



# Prioritizing Methods of Financing Innovation and Research and Development for Economic Growth

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## Abstract

According to the existing endogenous growth literature, research and development can be considered as a significant factor in enhancing gross domestic product (GDP). The objectives of research and development can be different but are generally categorized into four groups based on a review of the existing literature: 1 Expanding the frontiers of knowledge and enriching existing science, 2. Patent registration or innovation, 3. Increasing productivity, and finally 4. Creating innovation in the production process and production of new capital goods.

The present study seeks to prioritize the best financing methods for each of the aforementioned four objectives using the fuzzy Delphi method.

The results obtained from the Delphi questionnaire are as follows: 1. From the experts' point of view, private accelerators and incubator are the top priority for financing research aimed at creating new ideas and prod; 2. Regarding the most appropriate methods of financing research to expand the boundaries of knowledge, direct government investment is the primary method, followed by government loans, guarantees, and tax incentives; 3. For research aimed at improving productivity, venture capital funds, corporate venture capital are emphasized; 4. From the perspective of experts, corporate venture capital is the first priority for financing research to promote innovation in the production process, followed by various types of private venture capital.

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## Introduction

Research and development (R&D) plays a fundamental role in promoting economic growth through multiple channels. Existing literature suggests that R&D contributes to (1) the generation of new ideas and patented inventions, (2) improvements in production efficiency, (3) innovation in production processes and the development of new capital goods, and (4) the expansion of scientific knowledge and technological frontiers. Each of these outcomes contributes to economic growth through distinct mechanisms and varying pathways.

Despite these significant benefits, one of the major challenges associated with R&D activities is securing appropriate financial resources for research projects and innovative firms. Because different research objectives require different financing mechanisms, selecting the most suitable financing instrument has become an important policy and managerial concern. Given the wide range of available financing options, identifying and prioritizing the most effective mechanisms according to the specific objectives of research is essential for improving the efficiency of R&D investment.

Accordingly, this study seeks to identify and prioritize the most appropriate financing instruments for research and development based on four major research objectives by employing expert judgments through the Fuzzy Delphi Method.

## Methodology

This study employed the **Fuzzy Delphi Method (FDM)** to validate, refine, and screen the indicators identified through the literature review. The Fuzzy Delphi Method is a well-established decision-making approach that integrates the traditional Delphi technique with **Fuzzy Set Theory**, thereby reducing ambiguity and uncertainty associated with expert judgments while facilitating consensus among specialists.

The study population comprised university faculty members, relevant government officials, and experts from the private sector, particularly those with extensive experience in venture capital firms and startup accelerators. The expert panel was selected using purposive sampling and included professionals from venture capital companies, private- and public-sector accelerators, banking institutions, managers of technology-based startups, university academics, and specialists with substantial knowledge and experience in research and development (R&D) financing.

Considering the wide range of R&D and innovation financing mechanisms identified in previous studies, a structured questionnaire was designed based on the extracted financing methods and distributed among the selected experts. A total of **16 completed questionnaires** were collected and analyzed using Microsoft Excel.

The responses were aggregated and analyzed based on the frequency of expert evaluations for each financing method. Subsequently, the Fuzzy Delphi Method was applied to evaluate, validate, and prioritize the identified financing mechanisms. The implementation of the Fuzzy Delphi Method in this study was carried out through several sequential stages, enabling the identification of the most appropriate financing methods and the establishment of their relative priorities.

## Findings

The findings indicate that the panel of experts who participated in this study expressed considerable skepticism regarding the feasibility of utilizing **international financing sources** to support research activities across various sectors aimed at promoting production growth. Evidence supporting this conclusion is reflected in the experts' responses, which consistently demonstrated that international financing mechanisms were not considered appropriate or viable options for funding research and development (R&D) in the country. Consequently, financing methods based on foreign funding sources were excluded from the final set of recommended financing mechanisms in almost all evaluated sectors.



Another significant finding emerging from the study is that the experts' reservations were not limited to international financing sources. The respondents also expressed a cautious attitude toward **government-funded financing mechanisms**, questioning their effectiveness in supporting research and innovation. Overall, government financing was perceived as less effective than private-sector financing in promoting research, technological development, and innovation. This finding highlights the experts' stronger confidence in private-sector financing mechanisms as more efficient and sustainable instruments for supporting R&D activities and fostering production growth.

### Discussion and Conclusion

This section discusses the findings obtained from the Fuzzy Delphi analysis concerning the prioritization of research financing mechanisms across four major categories of research activities, namely **new product development, expansion of the knowledge frontier, productivity enhancement, and innovation in production processes**.

#### Financing Research for New Product Development

The prioritization results indicate that, according to the expert panel, **private incubators and startup accelerators** constitute the most appropriate financing mechanism for research aimed at generating new ideas and developing innovative products. Government-supported incubators were ranked second, indicating a broad consensus among experts regarding the effectiveness of incubation programs in supporting innovation-driven research.

These findings are consistent with the existing literature on innovation financing, which recognizes business incubators as one of the most effective policy instruments through which governments can support innovation. Rather than merely providing financial resources, incubators create an enabling ecosystem by offering mentoring, technical assistance, networking opportunities, and business development services, thereby substantially increasing the likelihood of successful commercialization. Among market-based financing mechanisms, **venture capital firms** ranked fourth. In contrast, **commercial banks** were not regarded as an appropriate source of finance for research at this stage. The experts agreed that banks are generally unwilling to finance startups during the ideation and product development phases because these ventures are characterized by high technological uncertainty, limited operating history, and insufficient collateral.

#### Financing Research for Expanding the Knowledge Frontier

The prioritization of financing mechanisms for research directed toward expanding the knowledge frontier demonstrates an overwhelming preference for **government-supported funding**. Direct government investment ranked first, followed by government loans, public guarantees, and tax incentives. With the exception of foreign financial assistance, nearly all preferred financing mechanisms were associated with public-sector support.

Interestingly, venture capital financing was considered appropriate only when implemented through **government-owned or government-sponsored venture capital funds** operating under public supervision. The experts believed that privately managed venture capital firms and investment funds would have little incentive to finance this category of research because of its uncertain commercial prospects and limited short-term financial returns.

This finding can be explained by the theory of **market failure** in research and development investment. Fundamental research often generates substantial social benefits that exceed the private returns captured by individual investors. Because knowledge created through research frequently spills over to competitors and society at large, firms cannot fully appropriate the economic benefits of their investments. These knowledge spillovers reduce private incentives to invest in basic research, thereby justifying government intervention to ensure an efficient level of investment in scientific knowledge creation.



### Financing Research for Productivity Enhancement

The financing priorities identified for research aimed at improving productivity differ considerably from those associated with new product development and basic research. This distinction largely reflects the different financing requirements that emerge throughout the startup life cycle.

In the early stages of development, startups face substantial barriers in attracting external investment because of high uncertainty and elevated investment risk. However, productivity-enhancing research is typically undertaken during the expansion and growth phases, when firms have already established production activities, accumulated operational experience, and generated increasing revenues. During this stage, inventories and accounts receivable expand, while firms may or may not have reached sustained profitability.

Research expenditures at this stage are generally directed toward production expansion, marketing activities, working capital, product improvement, and operational efficiency. Consequently, **private venture capital funds** demonstrate a greater willingness to finance such projects. Likewise, **corporate venture capital (CVC)** and government-supported venture capital funds managed by private organizations become increasingly attractive financing mechanisms. These findings closely correspond to the priorities identified by the expert panel through the Fuzzy Delphi analysis.

As firms mature and strengthen their financial positions, access to **bank financing** also becomes considerably easier. Consequently, commercial bank lending emerges as one of the principal financing mechanisms for research intended to improve productivity. In contrast, **angel investors** play a relatively limited role at this stage, as their investments are generally concentrated in earlier phases of startup development.

### Financing Research for Innovation in Production Processes

Research aimed at enhancing innovation in production processes shares many characteristics with productivity-enhancing research, as both are generally conducted during the expansion and maturity stages of a firm's development. At this point, firms have already demonstrated their commercial viability and possess stronger financial performance, making it easier to obtain external financing from venture capital firms, investment funds, and commercial banks.

The findings of the Fuzzy Delphi analysis indicate that **corporate venture capital (CVC)** is considered the most appropriate financing mechanism for research focused on innovation in production processes. Various forms of **private venture capital** ranked second, reflecting the experts' strong preference for market-oriented financing mechanisms during the later stages of technological development.

Unlike conventional venture capital, corporate venture capital is primarily motivated by strategic objectives rather than solely financial returns. Firms operating CVC programs generally regard these investments as complementary to their internal research and development activities, enabling them to gain early access to emerging technologies, innovative business models, and future market opportunities. Consequently, financial returns are often viewed as a secondary objective, distinguishing corporate venture capital from traditional venture capital financing.

Nevertheless, corporate venture capital programs face numerous organizational and governance challenges, many of which depend on the structural arrangements adopted by sponsoring corporations. In response to these challenges, a variety of new investment vehicles and financing instruments have emerged over time, reflecting the technological characteristics, strategic priorities, and financing requirements of different industries. These evolving financing models provide firms with greater flexibility in supporting innovation while enhancing their ability to respond effectively to rapidly changing technological environments.

Overall, the findings suggest that **no single financing mechanism is universally appropriate for all categories of research and innovation activities**. Instead, the optimal financing strategy depends on the nature of the research objective, the stage of the firm's development, the level of technological



uncertainty, and the expected economic returns. Accordingly, policymakers should adopt a differentiated financing framework that aligns financing instruments with the specific characteristics of research activities, thereby improving both the efficiency of resource allocation and the effectiveness of national innovation policies.

