Cuadernos de economía

ARTÍCULO

The Adoption of Knowledge Economy Pillars in the Kingdom of Bahrain`s Banking Sector

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Jel Codes:

Keywords:
Knowledge Economy,
Banking Sector

Abstract: The objective of this study is to assess how well commercial banks in the Kingdom of Bahrain have embraced the pillars of the knowledge economy. The study employed a quantitative approach, utilising questionnaires to gather data from 15 commercial banks. The collected data was then analysed using a descriptive-analytical method to derive the findings. The research findings often pertain to the integration of ICT, as the results reveal that nearly all banks recognise the crucial role of technology and implement advanced technologies. Additionally, they prioritise comprehensive training for their employees. The study revealed that the majority of the bank's employees are highly skilled individuals who possess a wealth of knowledge. Significant advancements are anticipated with the introduction of the education strategy in the kingdom of Bahrain, where training and research centres are not commonly found in commercial banks. In general, innovation is not readily apparent in the commercial banks of the Kingdom of Bahrain. This can be attributed to the education system of past decades.

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Introduction

In today's world, the financial services sector closely intertwines technology and business. Companies engage in competition by providing innovative services using contemporary technology. The advancement of communication technology enables financial institutions to develop more effective tools. This emphasizes the importance of improving technology-related factors, such as science, education, and regulations.

Innovation is crucial for developing contemporary financial products that enhance transactional convenience and improve service efficiency. Commercial banks are leveraging advanced banking technology to improve customer service. Banks play a significant role in the knowledge economy by actively utilising and contributing to knowledge-based advancements.

The effective use of knowledge tools is crucial for banks to enhance their services in the face of growing technology-driven services. Banks' success currently depends on their technological capabilities for customer acquisition. The effectiveness of a bank's knowledge tools directly influences the quality of its services. Furthermore, there is a correlation between employee education, research, innovation, and technology in the banking sector. In order to assess contemporary banking services, it is essential to understand the role of commercial banks in the context of knowledge-focused operations.

Statement of the Problem

This study examines the correlation between the banking sector and technology, education, and innovation. As it evolves, the banking sector becomes more interconnected with important aspects of the knowledge economy. This study aims to evaluate the integration of knowledge components in banks and financial institutions in the Kingdom of Bahrain. The pillars of the knowledge economy will establish specific criteria and standards to assess individual progress. This evaluation is crucial for comprehending the present state of economic progress.

In order to assess the development of the banking industry in Bahrain, we will conduct a separate analysis of each knowledge pillar. This study aims to assess the development of the banking sector in Bahrain in relation to global standards, which is essential for effective competition in the current globalised environment.

This study investigates the adoption of knowledge pillars, including Education and Training, Information Technology, and Innovation, by commercial banks in Bahrain. This study aims to evaluate the use of modern technologies in banking operations and examine the influence of education quality and training on bank employees. In addition, we will assess the level of innovation in the banking industry. The research questions guiding this study are as follows:

- Is the recent banking industry in the Kingdom of Bahrain in progress for the adoption of the pillars of the knowledge economy (Education & Training, Information technology) to enhance its operations?
- To what extent the banking industry be classified as a knowledge-based industry?

Objectives

This study seeks to investigate the fundamental components of the knowledge economy and the methods used to assess

its benchmarks. The application of these standards will be used to assess the performance of the banking industry in Bahrain. The study examines the effectiveness of education and training programmes, the technological advancements in banking products, and the level of innovation in Bahraini banks. This study aims to emphasise the advancements made by Bahrain's commercial banks in relation to the pillars of the knowledge economy.

Hypothesis

H1-There's a positive relationship between the employee education quality and training standards and the advancement of Bahrain's bank in knowledge banking.
H2- Technological services provided through banking institutions in the kingdom of Bahrain indicating high progress of Bahrain's towards the knowledge banking.
H3- A research centres, think tanks in Bahrain banking institutions create new knowledge, advance products and support innovations.

Research Model

The structural equation model is a valuable tool for elucidating the correlation between research variables. The model in this study aims to explain the relationships among the independent variables, as depicted in Figure 1.
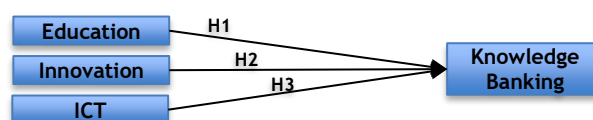

Figure 1: Research Model.

Literature Review

Over the past two decades, a significant correlation has been observed between knowledge and prosperous economies. This phenomenon holds true not only in developed nations but also in developing ones. Globalisation and technological advancements have facilitated opportunities for developing nations to enhance their economies and participate in global competition. To achieve this, they must continually implement modifications and prioritize the development of knowledge-based economies.

Prior research on knowledge economy (KE) pillars in the banking sector, such as Bashir (2019), has partially examined the topic. Bashir's study suggests that the knowledge economy has the potential to enhance the competitive advantage of commercial banks. Some commercial banks are unable to effectively compete due to limited technology and financial efficiency. The current research examines the concept of knowledge banking, which encompasses competitive advantage and other dimensions. In a study by Al-Salaymeh (2013), the author explored the relationship between banking innovation and creativity as dimensions of KE. The study found a correlation between the level of creativity and innovation in banking services. This finding aligns with the current study, which also considers innovation as a crucial aspect of R&D. In previous studies, researchers have explored the role of technology as a key factor in driving innovation within the banking sector. The findings from these studies consistently highlight the significant impact that technology has on enabling efficient services. This aligns with the current study, which examines the interconnectedness and mutual support of three pillars.

In a study conducted by Simplice (2014) the four pillars of the knowledge economy were examined to understand their

influence on the financial sector. A lack of education and innovation hindered the industry's growth, according to the findings. However, it is important to note that these results do not align with the findings of the current study. The main hypothesis of this study is that information technology has a positive effect on the banking sector's development. It is worth mentioning that this study specifically focused on the banking sector rather than the broader financial sector, which encompasses other institutions. Reis et al. (2013) examined the main impact of technological innovation on the quality of banking services in their study. The results showed that information technology plays a significant role in the development of the banking sector.

However, the current study also considered the impact of education and innovation in addition to ICT. The current study's hypothesis regarding ICT and innovation partially aligned with the results of Joana et al.'s study but did not find education to be a significant factor. Abu-Tahia and Alawaj (2017) conducted a study with the main objective of analysing the impact of investing in human capital on the enhancement of banking services' quality. The study examined human capital as a comprehensive concept, encompassing education, training, and development, but without providing in-depth explanations.

Various research studies have examined the pillars of the knowledge economy, specifically focusing on the impact of ICT on banking performance in the GCC countries (Abdull Razak et al., 2016; El-bannany, 2012; Al-Musali and Ku Ismail, 2012a, 2012b). El-bannany (2012) conducted a study in the U.A.E. to analyse the various factors that impact banks' performance in relation to information technology. The study discovered a link between the performance of information technology and several factors, such as the age and size of the banks and entry barriers. Several studies have demonstrated the correlation between information technology (ICT) efficiency and a company's performance in various countries, including Taiwan, Greece, Malaysia, Pakistan, Australia, Iran, India, and Italy (; Wang, 2011; Cohen and Kaimenakis, 2007; Maditinos et al., 2011; Gan and Saleh, 2008; Makki and Lodhi, 2008; Ahmad and Ahmed, 2016; Clarke et al., 2011; Zanjirdar and Kabiribalajadeh, 2011; Pal and Soriya, 2012; Guerrini et al., 2014) (Chen & Dahlman, 2005). Several studies have examined the correlation between ICT efficiency and corporate performance in various countries around the world. For example, Goh (2005) conducted a study in Malaysia, Yalama and Coskun (2007) in Istanbul, Turkey, Kamath (2007) in India, El-Bannany (2008) in the UK, Joshi et al. (2010) in Australia, Zou and Huan (2011) in China, Abdulsalam et al. (2011) in Kuwait, and Al-Musali and Ku Ismail (2014, 2016) in Saudi Arabia and the GCC.

This study provides a comprehensive analysis of the impact of the three pillars on the knowledge bank, which represents a high level of adoption of the KE pillars. This study emphasizes the significance of knowledge economics in the banking industry's performance, highlighting its technical and scientific importance. Research on the knowledge economy relies heavily on benchmarking techniques to assess technical prospects. For measurement purposes, this study will utilize both benchmarking and surveys. Most research on the knowledge economy has primarily focused on assessing a country's readiness to transition into a knowledge-based economy. However, this research specifically examines the knowledge economy within the banking sector, making it distinct in its objective.

Knowledge and Traditional Economy

Every historical era is characterised by distinct features. Consider the Ice Age, the Stone Age, or the Machine Age. Currently, we are situated in the commonly referred-to information age. The prevalence of information technology has significantly impacted various aspects of our lives. The advent of information technology has given rise to the knowledge economy, fundamentally altering our understanding of economics and production. Technology has become an essential component of production, alongside traditional factors such as capital, labour, land, and organisation. Knowledge is now a highly valuable resource for economic activities. Sharing knowledge is critical to the success and longevity of these activities. The concept of knowledge emerged in the mid-1990s (; Shapiro and Varian, 1999; Karvalics, 2007; Mansel, 2009; European Commission, 2010) (Lundvall & Foray, 1996; OECD). The exploration of knowledge concepts emerged in the early 1960s, with notable contributions from pioneers such as Machlup (1962), Drucker (1968), Bell (1973), Porat (1977), and Toffler (1980). These individuals made significant advancements in various aspects of social science methodology and macroeconomics. The works emphasised the significance of education and scientific research in relation to production and explored strategies for generating and disseminating knowledge.

Peter Ferdinand Drucker (1909-2005) played a significant role in popularising the concept of the knowledge economy through his book "The Age of Discontinuity." In chapter twelve, titled "Knowledge Economy," Drucker discussed the factors that would facilitate the shift from a traditional economy to a knowledge-based one. He identified four gaps: the impact of technology on production structures; the incomplete transition to a global economy due to a lack of policies and institutions; the political and social challenges posed by existing institutions; and the role of modern education and knowledge in economic development (Derek and Dahlman, 2006).

In general terms, according to Musterd and Gritsai (2013), knowledge is the result of combining ideas and processing information, leading to an advancement in understanding. The knowledge economy is defined as an economy that efficiently develops, accumulates, transforms, and uses knowledge for economic and social advancement. This definition is comprehensive and includes all facets of the knowledge economy (Derek & Dahlman, 2006). It is important to differentiate between two concepts in order to accurately define the knowledge economy. This distinction helps prevent confusion when applying knowledge to institutional processes. The first concept is a knowledge economy, which involves the use of knowledge in economic processes, including costs related to research and development, training, management, consulting, and the resulting economic returns. The second concept is a knowledge-based economy, which is characterised by its reliance on knowledge as a primary driver of economic activity. This concept encompasses a broader understanding of the economy. The term "knowledge sector" pertains to the various domains of knowledge, information, and intellectual consultation within the economy. These sectors can be categorised as either commodity or service activities, resulting in distinct definitions at macro and micro levels. While these levels are interconnected, they maintain differences. Consequently, there is knowledge pertaining to entire economic activities, as well as specific knowledge at the organisational level (Lundvall, 1992).

The concept of the 'knowledge-based economy' is encompassed within the discourse of New Growth Theory, which seeks to explain the current transition from a

resource-based economy to a knowledge-based one. (Kozhieva, 2015). The New Growth Theory emphasises the significance of knowledge and human capital in economic growth. It asserts that knowledge is the primary catalyst for growth and highlights the critical role of the process that generates and spreads new knowledge in determining the economic development of communities, nations, and firms. New Growth Theory, also known as endogenous growth theory, incorporates technology into a model of market functioning, in contrast to traditional growth models such as Solow's (1956) that treat knowledge as an exogenous factor ((Society, 1972). In New Growth Theory, knowledge and technological progress, which were previously seen as outcomes of nonmarket forces or overlooked, are now recognised as products of economics. It is critical to understand the distinctions between knowledge and ordinary commodities, as well as how they impact the knowledge economy. These differences have significant implications for the organization of a knowledge economy, as well as for public policy. There is significant variation in conceptualizations of the 'knowledge economy', with many focusing primarily on information and communication technology (ICT) or high technology. Smith (2002) has identified four approaches in the literature for presenting the concept. The first approach assumes that knowledge is now more important as a production input, both in terms of quantity and quality, compared to the past. The second perspective argues that knowledge is increasingly valuable as a product and that new economic activities focused on the exchange of knowledge products are emerging. The third strategy partially incorporates the notion that codified knowledge holds greater importance within economically valuable knowledge bases. The fourth basic approach argues that the knowledge economy relies on the transformation of ICT technology, which changes the physical limitations and costs associated with collecting and disseminating information. Lundvall identifies learning as the central process in the knowledge economy. He argues that the distinguishing factor in current economic development is not the use of knowledge itself, but rather the speed at which learning and forgetting to occur. (Lundvall, 1992). The concept of the 'learning economy' emphasises that the performance of companies is not only determined by the amount of knowledge they possess but also by their ability to acquire and apply that knowledge. The premise of this argument is the acceleration of technological and economic advancements. New product life cycles are shortening, and manufacturing processes are spreading faster than before. Completion refers to the speed at which knowledge is learned and applied to new services and products. This concept was previously ambiguous, but recent health circumstances have led to the emergence of new service provisioning models, reducing the gap through innovation.

Innovation is a method for comprehending the knowledge economy. The economic process related to knowledge involves the conversion of ideas and innovations into knowledge-based products and services. The level of innovation associated with the outputs of an economic process can serve as a measure of cognitive progress. Innovation is a crucial factor in comprehending the knowledge economy as an innovation-driven economy. Florida's latest work, "The Rise of the Creative Class," classifies professionals who work in creative fields such as scientists, engineers, artists, musicians, designers, and knowledge professionals as part of the "Creative Class" (Florida, 2002).

The literature lacks clear definitions of the term "knowledge economy" due to the various conceptualizations of the concept. People commonly employ the notion as a metaphor, rather than as a precise concept. The OECD's use of the notion provides a clear definition of the problem. As all economies are to some extent based on knowledge, this definition appears to be all-encompassing yet vague. It is challenging to envision an economy that primarily revolves around the creation and dissemination of knowledge. The concept of knowledge is applicable to evaluating organisations, as it is not limited to economies and can serve as a measure of institutional performance. The literature consistently acknowledges the significant influence of knowledge on goods and services, including all its aspects. As a result, organizations that incorporate these pillars exhibit improved performance. While the macro-economic transition to the knowledge economy is frequently examined, there is a limited amount of research that focuses on the micro level, particularly institutions. Various studies have established a connection between the flow of information and knowledge and the use of information and communication technology (ICT). Additionally, studies have found that ICT contributes to the reduction of uncertainty and transaction costs, offering several benefits (Bank, 2014; Becker & Dietz, 2004; Cette et al., 2005; Chen & Dahlman, 2004; De Faria et al., 2010; Lee et al., 2005; Vu, 2011; Zeng et al., 2010). Multiple studies on the banking sector provide evidence that banking services facilitate a country's transition to a knowledge-based economy. Schumpeter (1912) discussed the importance of money in economic development and its potential to facilitate entrepreneurial success. According to King and Levine (1993), Morales (2003), and Acemoglu et al. (2006), banks should encourage innovation-related activities. The banking sector's positive outlook is attributed to its influence on the resource allocation process and its impact on knowledge-related growth, which in turn supports innovative activities. The transition of a country to a knowledge-based economy has a positive impact on all sectors and industries, not just the financial sector. (Havens & Knapp, 1999). The banking sector is crucial for economic growth, especially as economies become more liberalised and transnational. (Kamath, 2007). Banks in countries that have made progress in the pillars of a knowledge economy will achieve progress in three areas: (i) adopting innovative methodologies to enhance the bank's competitiveness; (ii) utilising modern information and communication technologies and advanced products for clients; and (iii) recognising the importance of intellectual assets and effectively utilising them (Kridan and Goulding, 2006).

Measurements of Knowledge Economy

To promote KE in a country, one must carefully plan and make sustained efforts. This entails activating the key pillars, which encompass the essential areas required for the establishment of a comprehensive KE system. To achieve this, countries should conduct a thorough analysis to identify the strengths and weaknesses of their KE efforts. Based on this analysis, a suitable strategy, policies, and plans can be designed.

The World Bank Institute, in collaboration with the Knowledge for Development Programme (K4D), has released a comprehensive database and indexes to assess and rank countries' progress in KE development. These web-based tools provide valuable insights into the ranking results and factors that are relevant to KE. They also offer a necessary assessment of regions and countries' progress in KE based on the four pillars of knowledge economy (KAM, 2019). Utilising 80 qualitative and structural variables. Comparisons are

made for the four pillars to evaluate the countries and regions developing in KE from an academic perspective. Utilising 80 qualitative and structural variables employed in this study. Comparisons are made for the four pillars to evaluate the countries and regions developing in the field of kE. The comparison included 9 regions and 128 countries, and the results are available online through various charts and figures. These visual aids help illustrate the differences and similarities between countries, as well as how they are progressing in four key areas. The KAM basic scorecard provides a comprehensive report on the region's performance and development in the twelve standards that make up the KE pillars:

2-standards known as (performance factors) that gave the country a grade based on its GDP and human development 10 standards known as (knowledge variables) used in KE index measurement. Typically, when evaluating and comparing the knowledge economies of different regions and countries, a variety of factors are considered. These factors include economic determinants, institutional measures of economic openness, government efficiency, and the quality of regulations and rules. Education variables assess the measurable accomplishments of the education system, utilising consistent variables across various levels. ICT refers to the measurement of telecommunication, the internet, and computers. The challenges of quantifying innovation and the limited availability of data primarily drive the parameters used to measure the innovative aspect in this field.

ITIF has developed another system of knowledge economy indicators. In the Atlantic Century report, the Foundation revealed its core index of competitiveness and innovation. This report evaluated global competitiveness by analysing the innovations of various countries, including the United States, the European Union, Argentina, Chile, Indonesia, Malaysia, South Africa, and Turkey (ITIF, 2011). The FBA World Innovation Index was calculated using the resources listed in Table 3's third column. INSEAD and the World Intellectual Property Organisation have collaborated to create and analyse a third system (Cornell University, INSEAD and WIPO, 2014).

The Arab Knowledge Index has successfully developed the concept of "knowledge from a development perspective," which is truly exemplary. The index considers the distinctive circumstances, demands, and challenges of the Arab region, as well as the vital role of Arab youth in building a knowledge society in the region. The Arab Knowledge Index places its focus on several key areas: 1. Pre-university, higher, and technical vocational and training education are essential for personal growth and development. 2. Research, advancement, and innovation drive progress in various fields. 3. The economy greatly benefits from a well-educated workforce. Information and communication technologies play a crucial role in today's interconnected world. There are approximately 300 factors at play. The Arab Knowledge Index adopts a unique approach by considering sectors often overlooked in similar initiatives. These include Technical Vocational Education and Training, the correlation between research and development (R&D) and innovation, and the interconnection between various sectors. The Index has recently broadened its coverage to encompass 131 countries, making it a comprehensive knowledge index that extends from the Arab world to the rest of the globe. The release of two Arab Knowledge Indexes in 2015 and 2016 marked an important development. In 2017, they established the Global Knowledge Index.

Various indexes gauge countries' development in relation to the knowledge economy. These indexes emphasise education, ICT, and innovation, recognising the interconnectedness of these pillars and their significant influence on one another. This aligns with the research hypothesis, which incorporates these three pillars to assess the progress of banking institutions in the Kingdom of Bahrain in terms of knowledge.

The Banking Sector's Knowledge-Economy Pillars

Banking and ICT

An up-to-date and sufficient information infrastructure promotes efficient communication and distribution, streamlining the handling of information and knowledge. Information and communication technologies (ICTs) are crucial in today's global, information-based economies. Technological innovation fosters a highly dynamic business environment as consumers' awareness and demands increase. Corporations, including the banking sector, function within a highly intricate and competitive environment due to the significant shifts occurring in various domains. Information and Communication Technology (ICT) is the focal point of this extensive global transformation. ICT plays a crucial role in the knowledge economy, especially in the banking sector. Banks need to have a strong and advanced ICT infrastructure to meet the evolving demands of clients and keep up with modern society. By leveraging technology and communication, banks have been able to enhance customer support, maintain accurate records, offer a wide range of services, provide flexible business hours, ensure prompt and fair attention, and improve overall efficiency (Ovia, 2005).

Utilizing ICT improves banks' reputations and contributes to a market that is more transparent, expedient, and effective. It has also simplified work, made it more engaging, enhanced banks' ability to compete, strengthened customer relationships, and helped address fundamental operational and planning challenges. (Abbas et al., 2015). The banking industry is quickly embracing technology to drive growth, enhance customer satisfaction, and improve overall performance. As a result, there is a growing emphasis on the importance of information and modern technology in the banking sector. It is crucial for banks to enhance and develop their technological infrastructure in order to provide a wider range of services. Because of competition, many institutions are now facing the challenges of comprehensive development in creating knowledge-based services. However, banks have made significant strides in providing cutting-edge services through the use of innovative technologies such as mobile banking. Customers can now conveniently perform transactions and manage their accounts online. The banking industry is set to experience a significant transformation with the introduction of new technology. This includes the enhancement of ATMs and the revolutionary impact of blockchain technology on the industry. Signature retrieval facilities for e-banks. The health conditions resulting from COVID-19 highlighted the significance of technological services. Banks successfully navigated this challenge by leveraging ICT to provide alternative banking services.

The banking industry has embraced the use of technology to enhance the speed, efficiency, and security of client services. The banking industry has undergone a significant transformation, moving away from traditional paper-based and branch-focused operations to embrace the digital age and interconnected banking services, thanks to advancements in technology. Technology has revolutionised

the accounting and management systems of all banks and is currently transforming the way banks deliver services to their customers. There have been numerous studies conducted on knowledge management applications in banking services worldwide, along with the prevalence of knowledge management implementation by banks (Grant and Grant, 2005; Chatzoglou, Vanezis and Christoforidis, 2005; Curado, 2008; Karkoulian, Halawi and McCharty, 2008; Kridan and Goulding, 2006; Klimikova, 2006; Lenga and Nasaruddin, 2008; Boom, 2005 and Chiran, 2008). Additional academic literature supports the notion that ICT played a crucial role in enabling banks to continue offering their services (Camous & Claeys, 2020; Dube et al., 2021; Gursoy & Chi, 2020; Kenny et al., 2021; Palomino et al., 2020; Sahu, 2020; Ventriglio et al., 2020).

Education

The level of education and training provided by an organisation is crucial for its success. Evaluating knowledge capital according to the Arab knowledge index involves assessing three key factors: enrolment, completion, and outcomes. These pillars provide a comprehensive evaluation of the accessibility of education for children. Additionally, the assessment also considers the education exclusion rate and other outcomes of the education process to determine the knowledge capital. This indicator specifically focuses on the skills acquired during the education period, including behavioural skills. Creating an environment conducive to education: The second indicator used by the Arab knowledge index to measure knowledge capital focuses on the readiness of the education environment to provide high-level education. This can be evaluated by looking at the investment in education. Education is seen as a valuable resource that requires resources to provide knowledge and skills. By implementing sensible policies that prioritise both students and the education process, the government can allocate a portion of the GDP towards basic and secondary education.

Additionally, the current expenditure on education as a percentage of overall expenditure in public institutions can also be used as an indicator of this evaluation (Arab knowledge index, 2017). The inclusion of early childhood education as a sub-pillar highlights its significance as a foundation for the entire education system. Two specific parameters were selected to measure its impact: the net enrollment ratio in early childhood education for both genders, and the percentage of new entrants to grade 1 of primary school who have prior experience in early childhood education. (Arab Knowledge Index, 2017). The various sectors within the banking industry require different areas of expertise. These sectors encompass management, decision-making, and analysis.

It is widely recognised that an employee's educational background and standards greatly enhance their motivation, problem-solving abilities, and capacity for innovative thinking (Sannino et al., 2021). "As the human characters within the organization, the collected wisdom, competence, and knowledge that characterizes the firm," according to Bontis et al. (1999), human capital is defined. This statement acknowledges the importance of human resources in the modern banking industry. The importance of human capital in banks cannot be overstated. According to Singh and Mohanty (2012), the skills and knowledge possessed by employees are crucial for the competitiveness, performance, and growth of an institution.

Innovation: Research and Development (R&D)

R&D plays a vital role in the economic literature for various reasons. Both industrial organization and international trade theory see R&D as a crucial factor for firms to gain or retain market shares. Governments also play a role in giving their domestic firms an advantage in international trade, either by reducing costs through process R&D or by creating product differentiation through product R&D. Growth theory and management literature widely regard research and development as a valuable investment in knowledge and absorptive capacity. Therefore, people perceive it as an indirect contributor to economic growth. Given that the business enterprise has two fundamental functions—marketing and innovation—Peter Drucker's statement encompasses various research and development (R&D) activities that can revitalise or expand existing businesses as well as create new ones. These activities include developing core competencies, inventing new products, and improving processes. It is crucial for every bank in Bahrain to acknowledge the significance of research and development, just like Peter Drucker did. They should make a collective decision to initiate R&D activities that align with the bank's overall operations. The R&D division plays a crucial role in providing valuable and timely information to all other units within the bank. The bank uses this information to make crucial business and investment decisions that directly influence its profitability and overall value.

The environment nurturing research and development (R&D) serves as a vital catalyst for generating novel goods, services, processes, and knowledge, constituting a significant driver of technical advancement. This environment encompasses institutions, research centers, universities, and consultants, collectively shaping the mechanisms through which a nation accesses, generates, disseminates, and applies knowledge. An effective innovation system comprises firms, research centres, universities, consultants, and other institutions that stay updated with new information and technology. These entities tap into the growing global knowledge, assimilate it, and adapt it to local requirements. The system encompasses a wide range of infrastructure and institutional tasks, including basic technological diffusion, advanced research activities, and public support for innovation, science, and technology. Most financial institutions rely on research sources to acquire the knowledge and technology that drives innovation.

According to Squicciarini and Loikkanen (2008), businesses, governments, universities, and the labour market play important roles in sustaining innovation. Businesses invest in research to produce new and innovative products and services using private resources. Businesses develop new business models to enhance competitiveness in the global economy. Small and medium-sized enterprises can benefit from innovation clusters, which enhance productivity and innovation beyond what they could achieve independently. Institutions leverage research and development (R&D) to gain a competitive edge by creating profitable products that differentiate them from other businesses (Resutek & Donelson, 2012). Chan et al. (2001) argue that R&D investment is comparable to investing in intangible assets as it enhances a firm's long-term success. Investing in human capital enables organisations to acquire qualified staff, leading to different types of innovation (Lerner, 2010). R&D plays a crucial role for all stakeholders within a company, as it directly affects the quality of services provided, depending on the specific approach employed. Increasing the firm's value added and enhancing customer satisfaction results in increased profitability. The successful implementation of R&D plans is contingent upon the

business's level of interest in R&D (Vlachos et al., 2010). In their study, Xin et al. (2010) investigated the impact of technological advancements on operating performance. Factors such as firm size, industry, and financial leverage influence the impact of R&D on firm performance (Ehie, 2010). Gunday et al. (2011) examine the influence of a company's products and marketing innovations on its overall performance. Atalay et al. (2013) conducted a study that analyzed the impact of technological advancements on company performance.

Research Methodology

A suitable methodology was employed to address the objectives and research problem of the study. A descriptive-analytical method was employed to accurately describe the phenomenon. This method involved gathering theoretical and applied data on the research problem and analysing it to obtain the desired results. This study will utilise a diverse range of Arabic and international references, publications, and articles to gather relevant material pertaining to the subject of study. The sample for this study consists of 15 commercial banks from Bahrain. This study examines the relationship between knowledge in banks and several dependent variables, including education, innovation, incentives, and technology. The survey was developed with five main components, including Education and Training. The topics of innovation, incentives, and technology and knowledge banks are discussed. The questionnaire was distributed to 15 banks in the Kingdom of Bahrain. A total of 50 responses were collected and subsequently coded for analysis using Smart PLS.

Data Analysis

The dataset consists of six elements. The concept of gender. The individual's age: Social status. Position title: Academic credentials: Considerable experience. In terms of gender, the sample consisted of 66.4% males and 33.6% females. The distribution of age groups in the sample was as follows: 15.4% were 30 years of age, 50.6% belonged to the 30-39 age group, 28.7% were aged 40-49, and 5.3% were 50 years and older. In terms of social status, 70.4% of individuals were married, while 25.1% were unmarried, and 4.4% fell into another category. The job titles of the respondents are distributed as follows: 5.3% are principals, 32.8% are supervisors, 42.9% are employees, and 19% are professionals. This study examines the scientific qualifications of the Baclaryus category, with 82% representing undergraduate students and 12% representing postgraduate students. Regarding years of experience, 18.6% have less than 5 years, 32% have 5 to 9 years, 26.3% have 10 to 14 years, and 23.1% have over 15 years. The term "year" refers to a unit of time that is commonly used to measure the duration of the Earth's orbit around the

Model Validity and Reliability

The evaluation of the measurement model (outer model) is the initial analysis in PLS-SEM. The external model focuses on component measurement, which assesses the theoretical loading of indicators and their association with related constructs. In order to validate the model, we utilised SMART PLS to perform exploratory factor analysis and empirical analysis on the four-dimensional study model, which includes education, innovation, technology, and knowledge banks. In order to evaluate the suitability of the outer model, it is important to ensure that each variable in the questionnaire, which consists of 23 words, has a factor greater than or equal to 0.7:

(1) Convergent validity, includes Individual item reliabilities
(2) Composite reliability (CR).
(3) Average variance extracted (AVE)

Results of Measurements Model-Convergent Validity

Convergent validity refers to the extent to which measures of interconnected constructs are correlated with each other (Henseler et al., 2009) . It is evident from the research that there is a strong correlation between different measures of the same construct (Hair Jr et al., 2016). Table (1-1) displays loading values above 0.70, with two items related to innovation being excluded due to values below 0.70. Cronbach's alpha, CR, does not assume that all construct indicators have equal loadings. It is important to note that the threshold value for CR should not be lower than 0.60, as stated by Henseler et al. (2009). A value of 0.70 and above is highly desirable, according to Hair et al. (2012). In terms of internal consistency, a CR score between 0.6 and 0.7 indicates an average level, while a score between 0.70 and 0.90 is considered more appropriate (Nunnally & Bernstein, 1994). In this study, all CR and Cronbach's alpha values for all constructs were analysed. The results in Tables 1–2 show that they all exceed the proposed threshold value of 0.70. (; Henseler et al., 2009) (Hair Jr et al., 2016). The CR values in this investigation ranged from 0.829 to 0.950, indicating a high level of reliability in the measurement model. The AVE is used with a threshold value of 0.50 and above to show that there is a level of convergence in the measurements of the construct (Henseler et al., 2009). The AVE score of 0.50 indicates that the convergent validity is satisfactory. Put simply, the latent construct explains 50% of the variation in its indicators, which suggests that it has adequate convergent validity (Hair Jr et al., 2016). The study utilised AVE values to assess the convergent validity. The AVE value of all constructs surpasses the threshold value of 0.50, as indicated in Tables 1–2.

Table (1-1)

Construct	Items	loading	AVE	CR
Education	Edu1	0.855	0.702	0.950
	Edu2	0.853		
	Edu3	0.916		
	Edu4	0.854		
	Edu5	0.866		
	Edu6	0.801		
	Edu7	0.823		
	Edu8	0.725		
Innovation	Inv1	0.904	0.520	0.829
	Inv2	**0.482**		
	Inv3	**0.335**		
	Inv4	0.910		
	Inv5	0.780		
Technology	Tech1	0.754	0.620	0.919
	Tech2	0.782		
	Tech3	0.726		
	Tech4	0.854		
	Tech5	0.768		
	Tech6	0.767		
	TECH7	0.733		
Knowledge Banking	KB1	0.790	0.669	0.858
	KB2	0.832		
	KB3	0.828		

Table (1-2)

	Cronbach'sAlpha	rho_A	CompositeReliability	Average Variance Extracted (AVE)

EDU	0.939	0.946	0.950	0.706
INV	0.762	0.875	0.829	0.520
KB	0.725	0.759	0.858	0.669
TECH	0.898	0.900	0.919	0.620

Discriminant Validity. Through evaluating the connections between different measures, one can determine the extent to which items differentiate between concepts or measure distinct ideas. This can be done by examining the discriminant validity using the Fornell-Larcker criterion and the indicator's outer loadings.

Cross Loading

Items should have a stronger influence on their respective constructs in the model, and the level of agreement between each construct and its measures should be higher than the agreement between the construct and other constructs (Fornell & Larcker, 1981; Compeau et al., 1999). Education, innovation, technology, and knowledge banking were given greater emphasis in the model, as indicated in tables (2-1) and (2-2). Exploring the connections between the constructs by utilising the variable correlation-root square of AVE. Based on empirical standards, it is essential for the construct to be distinct from other constructs.

Table (2-1)

Latent variable Correlation			
	Edu	INV	KB	TECH
EDU	0.838			
INV	0.616	0.721		
KB	0.432	0.582	0.817	
TECH	0.557	0.796	0.670	0.771

Table (2-2)

Cross Loading				
Construct	EDU	INV	TECH	KB
EDU1	**0.855**	0.548	0.467	0.376
EDU2	**0.853**	0.628	0.575	0.387
EDU3	**0.916**	0.611	0.602	0.425
EDU4	**0.854**	0.519	0.590	0.434
EDU5	**0.866**	0.521	0.588	0.380
EDU6	**0.801**	0.444	0.455	0.275
EDU7	**0.823**	0.498	0.469	0.291
EDU8	**0.855**	0.328	0.316	0.363
INV1	0.502	**0.904**	0.652	0.599
INV2	0.292	**0.482**	0.217	0.233
INV3	0.188	**0.335**	0.188	0.048
INV4	0.653	**0.910**	0.780	0.500
INV5	0.475	**0.780**	0.615	0.444
TECH1	0.635	0.609	**0.754**	0.500
TECH2	0.475	.0788	**0.782**	0.444
TECH3	0.560	0.558	**0.726**	0.583
TECH4	0.559	0.648	**0.854**	0.500
TECH5	0.331	0.496	**0.768**	0.451
TECH6	0.323	0.517	**0.767**	0.369
TECH7	0.421	0.570	**0.733**	0.503
KB1	0.168	0.401	0.575	**0.790**
KB2	0.465	0.593	0.523	**0.832**
KB3	0.461	0.425	0.418	**0.828**

Structural Model

Hypothesis Relationships

A comprehensive analysis of the structural model was conducted in this study to present a holistic view of the results and thoroughly examine the hypotheses presented in Table 3-1. When evaluating the inner model, the first step is to examine the direct relationships between the independent factors and the dependent variable. The size of the path coefficients was examined in SmartPLS 3.0 using the PLS-SEM algorithm, while the significance of the association was assessed using the PLS-SEM bootstrapping technique. An initial count of cases was used as the case count, and 500 bootstrapping samples were utilised (; Henseler et al., 2009) (Hair et al., 2011; Hair et al., 2012; Hair Jr et al., 2016).

The first model focused on examining the direct relationship between the independent and dependent variables (H1 to H3). The PLS-SEM algorithm and bootstrapping procedure described above reveal the path coefficients of the independent variables and the dependent variable. According to the results, all of the independent factors show a positive correlation with the dependent variable. The relationship between one of the independent variables and the dependent variable is statistically significant at a significance level of p.01, as indicated by the bootstrapping result in Table 3-1. The path coefficients, t-statistics, and p-values are displayed.

Table (3-1)

Path Coefficients of The Research Hypothesis						
Hypothesis	Relationship	Original Sample (O)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Decision
H1	EDU -> KB	0.208	0.012	17.33	0.000	supported
H2	INV -> KB	0.302	0.101	2.99	0.003	supported
H3	TECH -> KB	0.095	0.011	8.63	0.000	supported

According to Chen et al. (2004), R Square coefficients of 0.67, 0.33, and 0.19 in PLS-SEM are considered significant, moderate, and weak, respectively. The value of 0.457 in Table (3-2) indicates a moderate level. The variable effect for each table indicates a moderate influence (3-3). The purpose of the GOF model is to analyse both the measurement and structural aspects of a study model, with an emphasis on evaluating the model's overall performance (Chin, 2010). The GOF calculation yielded a value of 0.536, indicating sufficient global PLS model validity. The study examines the predictive relevance of Testing Q 2, which assesses the overall impact on the endogenous variable, as presented in Table 3-4. The SSE/SSO value is greater than zero, suggesting that the study model possesses adequate predictive capability.

Table (3-2)

R Square of Endogenous Latent Variable		
Construct Relation	R^2	Result
Knowledge Banking	0.457	Moderate

Table (3-3)

The Effect Size of Endogenous Constructs		
Constructs	F^2	Result
EDU -> KB	0.245	Medium
INV -> KB	0.266	Medium
TECH -> KB	0.291	Medium

Table3-4

Constructs Cross Validity Redundancy			
	SSO	SSE	Q2(1-SSE/SSO)
EDU	400.00	400.00	
INV	250.00	250.00	
KB	150.00	114.510	0.536
TECH	400.00	400.00	
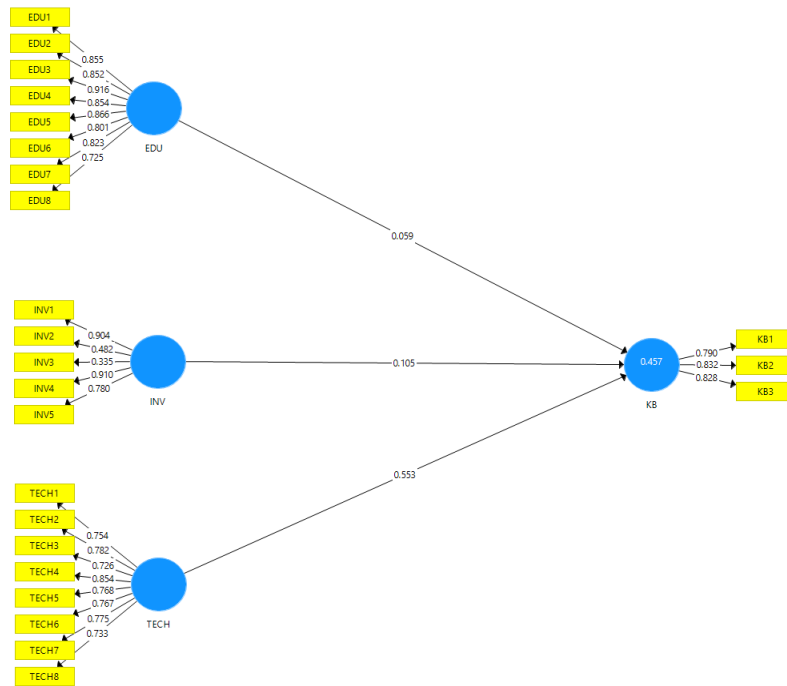
Figure 2: PLS Structural Equation Model.

Results Discussion

The kingdom of Bahrain's commercial banks is improving because they concentrated on technological infrastructure and communication which in turn increases their clients and facilitates their business and communication with new customers. The advanced financial services offered in Bahrain demonstrate the application of advanced technologies, indicating significant progress in the knowledge economy pillar of information and communication technology (ICT). The Central Bank of Bahrain supports this by encouraging commercial banks to update their technologies and services through its efforts and policies. The research findings highlight the significant relationship between knowledge banking and technology, with the level of technology determining the level of financial services. This relationship is evident in the questionnaire analysis, particularly in the advanced technology adoption by commercial banks in Bahrain to achieve progress in ICT.

To achieve its strategic goals, the Kingdom of Bahrain will implement a comprehensive education strategy until 2030. In higher education institutions, there is a particular emphasis on research quality and quantity. However, the analysis suggests that Bahrain needs to exert more effort to enhance education and knowledge to meet the demands of the banking sector. Additionally, the lack of research and development centres in Bahrain's commercial banks hinders their competitiveness and progress in knowledge indicators. The focus of training programmes is typically on professional skills rather than technical skills, although there are some programmes that incorporate both.

Bahrain excels in terms of knowledge infrastructure. The Global Knowledge Index 2020 ranks Bahrain 43rd out of 138 nations and 41st out of 56 countries with extremely high human development. Strengths in Bahrain include internet usage, the unemployment rate, joint ventures through strategic alliance partnerships, higher education research, and the total tax and contribution rate. The Quality Authority for Education and Training in Bahrain, specifically the Public Schools Performance Review Department, conducts performance reviews based on the school performance review framework. These reviews focus on the main themes. The quality of the outputs encompasses various factors: The main goal of this study is to ensure the quality of outputs and processes, such as leadership, management, and governance, in order to promote academic achievement and personal development. The evaluation of performance effectiveness and the absorptive capacity of improvement and development are interrelated (Kingdom of Bahrain, Education & Training Quality Authority, Annual Report 2017).

The Quality Education and Training Authority, through its Higher Education Institutions Review Department, conducts two types of reviews in higher education: the Institutional Quality Review, which comprehensively evaluates the higher education institution, focusing on the effectiveness of its quality assurance arrangements. The review of academic programmes assesses the quality of teaching and learning, as well as the academic standards. Programs with reduced performance are subject to judgement. The Commission concluded the initial round of Institutional Quality Reviews

in 2013. The first phase of the programme review began in 2011, followed by the second phase in May 2012. These reviews focused on evaluating and revising the academic programmes at the bachelor and master levels offered by higher education institutions in Bahrain. Additionally, the Commission finalised the Framework for Institutional Quality Review for the second cycle, which includes final provisions. The Commission is anticipated to conclude its initial review of academic programmes by December 2017 and subsequently establish the framework for the second cycle of programme reviews (Kingdom of Bahrain, Education & Training Quality Authority, and Annual Report 2017).

It is crucial for banks to provide education to their employees to enhance productivity, performance, and efficiency. The commercial banks in Bahrain prioritise the education level of employees and job applicants. The study revealed that all employees in banks possess at least a Bachelor of Science degree, with some holding higher qualifications such as a master's or PhD degree. The researcher administered a questionnaire during the study period to obtain this information. The discussion also encompasses the training programmes offered by the organisation. We found that almost every bank in Bahrain offers a certain level of training to its employees.

Although the GCC countries as a whole have low rates in the R&D indicator, the Kingdom of Bahrain stands out with a relatively high level. However, to further develop the R&D sector, which closely links to innovation, education output, and the labour market, more effort is still required. This has implications for Bahrain's banking sector, as development in banking services and technologies cannot be separated from innovation. Bahrain, a pioneer in the Islamic banking industry, has the responsibility to guide progress in this sector. Bahrain's research strategy places significant emphasis on Islamic banking, aiming to yield better results in terms of necessary innovations for the development of Islamic banking services (GKI 2017)

The economic Vision 2030 for the Kingdom of Bahrain acknowledges the crucial role of scientific research in facilitating the transition from an oil-based economy to a productive economy that fosters new opportunities and sustainable growth. "Encouraging research and development in universities and academic institutions to provide a platform for a knowledge-based economy," the Kingdom says. The Bahrain Higher Education Council has developed the National Research Strategy to achieve these objectives, emphasising the significance of research in fostering a knowledge-based economy. The priority sectors identified by the National Strategy for the Bahrain Economic Development Board and the Higher Education Strategy align with the main objectives of the national research strategy. The selection of research priorities is determined by the Kingdom's human capital strengths and takes into account the significance of promoting applied research in areas that align with Bahrain's economic and social goals for the strategy (HEC,2014).

The three most important priorities are as follows:

▪ Investment Management, Islamic Banking, and Insurance
▪ Gulf Region Health & Translational medical science, Medical Services & Population Health
▪ Information and Communications Technology (ICT)

The ("Central Bank of Bahrain, Financial Stability Report,") has established a dedicated Fintech and Innovation Unit to enhance services for clients by promoting a flexible regulatory framework that supports FinTech and innovation.

Additionally, the unit aims to facilitate the transition to knowledge banking through advancements in digital financial services. The CBB has recently implemented several initiatives, such as the establishment of a Regulatory Sandbox for startups, FinTech firms, and licensees to offer innovative banking and financial solutions. Additionally, the CBB has also published regulations for Crowdfunding services, covering both traditional and Sharia-compliant offerings. The CBB's FinTech & Innovation Unit oversees the approval process for participation in the Regulatory Sandbox, monitors the testing progress of authorized Sandbox companies, leads strategic FinTech initiatives, and collaborates with stakeholders in the Kingdom's FinTech ecosystem ("Central Bank of Bahrain, Financial Stability Report," 2018).

Bahrain's commercial banks can be characterised as knowledge banks, as their employees are predominantly university-educated knowledge workers. The education sector requires additional policies and advancements to address its weaknesses. Both general and higher education institutions need to make progress in the education process. The education strategy in the Kingdom of Bahrain aims to enhance the quality of education and will have a positive impact in the future.

The research indicates a significant relationship between knowledge banking and the regulatory and institutional frameworks that govern commercial banking. These frameworks can either support or hinder the progress of banks in knowledge banking. The study also highlights the efforts of central banks in promoting financial services and technologies by introducing new technologies and relevant regulations to encourage commercial banks to adopt the advanced technologies,

Recommendations

- Although the banks are performing pretty well in ICT and training as well as education, they lack research centers that obstruct the innovation process and development. Therefore, managers should take into consideration the power of research centres and what those research centers have to offer.
- The bank's managers should be aware of the fast transition and development in technology and information and start working strenuously on that side.
- Commercial banks in particular have to realize the important role of technical training and to start acting in providing technical training along with professional training.
- Education, training, and technology form the basis of the modern world and thus it is business so if bank managers want their business to be profitable these things are worth being focused on.
- Fortunately, the banks turned out to have a very solid belief in the role of technology which led to better performance and accelerated profits.
- Banks should work as well on governance to the proper functioning of the banking sector and the economy as a whole.

Limitations and Further Studies

This research looks at the impact of the pillars of the knowledge economy in generating knowledge banking, specifically on the performance of commercial banks in the Kingdom of Bahrain. The study's findings show that the data

has an adequate level of dependability across all variables. The importance of these variables was established by the targeted banking respondents. Furthermore, the dependent and independent variables have a considerable association. The findings, on the other hand, have a lot of ramifications for future research. To begin with, future research may look at similar variables in various universities. Second, conducting research on various pillars of the knowledge economy in other countries with a larger sample size is intriguing. Finally, future research could look into the same variables in different contexts.

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