# Research on the Impact of Digital Finance on Enterprise R&D Investment

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**Abstract.** This paper selects the data of listed companies on the small and medium board from 2011 to 2018 as a sample, and uses multiple regression analysis to study the impact of the development of digital finance on the level of corporate R&D investment. The research results show that: the higher the degree of digital finance development, the higher the level of R&D investment of enterprises. The article further analyzes the differences in the degree of influence of the three different dimensions of digital finance on the level of R&D investment of enterprises: Among them, the coverage of digital finance has the most significant positive effect on the level of R&D investment, followed by the depth of usage, and the degree of digitization. Based on the research conclusions, this article puts forward suggestions for enhancing corporate innovation capabilities from three perspectives: actively using new financing methods, accurately grasping the impact of digital finance, and categorizing policies to enhance policy pertinence.

## 1. Introduction

After decades of Reform and Opening up, our country's economic development has entered a high-quality stage. At the same time, the rise of international trade protectionism has caused our country's overseas market share of homogenized products to shrink sharply. A large number of "stuck neck" products have also hindered our country's projects in certain key areas. Therefore, accelerating product innovation and technological innovation and improving core competitiveness are not only the only way for enterprises to seek development in a fierce market environment, but also an important support for enhancing our country's voice on the world economic stage.

However, innovation is an activity that consumes huge resources and is extremely uncertain. Ensuring sufficient and continual R&D investment is the key to determining innovation output. When their own capital supply capacity is insufficient, companies usually resort to external financing to make up for the funding gap. Therefore, the efficiency of financial resource allocation will put an important impact on the level of R&D investment of enterprises.

Digital finance is the product of the combination of advanced modern digital technology and financial activities. It has greatly reduced the threshold of financial activities with the help of cloud computing, big data and other information technologies[4]. In just a few years, digital finance has played an incomparable role in alleviating corporate financing constraints, supporting the development of the real economy, and narrowing the urban-rural income gap. So, what impact does digital finance have on corporate R&D investment? Do different dimensions of digital finance have the same impact on corporate R&D expenditures? This article will study the above issues.

## 2. Empirical Research

### 2.1. Theoretical Analysis and Research Hypothesis

With increasingly fierce market competition, all companies are aware of the importance of increasing R&D investment and cultivating their own competitive advantages. Financing constraints have become one of the biggest stumbling blocks for companies to imply innovation strategies. The development of digital finance has significant positive significance in solving this

problem for enterprises: First of all, digital finance provides every individual with the opportunity to participate in financial activities, which greatly increases the total capital supply in the financial market, and thus reduces the difficulty of obtaining capital for the capital demanders[1].

Secondly, digital finance uses technologies such as big data and cloud computing to greatly reduce the labor and time costs of credit investigation and review[6]. The reliability of the data also allows the fund suppliers to assume lower risks, thereby reducing the required rate of return, so that the fund occupiers can obtain the required resources at a lower capital cos[2].

Finally, digital financial inclusion breaks through the limitations of geographic scope, and companies can seek out scarce resources across regions when financing, thereby increasing the possibility of successful matching of supply and demand[7]. In summary, this article proposes the first hypothesis:

H1: The development of digital finance helps to increase the level of R&D investment of enterprises.

The Digital Finance Research Center of Peking University, based on the massive data of Ant Financial, measured the development level of digital finance from the three aspects of coverage, depth of use, and digitization[3]. The breadth of coverage can reflect the number of people covered by digital finance. The depth of usage reflects the frequency of the use of financial services by individuals or companies in a certain area and the diversity of the types of financial services they receive. The degree of digitization reflects the extensiveness and integration of advanced information technologies such as big data and cloud computing in financial activities[5]. The three different dimensions of digital finance have different economic and practical meanings. It is undeniable that they also have different own characteristics and development characteristics. So their impacts on social economic activities and micro-enterprises' organizational behavior are also different. Based on this, this article proposes the second hypothesis:

H2: The three dimensions of digital finance have different impacts on the R&D investment of enterprises.

## 2.2. Research Design

### 2.2.1. Sample Selection

This paper selects the 2011-2018 data of small and medium board listed companies from the CSMAR database as a sample, and uses EXCEL to screen the samples as follows: (1) Exclude ST, *ST, and PT companies; (2) Exclude listed companies in the financial industry; (3)Eliminate sample points of companies with missing necessary data; (4) Eliminate sample points of companies with zero R&D investment in the current period.   Finally, 4720 unbalanced panel data are obtained.

### 2.2.2. Variable Definitions

Explained variable: With reference to the existing literature, this paper selects the proportion of R&D investment in operating income to measure the level of R&D investment of an enterprise.

Explanatory variables: The Peking University Digital Finance Index reflects the development level of digital finance at the provincial and municipal levels. Therefore, this article matches it with the registration place of the sample companies as a variable to measure the development level of digital finance.

Control variables: With reference to the existing literature, this paper selects the cash flow generated from the business activities of the enterprise (CF), the size of the enterprise (SIZE) and the profitability (PROFIT) as the control variables.

Table 1. Variable definition table.

| Variable type | Variable name | Variable symbol | Calculation method |
|---|---|---|---|
| Explained variable | R&D expenditure ratio | Ri | R&D expenditure/operating income at the end of the period |
| Explanatory variables | Digital finance | Index | Reference[3] |
| | Coverage | Breadth | Reference[3] |

| | Use depth | Depth | Reference[3] |
|---|---|---|---|
| | Degree of digitization | Digitization | Reference[3] |
| Control variables | cash flow | Cf | Cash flow / total assets at the beginning of the period |
| | Enterprise size | Size | Ln(Natural logarithm of total assets) |
| | Profitability | Profit | Ln(Operating income at the end of the period) |

## 2.2.3. Model Design

Based on the previous analysis, this article first builds model (1) based on the index of the development of digital finance as the main explanatory variable, and then uses the three secondary indicators (breadth, depth, and digitization of digital finance) are the main explanatory variables to construct model (2)-model (4).

In the model, i and t represent different companies and years respectively, and $\varepsilon_{i, t}$ represents random disturbance terms.

$$RI_{i,t} = \alpha_0 + \alpha_1 * INDEX_{i,t} + \alpha_2 * CF_{i,t} + \alpha_3 * SIZE_{i,t} + \alpha_4 * PROFIT_{i,t} + \varepsilon_{i,t}$$ (1)

$$RI_{i,t} = \beta_0 + \beta_1 * BREADTH_{i,t} + \beta_2 * CF_{i,t} + \beta_3 * SIZE_{i,t} + \beta_4 * PROFIT_{i,t} + \varepsilon_{i,t}$$ (2)

$$RI_{i,t} = \lambda_0 + \lambda_1 * DEPTH_{i,t} + \lambda_2 * CF_{i,t} + \lambda_3 * SIZE_{i,t} + \lambda_4 * PROFIT_{i,t} + \varepsilon_{i,t}$$ (3)

$$RI_{i,t} = \theta_0 + \theta_1 * DIGITIZATION_{i,t} + \theta_2 * CF_{i,t} + \theta_3 * SIZE_{i,t} + \theta_4 * PROFIT_{i,t} + \varepsilon_{i,t}$$ (4)

## 2.3. Empirical Results and Analysis

This paper uses the fixed utility model to perform regression, and the regression results are shown in the following table:

Table 2. Model regression results.

| | Model(1) ri | Model(2) ri | Model(3) ri | Model(4) ri |
|---|---|---|---|---|
| index | 0. 081[**] | | | |
| cf | 8. 569[***] | 8. 569[***] | 8. 575[***] | 8. 561[***] |
| size | 5. 698[***] | 5. 698[***] | 5. 700[***] | 5. 696[***] |
| profit | -6. 433[***] | -6. 433[***] | -6. 436[***] | -6. 430[***] |
| breadth | | 0. 075[***] | | |
| depth | | | 0. 068[**] | |
| digitization | | | | 0. 057[***] |
| _cons | 16. 62[***] | 16. 62[***] | 16. 63[***] | 16. 61[***] |
| N | 4720 | 4720 | 4720 | 4720 |
| $R^2$ | 0. 429 | 0. 429 | 0. 429 | 0. 429 |

Model 1 shows that the coefficient (0. 081) between digital finance and corporate R&D investment is positive and significant at the 5% level. This means that the higher the level of digital finance development, the higher the proportion of corporate R&D investment. The regression result is consistent with the hypothesis 1 proposed in this paper. Model 2-Model 4's regression coefficients are all positive, and are significant at the 1% and 5% levels, but they are not equal. This shows that the three dimensions of digital finance all help companies increase R&D investment, but the degree of impact of the three on companies is different. Among them, the breadth of coverage has the greatest effect on enterprises to increase the level of R&D investment; the degree of digitalization has the least effect on promoting enterprises to increase the level of R&D investment; the depth of use lies between the two. Therefore, Hypothesis 2 is verified.

## 3. Conclusions and Suggestions

### 3.1. Conclusions

This paper uses listed companies on small and medium-sized boards as a sample, and uses multiple regression methods to study the impact of digital finance development on corporate R&D investment. The research results show that there is a positive correlation between digital finance and corporate R&D expenditure, that is, the development of digital finance can significantly increase the level of corporate R&D investment. This article further analyzes the differences in the impact of different dimensions of digital finance on corporate R&D investment: The expansion of the coverage of digital finance has the most significant impact on the increase of enterprise R&D investment, followed by the depth of use, and the degree of digitalization has the smallest impact on R&D investment among the three.

### 3.2. Suggestions

First, enterprises should grasp the opportunities brought by the combination of technological advancement and financial policies to enhance their financing capabilities. This can increase the level of continuous R&D investment, thereby fostering its own core competitive advantages and further promoting the overall innovation capability of the society.

Second, relevant government departments should improve supporting measures to create a good financial environment for the improvement of enterprise innovation capabilities, and then form a good new trend of innovation in the whole society to ensure the smooth implementation of the innovation-driven strategy.

Finally, the breadth of coverage, depth of use, and digitization of digital finance have a decreasing degree of positive influence on corporate R&D investment. Therefore, relevant government departments should implement policies in different categories to enhance the pertinence and effectiveness of policy support.

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