both profitability and operational efficiency. While the impact of structural capital efficiency shows variability, it nonetheless contributes to sustaining organizational practice, optimizing internal processes and knowledge management. Capital-employed efficiency also proves essential, highlighting the need for effective resource management to enhance financial returns and overall bank performance.

Banks are encouraged to intensify their investment in intellectual capital to harness their resources' potential fully. This entails ongoing training and development programs for employees and substantial investments in technological advancements and innovative processes that bolster operational efficiencies. Furthermore, as banks navigate the complexities of the global economic environment, including challenges like those posed by the COVID-19 pandemic, there is a pronounced need for strategic management that leverages intellectual capital to enhance resilience and adaptability.

Policymakers also play a crucial role in fostering an environment conducive to the growth of intellectual capital within the banking sector. Regulations that promote the recognition of intellectual

 doi:10.20944/preprints202404.1887.v1

capital in financial reporting can spur greater transparency and encourage banks to invest further in these assets. Moreover, integrating sustainability considerations into business strategies using intellectual capital can lead banks to greater profitability and contribute more significantly to economic sustainability and social welfare.

This study underscores the need for Saudi banks to continually adapt and innovate, using intellectual capital as a cornerstone for growth and sustainability. As Saudi Arabia progresses towards achieving its Vision 2030 goals, the banking sector's ability to manage and utilize intellectual capital effectively will be paramount in navigating the future landscape of global finance and sustainability.

6. Research Limitations and Future Research

While comprehensive in its exploration of the impact of intellectual capital on the sustainable performance of banks in Saudi Arabia, this study has limitations. One significant area for improvement arises from the focus solely on the banking sector within a single country, which may restrict the generalizability of the findings to other sectors or geographical regions. The specific economic and regulatory environment of Saudi Arabia, particularly as it undergoes rapid transformation under Vision 2030, might influence how intellectual capital impacts bank performance in ways that are only partially replicable in other contexts.

Additionally, the reliance on publicly available data and annual reports to measure intellectual capital components might limit the depth of analysis. Such sources vary in the level of detail and transparency they provide, potentially leading to variations in the accuracy of the calculated metrics of human, structural, and relational capital efficiencies. Moreover, while robust, the study's methodological approach does not capture the potential nonlinearities and dynamic interactions between different components of intellectual capital and bank performance over time.

While quantitative methods provide clear empirical evidence of relationships between variables, they may overlook the qualitative aspects of how intellectual capital is managed and operationalized within banks. Qualitative insights could offer a deeper understanding of the strategies that underpin the effective use of intellectual capital to enhance performance and achieve sustainability goals.

These limitations suggest the need for a cautious interpretation of the study's findings and highlight areas where further research could enhance our understanding of intellectual capital's role in the banking industry. Expanding the research to include multiple countries or sectors, employing a mixed-methods approach, or incorporating longitudinal data to capture changes over time could provide a more comprehensive view of the dynamics at play. Such studies could further elucidate the complex mechanisms through which intellectual capital contributes to sustainable economic development in various contexts.

References

1. Abdelwahed, N. A. A., Al Doghan, M. A., & Soomro, B. A. (2022). Green Intellectual Capital and Sustainability in Manufacturing Industries in Saudi Arabia. AgBioForum, 24(3), 97-108.
2. Akbar, Y., & Heryani, R. A. (2020). The Effect of Intellectual Capital in Sustainable University Through Organizational Citizenship Behavior for The Environment at University. PalArch's Journal of Archaeology of Egypt/Egyptology, 17(5), 968-983.
3. Akkas, E., & Asutay, M. (2023). The impact of intellectual capital formation and knowledge economy on banking performance: a case study of GCC's conventional and Islamic banks. Journal of Financial Reporting and Accounting, 21(5), 1149-1170.
4. Al Issa, H. E., Abdullatif, T. N., Ntayi, J., & Abdelsalam, M. K. (2023). Green intellectual capital for sustainable healthcare: evidence from Iraq. Journal of Intellectual Capital, 24(4), 929–947.
5. Alghamdi, S., Wagih, M., Alzahrani, A., & Attia, M. (2016). Investing in the intellectual capital of Albaha University, Saudi Arabia: The concept and mechanisms. International Journal for Cross-Disciplinary Subjects in Education (IJCDSE), 7(1), 2717-2725.
6. Alharbi, A. A. (2023). The impact of intellectual capital on firm performance: A study of firms in Saudi Arabia. Scientific Journal for Financial and Commercial Studies and Research, 4(1), 1.
7. Al-Musali, M. A. K., & Ismail, K. N. I. K. (2014). Intellectual capital and its effect on the financial performance of banks: Evidence from Saudi Arabia. Procedia-Social and Behavioral Sciences, 164, 201-207.

8. Alrabei, A. M., Al-Othman, L. N., Abutaber, T. A., Alathamneh, M. S., Almomani, T. M., Qeshta, M. H., & Amareen, S. A. M. (2023). Nexus between Intellectual Capital and Financial Performance Sustainability: Evidence from Listed Jordanian Firms. Appl. Math, 17(5), 881-888.
9. Alrashidi, A., & Alarfaj, O. (2020). The impact of intellectual capital efficiency on bank risks: Empirical evidence from the Saudi banking industry. International Journal of Economics and Financial Issues, 10(4), 206.
10. Alshadadi, M. A., & Deshmukh, P. D. (2023). A Systemic Risk's Effect on the Stability of the Banking Sector: Evidence from Saudi Arabia. Studies in Economics and Business Relations, 4(2), 54–72.
11. Alturiqi, A., & Halioui, K. (2020). The impact of intellectual capital on firms' performance: Evidence from Saudi Arabia.
12. Alvino, F., Di Vaio, A., Hassan, R., & Palladino, R. (2021). Intellectual capital and sustainable development: A systematic literature review. Journal of Intellectual Capital, 22(1), 76-94.
13. Anthony Jnr, B. (2021). Green campus paradigms for sustainability attainment in higher education institutions–a comparative study. Journal of Science and Technology Policy Management, 12(1), 117-148.
14. Asiaei, K., Jusoh, R., Barani, O., & Asiaei, A. (2022). How does green intellectual capital boost performance? The mediating role of environmental performance measurement systems. Business Strategy and the Environment, 31(4), 1587-1606.
15. Asutay, M., & Ubaidillah. (2023). Examining the Impact of Intellectual Capital Performance on Financial Performance in Islamic Banks. Journal of the Knowledge Economy, 1-33.
16. Barak, M., & Sharma, R. K. (2023). Investigating the impact of intellectual capital on the sustainable financial performance of private sector banks in India. Sustainability, 15(2), 1451.
17. Barney, J. (1991). Special theory forum the resource-based model of the firm: origins, implications, and prospects. Journal of management, 17(1), 97–98.
18. Becker, G. S. (1964). Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. Columbia University Press.
19. Bengana, I., Adeleye, B. N., Mohammed, K. S., Salim, E. I. E., Semlali, Y., & Elrayah, M. (2023). Artificial Intelligence, Human Capital Development and Economic Performance In Saudi Arabia (1990-2019). Journal of Namibian Studies: History Politics Culture, 36, 794–815.
20. Bhattacharjee, S. (2023). Does intellectual capital efficiency improve bank performance and financial stability? Evidence from Bangladesh.
21. Bhatti, A., Ur Rehman, S., Mirza, F., Nguyen, N., Samad, S., & Kamal, I. (2023). Green intellectual capital, green transformational leadership, and sustainable performance: a moderated mediation model. World Journal of Science, Technology and Sustainable Development (WJSTSD), 19(2), 1–18.
22. Bontis, N. (1998). Intellectual capital: an exploratory study that develops measures and models. Management Decision, 36(2), 63–76.
23. Buallay, A. (2019). Intellectual capital and performance of Islamic and conventional banking: Empirical evidence from Gulf Cooperative Council countries. Journal of Management Development, 38(7), 518–537.
24. Edvinsson, L., & Malone, M. S. (1997). Intellectual CapiRealizingizing Your Company's True Value by Finding its Hidden Brainpower. HarperBusiness.
25. Ermawati, D., Nurcahyono, N., Sari, D. N., & Fakhruddin, I. (2023, May). The Dynamic Impact of Intellectual Capital on Firm Value: Evidence from Indonesia. In International Conference on Business, Accounting, Banking, and Economics (ICBABE 2022) (pp. 246-262). Atlantis Press.
26. Githaiga, P. N., Soi, N., & Buigut, K. K. (2023). Does intellectual capital matter to MFIs' financial sustainability? Asian Journal of Accounting Research, 8(1), 41–52.
27. Grant, R. M. (1996). Toward a knowledge-based theory of the firm. Strategic Management Journal, 17(S2), pp. 109–122.
28. Habtamu, T. G. (2023). The Effect of Intellectual Capital Efficiency on the Financial Performance of Commercial Banks in Ethiopia. Indonesian Journal of Business, Technology and Sustainability, 1(2), 90-108.
29. Hamdan, A. M., Buallay, A. M., & Alareeni, B. A. (2017). The moderating role of corporate governance on the relationship between intellectual capital efficiency and firm's performance: evidence from Saudi Arabia. International Journal of Learning and Intellectual Capital, 14(4), 295-318.
30. Harris, M., Yao, H., Tariq, G., Malik, A., & Javaid, H. M. (2019). Intellectual capital performance and profitability of banks: Evidence from Pakistan. Journal of Risk and Financial Management, 12(2), 56.
31. Jawad, M. A., Farhood, A. S., Jebur, N. A., & Khudhair, A. A. (2022). Exploiting Intellectual Capital to Increase its Contribution to Sustainable Development from the Point of View of Academics at the Iraqi University. Zien Journal of Social Sciences and Humanities, pp. 14, 79–97.
32. Jordão, R. V. D., Almeida, V. R. D., & Novas, J. (2022). Intellectual capital, sustainable economic and financial performance and value creation in emerging markets: the case of Brazil. The Bottom Line, 35(1), 1-22.
33. King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. The Quarterly Journal of Economics, 108(3), 717–737.

 doi:10.20944/preprints202404.1887.v1

34. Ku Ismail, K. N. I., & Abdul Karem, M. (2011). Intellectual capital and the financial performance of banks in Bahrain. Journal of Business Management and Accounting, Vol. 1 (1) 2011: 65-79, 1, 65-79.
35. Majumder, M. T. H., Ruma, I. J., & Akter, A. (2023). Does intellectual capital affect bank performance? Evidence from Bangladesh. LBS Journal of Management & Research, 21(2), 171-185.
36. Marcu, M. R. (2021). The impact of the COVID-19 pandemic on the banking sector. Management Dynamics in the Knowledge Economy, 9(2), 205–223.
37. Maria, S., Yudaruddin, R., & Azizil Yudaruddin, Y. (2022). The impact of COVID-19 on bank stability: Do bank size and ownership matter? Banks and Bank Systems, 17(2), 124-137.
38. Mondal, A., & Ghosh, S. K. (2012). Intellectual capital and financial performance of Indian banks. *Journal of intellectual capital*, *13*(4), 515–530.
39. Naushad, M., & Faisal, S. (2023). Intellectual capital efficiencies and performance of SMEs in KSA. International Journal of Applied Management Science, 15(2), 151-165.
40. Nguyen, D. T., Le, T. D., & Tran, S. H. (2023). The moderating role of income diversification on the relationship between intellectual capital and bank performance evidence from Viet Nam. Cogent Business & Management, 10(1), 2182621.
41. Ousama, A. A., Hammami, H., & Abdulkarim, M. (2020). The association between intellectual capital and financial performance in the Islamic banking industry: An analysis of the GCC banks. International Journal of Islamic and Middle Eastern Finance and Management, 13(1), 75-93.
42. Paramba, J. N., Salamzadeh, A., Karuthedath, S., & Rahman, M. M. (2023). Intellectual capital and sustainable startup performance: A bibliometric analysis. Heritage and Sustainable Development, 5(1), 19-32.
43. Pham, T. N. S., & Dut, V. V. (2022). The Effects of Intellectual Capital on Firms' Sustainable Growth: A Systematic Review and Future Research Agenda. Vnu Journal of Economics and Business, 2(4).
44. Rehman, A. U., Aslam, E., & Iqbal, A. (2022). Intellectual capital efficiency and bank performance: Evidence from islamic banks. Borsa Istanbul Review, 22(1), 113-121.
45. Rundengan, F. D. P., & Tjahjadi, B. (2023, July). The Impact of Green Intellectual Capital on Sustainable Performance Case Studies in Educational Organizations. In 3rd International Conference on Education and Technology (ICETECH 2022) (pp. 793-814). Atlantis Press.
46. Singh, S., Sidhu, J., Joshi, M., & Kansal, M. (2016). Measuring intellectual capital performance of Indian banks: A public and private sector comparison. Managerial Finance, 42(7), 635–655.
47. Sulphey, M. M., & Naushad, M. (2019). The Position of Intellectual Capital Among Saudi Banks. Marketing & Management of Innovations, (4).
48. Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18(7), 509-533.
49. Ul Rehman, W., Saltik, O., Degirmen, S., Ocak, M., & Shabbir, H. (2023). Dynamics of intellectual capital and financial performance in ASEAN banks. Arab Gulf Journal of Scientific Research.
50. Unger, J. M., Rauch, A., Frese, M., & Rosenbusch, N. (2011). Human capital and entrepreneurial success: A meta-analytical review. Journal of Business Venturing, 26(3), 341-358.
51. Vale, J., Miranda, R., Azevedo, G., & Tavares, M. C. The Impact of Sustainable Intellectual Capital on Sustainable Performance: A Case Study. Sustainability 2022. 14. 4382.
52. Xu, J., & Liu, F. (2021). Nexus between intellectual capital and financial performance: An investigation of Chinese manufacturing industry. Journal of Business Economics and Management, 22(1), 217-235.
53. Yusliza, M. Y., Yong, J. Y., Tanveer, M. I., Ramayah, T., Faezah, J. N., & Muhammad, Z. (2020). A structural model of the impact of green intellectual capital on sustainable performance. Journal of Cleaner Production, p. 249, 119334.
54. Zheng, C., Islam, M. N., Hasan, N., & Halim, M. A. (2022). Does intellectual capital efficiency matter for banks' performance and risk-taking behavior?. Cogent Economics & Finance, 10(1), 2127484.