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Identifying Factors Affecting the Financing of Knowledge-Based Businesses with Emphasis on the Role of the Banking System

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ABSTRACT

The present study was conducted with the aim of identifying the factors affecting the financing of knowledge-based businesses, with particular emphasis on the role of the banking system. The research employed a qualitative approach based on the grounded theory methodology. The statistical population consisted of banks providing credit facilities and financial support to knowledge-based companies, including Shahr Bank, Melli Bank, Mellat Bank, Resalat Bank, Saderat Bank, Export Development Bank of Iran, and Industry and Mine Bank. In this study, purposive non-probability sampling was used. The research instrument consisted of semi-structured interviews conducted with 15 experts and specialists in the field of financing knowledge-based businesses. In addition, document analysis was applied to identify the dimensions, characteristics, facilitating and inhibiting factors, and appropriate financing mechanisms for knowledge-based enterprises. To ensure the validity and reliability of the study, the Lincoln and Guba evaluation criteria were employed. The interviews were reviewed multiple times, and initial concepts were extracted through content analysis. Based on the conducted analyses, the identified factors included causal conditions influencing the financing of knowledge-based businesses (planning, human resource management, and economic factors), contextual conditions (supportive programs), the central phenomenon (collaboration), intervening conditions (effective management), strategies (investment), and outcomes (collaboration and networking, investment attraction, market development, increased production capacity, and technological development).

Keywords: Financing, Business, Knowledge-Based, Banking System

Introduction

The transformation of contemporary economies toward innovation-driven growth has fundamentally altered the role of financial systems in supporting productive activities, particularly those associated with knowledge-based enterprises. In knowledge economies, competitive advantage increasingly depends on intangible assets such as technological capability, human capital, research capacity, and innovation performance rather than traditional physical resources. Financial institutions therefore play a decisive role in enabling technological commercialization and facilitating sustainable economic development. Theoretical foundations linking finance and economic growth

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emphasize that well-developed financial systems enhance resource allocation efficiency, reduce information asymmetry, and accelerate technological convergence across economies (1). Early financial intermediation theory similarly highlighted how banks reduce liquidity risk and improve investment efficiency through maturity transformation and monitoring mechanisms (2). Empirical evidence also confirms that institutional quality and financial market development influence firms' financing structures and investment horizons (3). Within this broader perspective, the financing of knowledge-based firms represents a strategic intersection between innovation policy and banking system performance.

Knowledge-based businesses differ substantially from conventional enterprises because their value creation process relies heavily on research and development, intellectual property, and specialized human capital. Such firms typically experience high uncertainty, long commercialization cycles, and limited tangible collateral, which complicate traditional credit evaluation procedures. Consequently, financing innovation requires adaptive financial models capable of assessing technological potential rather than merely historical financial performance. Research has shown that innovation-oriented firms benefit from financial environments that encourage experimentation and risk-sharing mechanisms rather than conservative lending practices (4). In this context, banks increasingly operate not only as capital providers but also as strategic partners contributing to innovation ecosystems. Studies examining investment in technological projects emphasize that banking participation becomes feasible when institutional frameworks align risk assessment mechanisms with innovation dynamics (5).

The emergence of knowledge-based economies has also intensified interest in alternative financing mechanisms such as crowdfunding, fintech platforms, and digital financial intermediation. These instruments reduce barriers to capital access and diversify financing sources for innovative firms lacking traditional credit records. FinTech development and crowdfunding platforms have been identified as effective tools for improving financial inclusion among small and medium enterprises and technology start-ups (6). Global evidence demonstrates that determinants of fintech equity funding flows are strongly influenced by institutional trust, technological readiness, and regulatory support (7). At the same time, advanced analytical techniques applied to crowdfunding performance reveal that risk perception, transparency, and information quality significantly shape investor participation in innovation financing (8). These developments illustrate a structural evolution of financial systems toward digitally mediated investment ecosystems complementing traditional banking activities.

Despite the growth of alternative financing channels, the banking system continues to remain the backbone of financial intermediation in many developing and emerging economies. Banks possess the institutional capacity, regulatory legitimacy, and capital scale necessary to support large-scale innovation financing programs. However, effective participation requires risk-aware lending frameworks tailored to the specific characteristics of knowledge-based enterprises. Recent studies propose banking models integrating risk management procedures with innovation evaluation criteria to improve facility allocation decisions (9). The resilience and stability of banking systems further influence their ability to sustain innovation financing during systemic shocks, including global crises and pandemics (10). Research on banking system invulnerability likewise underscores the importance of governance quality, diversification, and institutional flexibility in maintaining credit flows to innovative sectors (11).

At the firm level, successful financing outcomes depend not only on financial structures but also on organizational capabilities. Human resource management plays a central role in shaping innovation performance and investment attractiveness. Knowledge-based human resource management models emphasize learning orientation, knowledge sharing, and capability development as drivers of organizational sustainability (12). Empirical findings

further demonstrate that knowledge-based companies located within academic incubators benefit from access to research networks, mentoring, and innovation support services, thereby increasing their likelihood of securing financing (13). Effective evaluation of commercialization potential also requires structured technology assessment frameworks integrating expert judgment and multi-criteria decision approaches (14). These organizational determinants indicate that financing decisions increasingly reflect intangible competencies rather than purely financial indicators.

Another critical dimension concerns the institutional and policy environment surrounding knowledge-based enterprises. Governments often implement credit guarantees, innovation funds, and targeted financial support programs to compensate for market failures associated with high-risk innovation activities. Comparative studies highlight the importance of credit guarantee systems in reducing perceived lending risk and enabling banks to extend financing to technology firms lacking sufficient collateral (15). Policy frameworks supporting financial crowdfunding and innovation financing ecosystems likewise contribute to expanding funding opportunities for entrepreneurial ventures (16). In addition, national economic conditions, including sanctions or external economic pressures, significantly influence firms' access to external financing and require adaptive financial strategies aligned with resilience-based economic models (17). Strategic financial support frameworks designed specifically for knowledge-based enterprises therefore play a decisive role in sustaining innovation ecosystems (18).

Market dynamics further shape financing requirements for innovative firms. Successful market entry depends on logistics capabilities, competitive positioning, and strategic alignment between innovation output and customer demand (19). Knowledge-based start-ups must simultaneously develop technological competence and market readiness to attract investment. Studies examining ICT start-ups demonstrate that market access, networking capacity, and commercialization strategies significantly determine growth trajectories and financing success (20). Moreover, sustainability considerations increasingly influence investor decision-making, as environmentally and socially responsible investment projects gain prominence within global financial markets (21). Financial risk networks and systemic interdependencies within regional financial systems also affect investment flows and stability, highlighting the interconnected nature of innovation financing environments (22).

Risk management represents another essential component of financing knowledge-based companies. Innovation investments inherently involve uncertainty, technological failure risk, and market volatility. Modern financial management emphasizes proactive risk governance combining operational, financial, and strategic risk mitigation mechanisms (23). Banking institutions must therefore balance innovation promotion with financial stability objectives. This balance becomes particularly important when financing high-technology ventures characterized by uncertain revenue streams and extended development cycles. Developing appropriate credit rating systems for knowledge-based companies has been proposed as a key solution for improving transparency and facilitating informed lending decisions (24). Such mechanisms enhance banks' capacity to evaluate innovation projects systematically while maintaining prudential risk standards.

In addition to institutional and financial determinants, broader socio-economic transformations have increased the strategic importance of collaboration networks among firms, universities, financial institutions, and policy actors. Innovation ecosystems thrive when knowledge exchange, technological learning, and cooperative investment mechanisms reinforce one another. Banking participation in collaborative innovation networks enables more accurate project evaluation and strengthens long-term investment relationships. Contemporary financial development theory suggests that sustained economic convergence depends on coordinated interactions between

financial institutions and innovation systems rather than isolated investment decisions (1). Consequently, financing knowledge-based businesses must be understood as a systemic process embedded within technological, institutional, and managerial environments.

Overall, the literature demonstrates that financing knowledge-based companies represents a multidimensional phenomenon shaped by economic conditions, organizational capabilities, technological readiness, financial innovation, institutional policies, and risk management practices. While alternative financing mechanisms are expanding, the banking system remains a central actor capable of integrating financial resources with national innovation strategies. Nevertheless, persistent challenges—including information asymmetry, risk perception, regulatory constraints, and insufficient evaluation frameworks—continue to limit optimal banking participation in innovation financing. Addressing these challenges requires a comprehensive analytical model capable of identifying causal factors, contextual conditions, strategic mechanisms, and developmental outcomes influencing banking investment behavior toward knowledge-based enterprises.

Therefore, the aim of this study is to identify the factors affecting the financing of knowledge-based businesses with emphasis on the role of the banking system.

Methods and Materials

Considering that the purpose of the present study was theory development—specifically identifying the factors affecting the financing of knowledge-based companies—a qualitative research approach was adopted. The qualitative design enabled the study to achieve three primary objectives: (1) to uncover the underlying dimensions of a relatively underexplored phenomenon and clarify what lies behind the concept under investigation; (2) to obtain subtle and detailed insights that are difficult to capture through quantitative methods; and (3) to move beyond merely explaining causal relationships toward interpreting phenomena related to the research topic and clearly illuminating their various dimensions. Among qualitative and interpretive approaches, grounded theory provides unique advantages for researchers due to its strong capacity for interpreting complex phenomena and granting greater analytical flexibility in exploring the research domain and allowing concepts to emerge inductively.

Based on the grounded theory methodology, and through semi-structured interviews with experts and specialists in the field of financing knowledge-based businesses, along with document analysis, the dimensions, characteristics, facilitating factors, and appropriate financing mechanisms for knowledge-based enterprises were identified. The statistical population included all banks providing credit and financial facilities to knowledge-based companies, namely Shahr Bank, Melli Bank, Mellat Bank, Resalat Bank, Saderat Bank, Export Development Bank of Iran, and Industry and Mine Bank. Purposive non-probability sampling was applied in this research. The sampling was purposive because participants were selected from banking professionals with experience in financing knowledge-based businesses, and it was non-probabilistic because statistical generalization was not the objective of the study.

The research instrument consisted of interviews. According to the grounded theory approach proposed by Strauss and Corbin, an appropriate sample size ranges between 10 and 25 participants, with expansion depending on theoretical saturation—that is, data collection continues until no new information or insights emerge from participants. In the present study, experts were identified through snowball sampling, and interviews continued until theoretical saturation was achieved. Ultimately, the perspectives of 15 experts were collected. All interview discussions were recorded, reviewed, and systematically analyzed. To assess content validity, the extracted

concepts were reviewed by several experts to qualitatively evaluate their relevance and adequacy, and qualitative content validity was confirmed. After transcription, the collected data were analyzed through coding procedures and categorized according to the three stages proposed by Strauss and Corbin—open coding, axial coding, and selective coding.

Findings and Results

The main research question addressed in this study was: *Which factors influence the financing of knowledge-based businesses with emphasis on the role of the banking system?* To answer this question, it was first necessary to address several subsidiary questions, including: which environmental factors (such as government policies, legal and regulatory frameworks, business conditions, information technology infrastructure, and related contextual elements) contribute to the growth of financing mechanisms, increased investment, and greater participation of the banking system? Additionally, what policies or strategic approaches within the banking system can be proposed to expand financial support for knowledge-based businesses?

To respond to these questions, semi-structured interviews were conducted. During the interviews, participants were asked questions such as: *What factors, in your view, lead to increased investment and greater participation of the banking system in knowledge-based companies?* and *What policies or practical strategies have been implemented in this field?* After transcription, the recorded interviews were examined line by line. Conceptualization and categorization were carried out, and concepts and categories (classes of concepts) were identified based on similarity, conceptual relationships, and shared characteristics among open codes.

In this study, the data were carefully examined to determine both main and subcategories, define their dimensions and attributes, and identify emerging patterns. The responses provided by interviewees were decomposed into smaller analytical units and repeatedly compared with one another. Through iterative comparison and identification of shared applications, essential concepts were developed. Analytical procedures proposed by Strauss and Corbin were employed throughout the analysis process.

During detailed data analysis, concepts emerged directly from interview transcripts through coding procedures, either as in vivo codes derived from participants' own expressions or through identification of common thematic applications. Interview transcripts were systematically reviewed to identify core categories, subcategories, attributes, and dimensional properties. Initially, participants' responses were divided into smaller units at the sentence or paragraph level. Subsequently, concepts were organized into broader categories, and categories were further classified into higher-level conceptual groupings.

Given the large number of open codes obtained, repetitive analytical cycles were conducted following each stage of data classification and review. Duplicate concepts were eliminated, and similar concepts were merged. This iterative process continued multiple times until logical saturation was achieved for core categories, subcategories, and their attributes. The boundaries of categories were not predetermined at the beginning of analysis; rather, they were continuously refined throughout the analytical process. Open coding was terminated when three conditions were satisfied: (a) a meaningful classification structure emerged after repeated examination of interview transcripts; (b) subcategories and attributes became repetitive; and (c) no new relevant data were identified in interview transcripts, or newly identified data were fully consistent with the existing classification framework.

Based on the analysis and coding of the conducted interviews, 12 subcategories and 53 open codes were extracted from the data analysis process. Table 1 presents the categories and the open codes associated with each category.

Table 1. Open Codes Reported by Participants

Subcategories	Open Codes
Economic Factors	1) Resilience against financial challenges and competition with other firms
	2) Appropriate investment in research and development
	3) Investment in companies with high growth potential and significant profitability
	4) Stronger presence in competitive markets and provision of innovative products and services
	5) Maximization of return on investment
	6) Greater capital allocation to start-ups and knowledge-based firms with rapid growth
	7) Increase in product sales
Human Resource Management	8) Effective management of financial, human, and technical resources
	9) Provision of research and commercialization opportunities
	10) Assessment of company strengths, weaknesses, resources, and capabilities
	11) Provision of specialized consulting and training services
	12) Evaluation of external environmental opportunities and threats including markets, competitors, technologies, and policies
	13) Venture investors with active management
	14) Comprehensive understanding of the company and its surrounding environment
	15) Continuous monitoring and management of investments and outcomes over time
	16) Long-term profit motivation
Planning	17) Utilization of external knowledge and experience and strengthening active connections with the scientific community
	18) Clearly defined objectives aligned with company strategy and characteristics
	19) Short-term perspective toward technology development and innovation
	20) Relatively long-term planning for higher profitability
	21) High level of innovation risk
Collaboration	23) Multiple advisory services supporting technology- and innovation-based start-ups
	24) Collaboration policies with research and technology funds
Investment	25) Granting temporary knowledge-based certification to start-ups based on proposed plans to enable access to benefits such as residential workspace facilities
	26) Establishment of governmental funds, investment institutions, and financial facilities supporting knowledge-based companies
	27) Policy for establishing the Innovation and Prosperity Fund in 2010
Support Programs	28) Planning to direct supportive loans toward knowledge-based projects and products to foster company development
	29) Approval through the Vice Presidency for Science and Technology
	30) Policy of providing microfinance facilities to SMEs and start-ups through the Innovation and Prosperity Fund
	31) Leasing facility policy
	32) Fully electronic loan application and processing policy
	33) Interest-free deposit and lease assistance loan policy
Effective Management	34) Use of existing legal instruments in company evaluation and qualification assessment processes
	35) Revision of evaluation, contracting, and loan supervision procedures
	36) Planning and knowledge transfer aimed at increasing company share value
Technology Development	37) Investment in research and development
	38) Advanced equipment
	39) Skilled human resources and technical infrastructure
	40) Improvement of organizational efficiency and technical performance
Increasing Production Capacity	41) Creating opportunities for organizational growth and expansion
	42) Meeting market demands
	43) Experience of strong competitive positioning
Market Development	44) Investment in marketing activities, advertising, communications, and market research
	45) Demonstrating competitive advantage
	46) Increasing market share
	47) Targeted marketing and effective customer communication
	48) Understanding customer needs and expectations
	49) Delivering market-oriented products and services
Investor Attraction	50) High profitability, risk acceptance, and enhancement of firm value

Collaboration and Networking		51) Collaboration, networking, and joint research with universities, research centers, and other organizations
		52) Utilization of external knowledge, experience, and resources
		53) Higher research and development productivity, improved innovation processes, and access to knowledge-based networks

Table 1 presents the results of qualitative data analysis derived from interview coding, through which 12 subcategories and 53 open codes were identified as factors influencing the financing of knowledge-based businesses within the banking system framework. The findings indicate that economic factors emphasize resilience to financial challenges, investment in research and development, allocation of capital to high-growth firms, innovation-oriented market participation, maximization of return on investment, support for rapidly growing start-ups, and increased product sales. The human resource management category highlights effective management of financial, human, and technical resources, provision of research and commercialization opportunities, organizational capability assessment, specialized consulting and training, environmental opportunity analysis, active venture capital management, comprehensive organizational awareness, continuous monitoring of investments, and long-term profitability orientation. Within planning, the extracted codes underline utilization of external knowledge, alignment of organizational goals with strategic orientations, short- and long-term innovation perspectives, and recognition of innovation-related risks. The collaboration category reflects advisory support for technology-based start-ups and cooperative policies with research and technology funds. The investment dimension includes temporary knowledge-based certification for start-ups, establishment of governmental and investment funds, and implementation of innovation-support policies initiated in 2010. Support programs encompass targeted allocation of financial facilities, approval mechanisms through national science and technology authorities, provision of microfinance and leasing facilities, electronic loan processing systems, and interest-free financial assistance programs. The effective management category focuses on legal evaluation mechanisms, revision of contracting and monitoring procedures, and experience transfer aimed at increasing firm value. Codes related to technology development include investment in research and development, access to advanced equipment, availability of specialized human resources, and improvement of technical performance. Production capacity enhancement reflects organizational growth opportunities, responsiveness to market demand, and strengthened competitive positioning. Market development highlights investments in marketing and communications, demonstration of competitive advantages, expansion of market share, targeted customer engagement, understanding customer needs, and delivery of market-oriented products. The investor attraction category emphasizes profitability, risk-taking capacity, and firm value growth, while collaboration and networking stresses partnerships with universities and research institutions, utilization of external knowledge and resources, increased research productivity, innovation improvement, and access to knowledge-based networks.

Table 2. Paradigm Model of Banking System Participation in Financing Knowledge-Based Firms

Paradigm Component	Category	Open Codes
Causal Conditions	Economic Factors	Resistance to financial challenges and competition; appropriate investment in research and development; investment in high-growth and highly profitable firms; stronger competitive market presence through innovative products and services; maximization of return on investment; prioritization of rapidly growing start-ups and knowledge-based firms; increase in product sales
	Human Resource Management	Effective management of financial, human, and technical resources; provision of research and commercialization opportunities; assessment of organizational strengths, weaknesses, resources, and capabilities; specialized consulting and training; evaluation of external opportunities and threats (market, competitors, technologies, policies); active venture

		capital management; comprehensive understanding of the firm and its environment; continuous monitoring of investments; long-term profitability motivation
	Planning	Utilization of external knowledge and experience; strengthening links with the scientific community; strategic goal alignment; short-term technological and innovation outlook; relatively long-term profit planning; recognition of innovation risk
Core Phenomenon	Collaboration	Advisory support for technology- and innovation-based start-ups; collaboration policy with non-governmental research and technology funds
Strategies	Investment Strategies	Temporary knowledge-based certification for start-ups to access operational benefits; establishment of governmental funds and investment institutions; creation of the Innovation and Prosperity Fund (2010)
Contextual Conditions	Support Programs	Direction of supportive loans toward knowledge-based projects; approval through national science and technology authorities; microfinance policies for SMEs and start-ups; leasing facilities; fully electronic financing processes; interest-free deposit and housing support loans
Intervening Conditions	Effective Management	Use of legal evaluation instruments; revision of assessment, contracting, and supervision procedures; experience transfer and planning to enhance firm share value
Consequences	Technology Development	Investment in R&D; advanced equipment; skilled workforce and technical infrastructure; improved technical efficiency and performance
	Production Capacity Expansion	Opportunities for organizational growth; meeting market demand; stronger competitive positioning
	Market Development	Investment in marketing, communication, advertising, and market research; demonstration of competitive advantage; increased market share; targeted marketing and customer engagement; understanding customer needs; market-aligned product and service delivery
	Investor Attraction	High profitability; risk-taking capacity; increase in firm value
	Collaboration and Networking	Joint research with universities and research centers; utilization of external knowledge and resources; improved innovation processes and access to knowledge-based networks

The table presents a comprehensive paradigm model explaining the factors influencing increased investment and participation of the banking system in financing knowledge-based companies. The findings reveal that banking engagement does not emerge from a single economic determinant but rather from a multidimensional interaction among causal conditions, contextual environments, strategic actions, managerial interventions, and developmental outcomes. At the foundation of this model lie causal conditions, which represent the primary drivers motivating banks to allocate financial resources toward knowledge-based enterprises. Economic factors play a decisive role by emphasizing resilience against financial uncertainty, expectations of high returns on investment, and the attraction of firms demonstrating rapid growth potential and innovation capability. From the banking perspective, financing becomes rational when investment risk is balanced by technological competitiveness, market expansion capacity, and measurable profitability outcomes.

Alongside economic determinants, human resource management emerges as a crucial causal component shaping financing decisions. Banks and investors evaluate not only financial indicators but also organizational competencies, managerial expertise, and learning capacity within knowledge-based firms. Effective management of human, financial, and technical resources enhances investor confidence and reduces perceived uncertainty. The provision of specialized consulting services, continuous monitoring of investments, and comprehensive environmental analysis enable banks to adopt an informed financing strategy aligned with long-term value creation rather than short-term speculative returns. These elements indicate that financing knowledge-based companies increasingly depends on intellectual capital and managerial maturity rather than collateral-based lending models.

The third causal dimension, planning, highlights the strategic orientation required for sustainable financing relationships. Knowledge-based enterprises must demonstrate structured planning processes, clearly defined strategic goals, and the ability to leverage external scientific knowledge networks. Banks tend to favor firms that combine short-term innovation initiatives with long-term profitability strategies, indicating a shift toward developmental banking logic. Recognition of innovation risk also appears as an inherent component of financing

decisions; rather than avoiding risk entirely, effective planning enables banks to manage uncertainty through structured evaluation frameworks and collaborative learning mechanisms.

At the center of the paradigm lies the core phenomenon of collaboration, which functions as the main mechanism linking banks with knowledge-based firms. Collaboration manifests through advisory services, partnerships with research and technology funds, and cooperative innovation ecosystems. The results suggest that banking participation evolves beyond traditional lender–borrower relationships toward network-based financial ecosystems involving universities, innovation funds, and technology intermediaries. Collaboration reduces informational asymmetry, enhances project credibility, and strengthens trust between financial institutions and innovative enterprises, thereby facilitating higher levels of investment participation.

The model further identifies strategies, contextual conditions, and intervening mechanisms that operationalize financing processes. Investment strategies include institutional support structures such as innovation funds, temporary certification policies enabling start-ups to access operational benefits, and specialized financial institutions dedicated to innovation financing. Contextual conditions—particularly supportive governmental programs—create an enabling environment by directing loans toward knowledge-based projects, simplifying financing procedures through digital platforms, and offering diversified financial instruments such as leasing and interest-free facilities. Meanwhile, effective management acts as an intervening condition ensuring that policies translate into practical outcomes through regulatory evaluation tools, improved monitoring procedures, and knowledge transfer practices that enhance firm valuation and investment sustainability.

Finally, the integrated model demonstrates that expanded banking participation produces multidimensional developmental consequences. Increased financing stimulates technology development through investment in research infrastructure, skilled human resources, and advanced equipment. These technological advancements subsequently expand production capacity, enabling firms to meet market demands and strengthen competitive positioning. Market development outcomes include enhanced marketing capabilities, improved customer engagement, and greater market share acquisition. Furthermore, successful financing attracts additional investors by increasing firm value and profitability expectations. The emergence of collaboration and networking outcomes—particularly partnerships with universities and research institutions—creates cumulative innovation effects, reinforcing knowledge exchange, accelerating innovation processes, and embedding knowledge-based firms within broader innovation ecosystems. Collectively, these outcomes illustrate that banking system participation functions not merely as financial support but as a catalyst for technological growth, market expansion, and sustainable innovation-driven economic development.

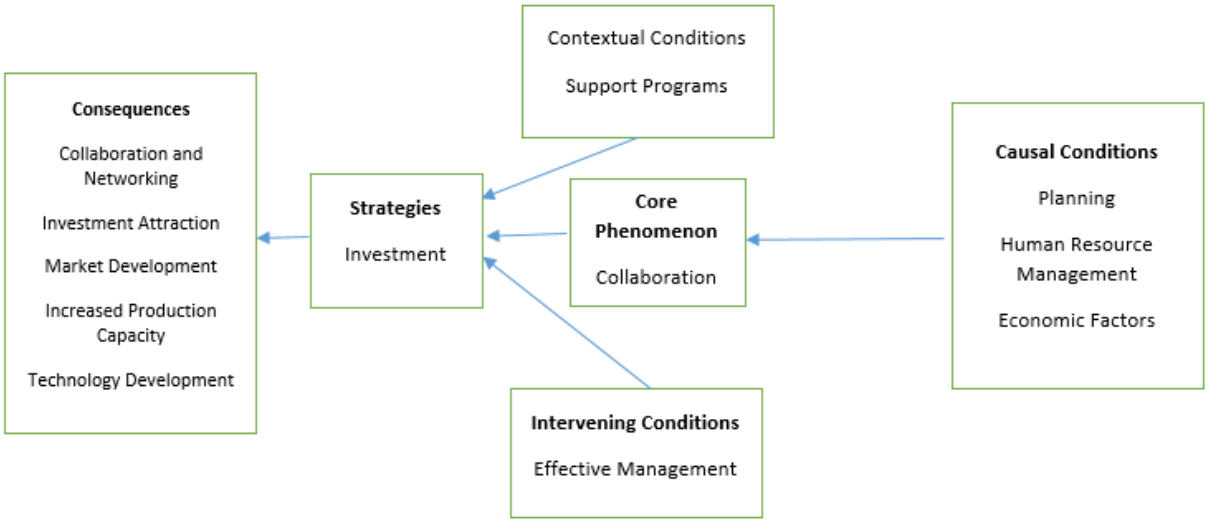

Figure 1. Final Paradigm Model of Banking System Participation in Financing Knowledge-Based Firms

Discussion and Conclusion

The purpose of this study was to identify the factors influencing the financing of knowledge-based businesses with emphasis on the role of the banking system through a grounded theory approach. The findings revealed a multidimensional paradigm consisting of causal conditions (economic factors, human resource management, and planning), a core phenomenon (collaboration), contextual conditions (support programs), intervening conditions (effective management), strategic actions (investment), and developmental consequences (technology development, market expansion, increased production capacity, investment attraction, and collaboration networks). The discussion interprets these results within the broader theoretical and empirical literature on financial development, innovation financing, and knowledge-based economic growth.

The first major finding concerns the importance of economic factors as primary causal drivers shaping banking investment behavior. Participants emphasized profitability expectations, innovation competitiveness, market performance, and return on investment as key determinants guiding financing decisions. These results align with financial development theory, which argues that efficient financial systems allocate resources toward productive sectors with higher growth potential and innovation capacity (1). Banks, as financial intermediaries, reduce liquidity and monitoring risks while facilitating long-term investment flows toward productive firms (2). Empirical research further confirms that institutional financial structures significantly influence firms' access to long-term debt and innovation investment opportunities (3). The present findings therefore reinforce the idea that banking participation in knowledge-based financing emerges when innovation activities demonstrate measurable economic value and sustainable revenue prospects.

Another important result relates to human resource management as a decisive factor affecting financing outcomes. The study showed that banks evaluate managerial competence, organizational learning capability, and technical expertise alongside financial indicators. Knowledge-based human resource management models highlight the strategic role of intellectual capital in organizational sustainability and innovation success (12). Similarly, research on academic incubators demonstrates that firms with strong knowledge management structures and skilled personnel exhibit greater investment attractiveness and growth potential (13). These findings suggest a

structural transition from collateral-based lending toward competence-based financing, where banks increasingly rely on qualitative organizational indicators to assess innovation projects.

The results also identified planning as a central causal condition influencing financing decisions. Strategic alignment, utilization of external knowledge, and recognition of innovation risk were found to strengthen bank confidence. Previous studies emphasize that successful commercialization requires systematic technology evaluation models integrating strategic foresight and market feasibility assessment (14). Moreover, knowledge-based start-ups entering competitive markets must demonstrate clear strategic planning capabilities to attract external financing (20). Planning therefore operates as a signal of managerial maturity and reduces informational asymmetry between banks and innovative firms.

The emergence of collaboration as the core phenomenon represents one of the most significant findings of the study. Collaboration between banks, innovation funds, universities, and technology intermediaries was identified as the main mechanism enabling investment expansion. Contemporary innovation financing literature emphasizes that collaborative ecosystems enhance information transparency, reduce uncertainty, and support joint risk-sharing among stakeholders (5). Digital financing environments, including crowdfunding platforms and fintech ecosystems, similarly demonstrate that collective participation strengthens investor confidence and improves funding performance (7, 8). These results suggest that banking systems increasingly function as components of broader innovation networks rather than isolated financial actors.

The study further highlights the importance of contextual conditions, particularly supportive governmental programs and policy infrastructures. Participants emphasized innovation funds, credit guarantees, electronic financing processes, and targeted loan programs as essential enablers of banking participation. Prior research confirms that credit guarantee mechanisms significantly reduce lending risk and expand financing access for knowledge-based firms lacking collateral (15). National financial support frameworks also enhance innovation ecosystem resilience and facilitate technology commercialization (18). Furthermore, alternative financing mechanisms such as crowdfunding and fintech platforms complement traditional banking channels by expanding funding diversity (6, 16). These findings collectively demonstrate that effective policy environments play a critical role in aligning banking incentives with national innovation strategies.

The model additionally identifies effective management as an intervening condition influencing the success of financing processes. Legal evaluation tools, monitoring procedures, and experience transfer mechanisms were found to enhance investment efficiency. Risk-aware banking frameworks have been proposed as essential for improving facility allocation decisions and managing uncertainty within innovation financing (9). Studies on banking system resilience indicate that institutional flexibility and governance quality strengthen banks' ability to maintain credit provision under volatile economic conditions (11). The importance of risk governance becomes even more evident during systemic crises, where proactive financial management mitigates instability across banking networks (10). Thus, effective management acts as a stabilizing force linking policy support and strategic investment outcomes.

Regarding investment strategies, the findings emphasize institutional investment structures such as innovation funds and temporary certification mechanisms supporting start-ups. Financial development literature suggests that diversified financing channels improve capital allocation efficiency and accelerate technological innovation (4). Sustainability-oriented investment studies further demonstrate that structured financial participation enhances long-

term project success and investor confidence (21). The establishment of innovation-focused financial institutions therefore reflects an evolution toward mission-oriented banking models supporting innovation-led growth.

The consequences identified in the study illustrate how expanded banking participation contributes to technological and economic development. Technology development emerged as a key outcome through increased investment in research infrastructure, advanced equipment, and specialized human capital. These findings align with innovation finance theory, which links financial access directly to technological productivity and innovation performance (1). Improved production capacity and market development were also observed, indicating that financing enables firms to scale operations and strengthen competitive positioning. Logistics and market readiness have previously been identified as critical success factors influencing growth trajectories of innovative firms (19).

The attraction of additional investors represents another important consequence identified in the findings. Enhanced profitability, risk tolerance, and firm valuation increase investor confidence and create cumulative financing effects. Credit rating systems designed for knowledge-based enterprises have been recommended as mechanisms to improve transparency and attract investment flows (24). Financial risk network analyses further demonstrate that interconnected investment environments amplify capital mobility and systemic innovation development (22).

Finally, collaboration and networking outcomes reinforce the systemic nature of innovation financing. Joint research activities, knowledge exchange, and access to innovation networks enhance learning processes and accelerate commercialization. Studies conducted under complex economic conditions highlight that collaborative financing mechanisms become especially important when firms face external constraints or market uncertainty (17). Ethical and responsible management of innovation ecosystems has also been recognized as a necessary component of sustainable technological development (13). Moreover, comprehensive risk management frameworks integrating operational and financial perspectives strengthen long-term innovation sustainability (23). Collectively, these findings confirm that banking participation functions not merely as financial support but as a catalyst for ecosystem-based innovation growth.

Despite providing a comprehensive model of financing factors for knowledge-based businesses, several limitations should be acknowledged. First, the qualitative nature of the study limits statistical generalizability, as findings are based on expert perceptions rather than large-scale quantitative evidence. Second, the study focused primarily on banking institutions involved in financing knowledge-based firms, which may not fully capture perspectives from venture capitalists, private investors, or fintech platforms. Third, contextual conditions specific to national regulatory and economic environments may influence the applicability of results to other countries or financial systems. Additionally, rapid technological changes in financial innovation may alter financing mechanisms over time, meaning that some findings could evolve alongside digital transformation in banking services.

Future studies may expand the proposed model through quantitative validation using structural equation modeling or longitudinal datasets to test causal relationships among identified variables. Comparative cross-country research could examine how institutional differences influence banking participation in innovation financing. Researchers may also investigate hybrid financing ecosystems integrating banks, fintech platforms, venture capital, and crowdfunding mechanisms. Another promising direction involves examining the role of artificial intelligence, big data analytics, and digital credit assessment tools in improving financing decisions for knowledge-based firms. Furthermore, future research could explore sector-specific financing challenges within biotechnology, information technology, or green innovation industries to refine policy and banking strategies.

From a practical perspective, banking institutions should redesign credit evaluation frameworks to incorporate technological capability, managerial competence, and innovation potential alongside traditional financial indicators. Policymakers are encouraged to strengthen credit guarantee systems, innovation funds, and digital financing infrastructures to reduce risk perceptions associated with knowledge-based enterprises. Knowledge-based companies should invest in strategic planning, professional management development, and collaboration networks to enhance investment readiness. Establishing stronger partnerships between universities, research centers, and financial institutions can improve information transparency and accelerate commercialization outcomes. Finally, continuous training programs for banking professionals in innovation assessment and technology evaluation may significantly improve the effectiveness of financing decisions and promote sustainable innovation-driven economic development.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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