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# Financial Innovation, Technological Innovation and Economic Growth
## ——Empirical Research from 31 Provinces and Cities in China

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**ABSTRACT**

By selecting 31 provinces and cities in China as samples, we constructed a panel data model from 2011 to 2019, and empirically analysed the impact of financial innovation and technological innovation on economic growth through regression analysis of fixed effects models. The results show that financial innovation and technological innovation have a positive role in promoting economic growth, and the interaction of financial innovation and technological innovation has a greater contribution to economic growth. Making full use of foreign businessmen and maintaining the increase in natural population growth is also conducive to economic growth.

*Keywords:* *Financial innovation, Technological innovation, Economic growth*

## 1. INTRODUCTION

At present, China's economy has shifted from rapid growth to a stage of high-quality development and has entered a period of new normal. The driving force of China's economic growth has changed from the factor-driven and investment-driven in the past to the innovation-driven. In the context of the new era, how to achieve high-quality economic growth has become a focus of attention from all sectors of society. Existing studies generally believe that financial innovation and technological innovation can promote economic development, and the high-quality development of China's economy in the future needs the support of financial innovation and technological innovation. Financial innovation is the engine of economic growth[1], which provides liquidity for the pillar industries of the real economy and effectively expands the allocation of resources[2]. The development of the real economy needs to rely on scientific and technological innovation, and scientific and technological innovation is inseparable from financial support. Only carrying out financial innovation and improving the quality of financial service products can ensure the better development of science and technology[3]. It can be seen that financial innovation and technological innovation play a key role in economic development. Therefore, exploring how financial innovation and technological innovation affect the quality of economic growth in the context of the new era has important practical significance for promoting the high-quality development of China's economy.

## 2. LITERATURE REVIEW

There are rich discussions on the relationship between financial innovation and economic growth. In the process of high-quality development of the modern economy, the role of financial innovation in driving high-quality development is not direct. Some scholars still notice that there is a strong causal relationship between the two. There is a long-term equilibrium relationship between financial innovation and the high-quality development of the regional economy[4], financial innovation plays a significant role in the high-quality development of regional economy[5]. The real economy is at different levels, and the impact of financial innovation on the quality of economic growth is also different. When the matching degree between finance and the real economy is high, financial innovation will achieve higher economic quality by improving the innovation ability of enterprises[6]. Financial innovation in developed economies has a two-sided impact on emerging market economies. If emerging market economies are non-leveraged and financially advanced economies are leveraged, financial

integration can raise asset prices and output in emerging market economies[7]. For China's regional economic development, both financial agglomeration and financial innovation can significantly promote regional economic growth, and the synergy of the two is more conducive to regional economic development than their individual effects[8]. In addition, financial technology innovation has a significant role in promoting the growth of the regional real economy. It is manifested in that financial technology innovation promotes the growth of the regional real economy by encouraging technological innovation of enterprises and narrowing the income gap between urban and rural areas[9]. Financial innovation in the financial system, such as emergence of mobile banking, specialized financing options to promote entrepreneurship, internet banking, agent banking, stimulates financial development process through capital maker development with a view to support capital adequacy to investors, establishment of nonbank financial institutions to support institutional credit for investment. Financial innovation such as mobile banking, specialized financing options to promote entrepreneurship, internet banking and agent banking, stimulates financial development process through capital maker development with a view to support capital adequacy to investors, establishment of nonbank financial institutions to support institutional credit for investment. The government's encouragement of financial innovation in the capital market will also help raise long-term investment funds and accelerate overall economic growth[10]. Traditional financial innovation promotes economic growth by reducing transaction costs, promoting technological progress, improving innovation efficiency, and realizing resource allocation[11]. Evidence from China, India, and Pakistan also shows that financial innovation generally has a positive and statistically significant impact on economic growth in the short and long term[12]. Judging from the existing literature, financial innovation can theoretically promote economic growth to a certain extent under certain conditions. At present, there are relatively few studies on financial innovation, technological innovation, and economic development. Therefore,

based on existing research, this paper selects data from 31 provinces and cities in China from 2011 to 2017 to conduct empirical research to analyse whether financial innovation and technological innovation can promote China's economic growth.

# 3. RESEARCH DESIGN

## 3.1. Index Selection

Taking into account the completeness and availability of the data, this paper selects the data of 31 provinces and cities in China from 2011 to 2019 as the analysis sample by establishing a panel data model and using the STATA 16.0 software for regression analysis. Before that, firstly explain the selection of indicators in the data, as shown in Table 1. Per capita gross regional product (PGDP) reflects the output of all production activities in a certain period and can measure the level of economic development in the region. The index of financial innovation ability can be measured by the loan balance of financial institutions (FLB). The balance of various deposits and loans of financial institutions refers to the number of deposits and loans of financial institutions at a certain point in time. Among them, financial institutions mainly include commercial banks and policy banks, non-bank credit institutions and insurance companies. Academia generally believes that the FLB is a comprehensive manifestation of financial innovation, which reflects the capital role of financial innovation in economic development. Therefore, we select the FLB as a measure of financial innovation. The technological innovation capacity of the region is measured by R&D expenditure and patent application volume, which respectively represent the technological innovation input and technological innovation output of the region. Foreign direct investment (FDI) reflects the supply of capital from abroad, while the natural population growth rate (NGR) reflects the population structure, representing the capital and labor factors that affect economic growth, so they are selected as control variables at the same time.

**Table 1.** Description of index selection

| Variables | Variable declaration | Observation |
|---|---|---|
| PGDP | Per capital gross regional product | Per capital gross regional product/yuan |
| FLB | Balance of various loans of financial institutions | Balance of loans of financial institutions at the end of the year / 100 million yuan |
| RDE | R&D expenditure | R&D expenditure of industrial enterprises above designated size/ten thousand yuan |
| NPA | Patent application | Number of valid invention patents of industrial enterprises above designated size /pieces |

| FDI | Foreign direct investment | Total investment of foreign-invested enterprises/million US dollars |
|---|---|---|
| NGR | Natural population growth rate | Natural population growth rate/% |

Note: The original data comes from the National Bureau of Statistics of China http://www.stats.gov.cn/

### 3.2. Model Construction

Based on theoretical analysis and variable index selection, we constructed econometric model (1) - (5).

$$LnGDPP_{it} = \beta_0 + \beta_1 LnFLB_{it} + \alpha X_{it} + \mu_i + \mu_t + \varepsilon_{it} \tag{1}$$

$$LnGDPP_{it} = \beta_0 + \beta_1 LnFLB_{it} + \beta_2 LnRED_{it} + \alpha X_{it} + \mu_i + \mu_t + \varepsilon_{it} \tag{2}$$

$$LnGDPP_{it} = \beta_0 + \beta_1 LnFLB_{it} + \beta_2 LnRED_{it} + \beta_3 LnFLB_{it} \times LnRED_{it} + \alpha X_{it} + \mu_i + \mu_t + \varepsilon_{it} \tag{3}$$

$$LnGDPP_{it} = \beta_0 + \beta_1 LnFLB_{it} + \beta_2 LnNPA_{it} + \alpha X_{it} + \mu_i + \mu_t + \varepsilon_{it} \tag{4}$$

$$LnGDPP_{it} = \beta_0 + \beta_1 LnFLB_{it} + \beta_2 LnNPA_{it} + \beta_3 LnFLB_{it} \times LnNPA_{it} + \alpha X_{it} + \mu_i + \mu_t + \varepsilon_{it} \tag{5}$$

In the above model, i represents each province and city in China, t represents the year, X represents the control variable, the individual fixed effect is $\mu_i$, the time fixed effect is $\mu_t$, and the random interference term is $\varepsilon_{it}$ . In order to eliminate the influence of the measurement unit on the variables and reduce the heteroscedasticity of the variables, we have carried out logarithmic processing on the data. Model (1) examines the impact of financial innovation on economic growth, and model (2) examines the impact of financial innovation and technological innovation on economic growth at the same time. Models (3) and (5) introduce the intersection of financial innovation and technological innovation to test their impact on economic growth.

## 4. EMPIRICAL ANALYSIS

### 4.1. Descriptive Statistics

We collected data from 31 provinces and cities of China from the National Bureau of Statistics of China from 2011 to 2019, and used the STATA 16.0 software to perform regression analysis on the data. Before the regression analysis, we did a descriptive statistical analysis of the variables, as shown in Table 2. We have noticed that the minimum value of NGR is less than zero. This is because the death rate of individual provinces and cities in a certain year is greater than the birth rate, and the natural population growth rate of that province and city is negative in that year, so we cannot calculate the logarithm of NGR. We also did a unit root test for panel data, and the results showed that all the data passed the unit root test, and they were all stable data.

**Table 2.** Descriptive statistics results

| Variable | Mean | Std. Dev. | Minimum | Maximum | Variable | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|---|
| PGDP | 54017.94 | 26223.38 | 16413 | 164222 | LnPGDP | 10.80 | 0.44 | 9.71 | 12.01 |
| FLB | 31234.71 | 26999.01 | 409.05 | 167994.60 | LnFLB | 9.98 | 0.94 | 6.01 | 12.03 |
| RDE | 3249627 | 4315085 | 1637 | 2.31E+07 | LnRDE | 14.09 | 1.70 | 7.40 | 16.96 |
| NPA | 20976.51 | 44200.86 | 32 | 375515 | LnNPA | 8.75 | 1.72 | 3.47 | 12.84 |
| FDI | 166293.60 | 274405.50 | 726 | 1953252 | LnFDI | 11.06 | 1.50 | 6.59 | 14.49 |
| NGR | 5.29 | 2.848031 | −1.01 | 11.47 | —— | —— | —— | —— | —— |

### 4.2. Panel Data Model Selection

Since the situation of each province and city is different, there may be missing variables that do not change over time, so it is more reasonable to use a fixed effects model. At the same time, before performing regression analysis on panel data, random effects or fixed effects need to be selected according to the results of Hausmann's test. The results of Hausmann's test show that p-values are all 0.0000, so fixed-effect models should be selected for models (1)-(5).

### 4.3. Analysis of Regression Results

Table 3 shows the regression results of the panel data fixed-effects model. Among them, the coefficient of LnFLB in the model (1) is 0.3940, which is significant at the 1% confidence level, indicating that financial innovation has a positive effect on economic growth. In model (2), the coefficient of LnFLB is 0.2536 and the coefficient of LnRED is 0.2607, both of which are significant at the 1% confidence level, and the coefficient values are relatively close, which means that financial innovation and technological innovation are equally important to promote economic growth. The

coefficient of technological innovation output LnNPA in the model (4) is 0.0754. Although it has a significant positive effect on economic growth, this effect is significantly smaller than the technological innovation input LnRED in the model (2). Model (3) and Model (5) have added the interactive terms of financial innovation and technological innovation. The results show that the coefficients of LnFLB are both positive and significant at the 1% confidence level. The coefficient of LnFLB*LnRED is 2.024, which is larger than the coefficient of LnFLB*LnNPA of 1.079. Both coefficients are highly significant, indicating that the interaction between financial innovation and technological innovation has a positive effect on economic growth. The role of the interaction item between financial innovation and technological innovation input is greater than the role of the interaction item between financial innovation and technological innovation output. At the same time, the

coefficients of LnFLB in the model (3) and the model (5) are larger than those in model (1), (2), and (4), indicating that the interaction of financial innovation and technological innovation contributes more to economic growth than financial innovation alone.

The coefficients of the control variable LnFDI in the models (1)-(5) are all positive and highly significant, which indicates that the increase in the degree of openness of each province's counterparty will facilitate the introduction of foreign direct investment, expanding the scope of capital flows and promoting the economic growth. In addition, the coefficient of NGR in model (2) (3) is positive. In addition, the coefficients of NGR in model (2) (3) are positive. Although they fail the significance test, the coefficients of NGR have a high level of significance in model (1) (4) (5), indicating the natural population growth rate still has a positive effect on economic growth to a certain extent.

**Table 3.** Fixed effect regression results of panel data

| Variable | Model (1) | Model (2) | Model (3) | Model (4) | Model (5) |
|---|---|---|---|---|---|
| LnFLB | 0.3940***<br>（0.0279） | 0.2536***<br>（0.0254） | 0.5105***<br>(0.0627) | 0.3034***<br>(0.0351) | 0.4766***<br>(0.0517) |
| LnRED | | 0.2607***<br>(0.0224) | 0.3907***<br>(0.0362) | | |
| LnFLB*LnRED | | | 2.024***<br>(0.4546) | | |
| LnNPA | | | | 0.0754***<br>(0.1858) | 0.1841***<br>(0.0304) |
| LnFLB*LnNPA | | | | | 1.079***<br>(0.0244) |
| LnFDI | 0.1019***<br>(0.0227) | 0.0722***<br>（0.0183） | 0.0479**<br>(0.0185) | 0.0723***<br>(0.0232) | 0.0051**<br>(0.0027) |
| NGR | 0.0149**<br>(0.0059) | 0.0047<br>（0.0049） | 0.0036<br>(0.0047) | 0.0135*<br>(0.0058) | 0.1029*<br>(0.0056) |
| C | 5.6569***<br>(0.1470) | 3.7681***<br>（0.1995） | 9.6344***<br>(1.3315) | 6.2371***<br>(0.2018) | 8.5592***<br>(0.5591) |
| $R^2$ | 0.8449 | 0.9008 | 0.9083 | 0.8547 | 0.8656 |
| F-value | 102.06 | 148.05 | 155.89 | 105.45 | 102.43 |

Note: ***, **, * are significant at the confidence levels of 1%, 5%, and 10%, respectively, and the corresponding standard errors are in parentheses.

## 5. CONCLUSION

The panel data of 31 provinces and cities in China from 2011 to 2019 are selected for empirical analysis, and the fixed effects model of the Stata software is used to test the effect of financial innovation on economic

growth. The results show that, regardless of the interaction between financial innovation and technological innovation, both financial innovation and technological innovation have a positive role in promoting economic growth, and the role of technological innovation input in promoting economic

growth is greater than that of technological innovation output. Taking into account the interaction of financial innovation and technological innovation, financial innovation has a more significant effect on economic growth. The interaction of financial innovation and technological innovation has played a greater role in promoting economic growth. The increase in the level of capital market opening is conducive to foreign direct investment entering the Chinese market. At the same time, the increase in the natural population growth rate is conducive to the improvement of China's labor structure. Ultimately, these factors will work with the financial technology innovation to promote China's economic growth.

## ACKNOWLEDGMENTS

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