


Article

Analysis of the Relationships between Financial Development and Sustainable Economic Growth: Evidence from Chinese Cities

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Abstract: At the stage of high-quality economic development, sustainable economic growth is worthy of attention. The supporting role of financial development for sustainable economic growth will become more important. This article aims to identify the influence of financial development on sustainable economic growth and its impact mechanism. Based on measuring the level of sustainable economic growth, this article theoretically and empirically identifies the impact of financial development on sustainable economic growth and its mechanism by adopting the panel data from 283 prefecture-level and above cities in China. The empirical results show that financial development is conducive to improving sustainable economic growth through the mechanism of capital deepening and technological innovation. Furthermore, for type I large and medium cities, financial development is conducive to enhancing sustainable economic growth, while the effect is not significant for type II large and small cities. Therefore, the local government could promote financial supply-side reform and implement differentiated financial development strategies for sustainable economic growth from aspects of capital deepening and technological innovation.

Keywords: financial development; sustainable economic growth; capital deepening; technological innovation



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1. Introduction

With China's economy entering the new normal, the pattern of economic growth has transitioned from extensive growth focusing on scale and speed to intensive growth based on quality and efficiency, and from factor-driven to innovation-driven [1]. In 2017, the 19th National Congress of the Communist Party of China proposed that the economy in China is a transition from a stage of rapid growth to that of high-quality growth. At the same time, the sustainable development strategy has also received more attention as the economy grows. Achieving sustainable economic growth is the direction and central issue of China's economic development both now and in the future. The urban area contains about 40% of the total population, and its gross domestic product accounts for almost 75% of that in China [2]. Promoting sustainable economic growth is self-evident for realizing high-quality growth in China.

With the gradual deepening of financial system reforms and financial supply-side structural reforms, the bank-led financial system is evolving into a market-led financial system. Financial development enables the financial sector to serve the development of the real economy with higher quality and more efficiency and becomes a driving force for high-quality development. Financial development theory believes that a sound financial system can effectively mobilize savings funds and direct them to productive investment. It is also conducive to deepening capital and promoting restructuring and technological

progress in urban industry, thereby achieving economic growth. This manuscript aims to verify the influence of financial development on sustainable economic growth and its impact mechanism and provide practical policy recommendations for further financial reform and promoting sustainable economic growth.

Scholars have carried out extensive research on the economic effects of financial development. Firstly, some studies pointed out the positive economic effect of financial development. From the national perspective, Gurley and Shaw (1955), Goldsmith (1969), and Shaw (1973) opened up the research theme of financial development and deepening, emphasizing the enhancement of financial development on economic growth [3–5]. Subsequently, studies have also found that the development of banks and the stock market had a strong impact on economic growth [6–8]. Greenwood and Jovanovic (1990) proposed that the financial system played an important role in resource allocation and economic development [9]. From the regional perspective, scholars have used provincial data to verify the impact of financial development on economic growth and found that promoting financial development was conducive to economic growth in the long term [10,11]. Fang et al. (2010) found that the spatial spillover effects of provincial financial support for economic growth were pronounced [12]. Lv (2018) developed an endogenous growth model to examine the economic effect of financial development from a perspective of incomplete contracts and revealed the long-term economic effect of financial development [13].

Secondly, some scholars' studies pointed out the negative economic effect of financial development. Shen and Lee (2006) employed cross-country panel data to conduct empirical analysis and found that the higher the corruption rate of a country or the worse the inflation, the greater the negative economic effect of the country's financial development [14]. Moreover, some studies have also found that financial development was non-linearly related to economic growth, such as at different economic development levels [15], economic development stages [16,17], and financial development levels [18], the economic influence of financial development is significantly different or even opposite.

Thirdly, literature explored the impact mechanism of financial development on economic growth, such as the efficiency of capital allocation, alleviation of financing constraints, risk-taking reduction, technological innovation, and capital accumulation. Bagehot (1873) related the efficiency of capital allocation with the degree of financial development and argued that the financial sector acts as an essential part to the industrialization process in the UK [19]. Levine (1999) proposed that financial development could reduce transaction costs [20], expand market transactions (Levine, 2005) [21], ease financing constraints in corporate innovation, and improve accurate evaluation of the value of new products (Schumpeter, 2013) [22]. In addition, it could also promote technological innovation and diffusion [23,24] and diminish the economic risks faced by enterprises [20], thereby enhancing social product development and economic growth. Benhabib and Spiegel (2000) disclosed the economic effect of financial development by the total factor productivity and investment [25]. In the stage of low-level development, financial development could increase physical capital accumulation by promoting the conversion of savings to investment, and it enables to increase in the investment of human capital to provide the necessary capital accumulation for economic growth [26]. Zhao and Lei (2010) analyzed the determinants of economic growth patterns and the economic influence of financial development [27]. Their results showed that financial development could push the intensive transformation of economic growth by lowering the threshold value of the transformation of growth pattern.

The existing literature research on the economic effect of financial development from national or regional level. Among them, most scholars pointed out that financial development has a positive impact on economic growth. Some studies have also tried to identify the effective mechanism of financial development affecting economic growth. Several impact mechanisms have been considered in the literature, including the efficiency of capital allocation, alleviation of financing constraints, risk-taking reduction, technological innovation, and capital accumulation. However, there are few studies concerning the relationship between financial development and sustainable economic growth. Only a few studies inves-

investigated the impact of financial development on high-quality economic growth [28,29]. This article fills the gap by investigating the influence of financial development on sustainable economic growth and its impact mechanism.

At the stage of high-quality economic development, it is of great significance to identify the influence of financial development on sustainable economic growth and its impact mechanism. Based on the theory of financial development and endogenous growth, this manuscript investigates the impact of financial development on sustainable economic growth through capital deepening and technological innovation. In accordance with measuring the level of sustainable economic growth, the effect of financial development on sustainable economic growth and its mechanism is investigated by employing panel data from 283 prefecture-level and above cities in China during 2003–2016. We find that financial development promotes the improvement of sustainable economic growth. Furthermore, this impact varies significantly among different city scales. For type I large and medium-sized cities, financial development is beneficial to improving sustainable economic growth, but the effect is not significant for type II large and small cities. In different positions of the conditional distribution, financial development has a stable positive impact on sustainable economic growth.

The manuscript makes three contributions to the literature. Firstly, unlike the previous studies focusing on the national or regional level, we employ prefecture-level panel data in China to verify the effect of financial development on sustainable economic growth. This is conducive to a more detailed disclosure of the economic impact of financial development. Secondly, a robust fixed-effect model is adopted to evaluate the influence of financial development on sustainable economic growth in this study. A variety of robustness tests and instrumental variables regression to alleviate endogenous problems make the conclusions of this article more reliable. Finally, we explore the mechanism of financial development on sustainable economic growth through the two channels of accelerating capital deepening and enhancing urban technological innovation capability from the theoretical and empirical aspects.

The rest of our article is arranged as follows: Section 2 analyzes the theoretical framework and hypotheses; Section 3 constructs the econometric model and introduces data; Section 4 demonstrates the empirical result, including baseline results, robustness check, heterogeneity analysis, and the effective mechanisms analysis; Section 5 discusses the empirical results and provides policy implications. The Section 6 draws conclusions and limitations.

2. Theoretical Framework and Hypotheses

The financial market is crucial for household savings, corporate investment, and financing decisions. The incompleteness of the financial market will lead to an insufficient supply of savings instruments in the market and impede channels of external financing. The inefficiency of the capital market prevents productive capital from being efficiently accumulated, thus hindering economic development. Some scholars have suggested that banks can change the path of economic growth by influencing capital allocation and interest rate adjustments [30]. From the term of capital formation mechanism, the flowing of financial factors plays a vital role in achieving efficient investment. Thus, financial development will ultimately affect economic growth through capital accumulation and capital deepening [31]. Capital deepening is an inevitable trend and stage in economic development [32]. The deepening of financial capital requires companies to reduce the input cost of human resources, which makes companies hope to introduce high-quality talents at the lowest cost, change the traditional production model, and increase labor productivity. In addition, it ultimately promotes sustainable economic growth [33]. Therefore, we propose:

H 1: *Financial development may promote sustainable economic growth by affecting the capital deepening process.*

Financial development is conducive to improving the allocation efficiency of innovation funds, reducing financing costs [34], and the risk of using innovation funds, thereby promoting technological innovation [35]. The financial market development can alleviate

the information asymmetry problem of R&D investment, significantly promoting investment effectiveness [36]. Moreover, various financing methods of financial markets are positively related to the R&D intensity [37], which enables an increase in the technological innovation capabilities of firms and cities. The neoclassical growth theory holds (Solow, 1957) that technological progress is the enforcement of sustainable economic growth due to diminishing returns on capital in the long run [38]. The subsequent development of the endogenous growth model further confirmed this view [39] and proposed that the conscious innovation activities of enterprises accelerate technological progress. Innovation activities are the core channel for social capital to promote economic growth (Akcomak and Weel, 2009) [40], and ultimately determine economic growth (Bravoortega and Marin, 2009) [41].

The endogenous growth theory proposes that technological progress is irreplaceable for economic development [42]. Endogenous technological progress has made a significant contribution to economic growth, and technological innovation promotes the transformation of economic growth patterns. Some scholars have also proposed that technological progress is a vital source of economic growth due to the various new products and services it produces. It is also a driving factor of long-term economic growth [43]. Levine (1999) proposed that financial development can reduce transaction costs [20], expand market transactions, ease financing constraints in corporate innovation (Levine, 2005) [21], and improve accurate evaluation of the value of new products (Schumpeter, 2013) [22], thereby enhancing social production development and economic growth. Technological innovation drives economic development and improves the quality of economic development. Thus, we propose:

H 2: *Financial development is beneficial to optimizing the allocation efficiency of innovation funds, enhancing the technological innovation capabilities of enterprises and cities, and further promoting sustainable economic growth.*

Too fast or too slow financial development could not promote economic growth. There is a roughly balanced and restrictive relationship between financial development and economic growth. Different degrees of financial development will provide various internal motivations for sustainable economic growth. China is a country with many cities, with apparent differences in factor endowments, comparative advantages, technological innovation capabilities, and resource allocation efficiency among cities. Therefore, the influence of financial development on sustainable economic growth may differ in city scales [15], as well as in more complete legal systems, high-tech talents, and more mature capital markets in economically developed regions. As a result, financial development may promote sustainable economic growth in such areas by enhancing innovation capability and capital deepening. Conversely, financial development may not affect sustainable economic growth in economically underdeveloped regions. Therefore, we propose:

H 3: *Financial development has a different impact on sustainable economic growth in various economic development levels and city scales.*

3. Model Specification and Data

3.1. Model Specification

To explore the impact of financial development on the sustainable economic growth, specifically, our specification is as follows:

$$\ln y_{it} = \beta_1 \ln finance_{it} + \beta_2 \ln pdensity_{it} + \beta_3 \ln road_{it} + \beta_4 \ln industry_{it} + \beta_5 \ln internet_{it} + \beta_6 \ln green_land_{it} + \beta_7 \ln rd_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where i indicates city, t represents year; y is the sustainable economic growth; and $finance$ is the level of financial development; we also add some controls variables, including population density ($pdensity$), transportation infrastructure ($road$), industry structure ($industry$), popularization of the Internet ($internet$), urban green level ($green_land$), and R&D investment

(rd); μ_i is the city fixed effects; ε_{it} is the error term. To alleviate possible heteroscedasticity and autocorrelation, standard errors are clustered at the city level with the reference of Bertrand et al. (2004) [44].

The estimated coefficient β_1 captures the influence of financial development on sustainable economic growth. We expect β_1 to be significantly positive. That is, the development of urban finance is conducive to improving sustainable economic growth. To examine the soundness of the specification, a series of robustness tests are conducted, including alternative measurement of urban financial development, the exclusion of the sample of municipalities, alternative estimation methods, estimation of the different periods, etc.

3.2. Data

Data for empirical analysis are derived from China City Statistical Yearbook, the China Statistical Yearbook. Due to the lack of data accessibility, this study populates the data for 283 prefecture-level and above cities in China from 2003 to 2016. All monetary value data are based on the year 2000.

The outcome variable of this study is sustainable economic growth (y). This study draws on the research of Mlachila et al. (2017) [45] and Shi and Zhang (2019) [46] to construct an indicator system for sustainable economic growth. Specifically, we consider the three dimensions of development fundamentals: social and ecological achievements. In addition, due to the incommensurability between the various indicators, the indicators are treated as dimensionless in this article. The selection of weight refers to the research of Shi and Zhang (2019) [46]. The specific indicators are presented in Table 1.

Table 1. The indicator system for sustainable economic growth.

Classification Indicators	Secondary Indicators	Basic Indicators	Unit
Development fundamentals	Intensity	Real GDP per capita	10,000 yuan
	Stability	The reciprocal of variation coefficient of urban economic growth rate	-
	Rationalization	The difference between the standard value 1 and the Theil index of urban three industries	-
	Extraversion	The proportion of foreign direct investment in GDP	%
Social achievements	Education	Number of college students per 10,000 people	person/10,000 persons
	Medical treatment	Number of doctors per 10,000 people	person/10,000 persons
Ecological achievements	Air pollution	Output per unit of sulfur dioxide emissions	10,000 yuan/ton
	Water pollution	Output per unit of industrial wastewater discharge	yuan/ton
	Solid pollution	Output per unit of industrial smoke and dust emission	10,000 yuan/ton

The core explanatory variable of this study is urban financial development (*finance*). Based on the analysis of Aghion and Howitt (2008) [47] and Yang (2014) [18], we use the proportion of the loans of the national banking system at year-end to the GDP. In the robustness test, we further adopt the loans per capita of the national banking system at year-end (*perfinance*) as a proxy variable for urban financial development.

In this study, we mainly consider six control variables. Firstly, we use the population per unit area of the city to characterize urban population density (*pdensity*). Secondly, transportation infrastructure is vital for economic development [48–50]. Transportation infrastructure (*road*) is represented by per capita area of paved roads in city. Thirdly, industrial structure (*industry*) is measured by the secondary industry's share of GDP. Fourthly, the popularization of Internet is measured by the number to subscribers of the Internet services. Fifthly, the urban green level (*green_land*) is expressed by green land per capita area. Sixthly, we use expenditure for science and technology per capita to measure urban R&D investment (*rd*). Table 2 is the descriptive statistics.

Table 2. Descriptive statistics of sample variables.

Variables	Symbol	Observation	Mean	S.D.	Min.	Max.
Sustainable economic growth	<i>y</i>	3962	0.138	0.055	0.028	0.424
Financial development	<i>finance</i>	3962	0.815	0.501	0.075	7.450
Population density	<i>pdensity</i>	3962	425.387	325.190	4.7	2661.54
Transportation infrastructure	<i>road</i>	3962	10.435	7.633	0.31	108.37
Industry structure	<i>industry</i>	3962	48.739	11.018	9	90.97
Popularization of Internet	<i>internet</i>	3962	54.444	125.158	0	5174
Urban green level	<i>green_land</i>	3962	38.976	53.451	0.57	1179.22
R&D investment	<i>rd</i>	3962	67.419	221.605	0	7481.006
Loans per capita	<i>perfinance</i>	3962	25,040.17	42,134.17	1177.785	673,951.8

4. Empirical Results

4.1. Baseline Results

Due to unobservable city fixed effects, this manuscript uses a fixed-effect model to estimate the result of Equation (1). Meanwhile, for the robustness of the estimation results, we adopt the stepwise regression method and sequentially add variables such as population density, transportation infrastructure, industry structure, popularization of the Internet, urban green level, and R&D investment. The results are shown in Table 3.

Table 3. Baseline results.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>lnfinance</i>	0.154 *** (0.020)	0.130 *** (0.019)	0.094 *** (0.016)	0.101 *** (0.017)	0.038 *** (0.013)	0.038 *** (0.013)	0.038 *** (0.013)
<i>lnpdensity</i>		0.790 *** (0.200)	0.576 *** (0.161)	0.569 *** (0.161)	0.271 ** (0.126)	0.263 ** (0.124)	0.167 (0.104)
<i>lnroad</i>			0.145 *** (0.014)	0.142 *** (0.015)	0.058 *** (0.011)	0.049 *** (0.010)	0.032 *** (0.010)
<i>lnindustry</i>				0.046 (0.036)	−0.035 (0.030)	−0.037 (0.030)	−0.067 ** (0.029)
<i>lninternet</i>					0.086 *** (0.006)	0.082 *** (0.006)	0.047 *** (0.005)
<i>lngreen_land</i>						0.021 ** (0.008)	0.011 (0.007)
<i>lnrd</i>							0.029 *** (0.003)
Constant	−1.993 *** (0.007)	−6.528 *** (1.150)	−5.623 *** (0.906)	−5.754 *** (0.917)	−3.856 *** (0.724)	−3.846 *** (0.705)	−3.070 *** (0.609)
City FE	YES	YES	YES	YES	YES	YES	YES
Observations	3962	3962	3962	3962	3962	3962	3962
Adjust R ²	0.076	0.192	0.349	0.350	0.488	0.491	0.532

Note: *** and ** represent the significance level at 1% and 5%, respectively. The standard errors are reported in parentheses and clustered at city level.

Financial development is significantly positive, indicating that financial development is beneficial to sustainable economic growth. Specifically, for every 1% increase in financial development, sustainable economic growth increases by 0.038%. Transportation infrastructure (*road*) is significantly positive, illustrating that the construction of urban transportation infrastructure contributes to achieving sustainable economic growth. The effect of the industry structure (*industry*) on the sustainable economic growth is significantly negative. A possible explanation is that many cities prefer to develop secondary industries with high pollution and high energy consumption, increasing urban energy consumption and pollution levels. This is not conducive to achieving sustainable economic growth. The popularization of the Internet (*Internet*) is significantly positively related to sustainable economic growth, indicating that the popularization of the Internet can improve the level of urban informatization and help the city achieve high-quality development. The increase

in R&D investment (*rd*) will increase sustainable economic growth. This demonstrates that governments should pay more attention to science and technology investment and give full play to the role of science and technology research in sustainable economic growth. At the same time, the impact of population density (*pdensity*) and urban green level (*green_land*) on sustainable economic growth is not significant.

4.2. Robustness Tests

For the sake of the robustness of the benchmark results, a series of robustness tests are conducted.

4.2.1. An Alternative Measurement of Financial Development

In previous studies, there was controversy about the characterization of urban financial development. We further use loans per capita as a proxy variable for urban financial development. The results are shown in Table 4, column (1). The coefficient of financial development is still significantly positive, suggesting that our estimates have not been affected by the measurement of urban financial development.

Table 4. Robustness tests.

Variables	(1)	(2)	(3)	(4)	(5)
<i>lnperfinance</i>	0.108 *** (0.011)				
<i>lnfinance</i>		0.040 *** (0.013)	0.025 *** (0.005)	0.005 (0.013)	0.081 *** (0.020)
<i>lnpdensity</i>	0.141 (0.091)	0.159 (0.104)	0.137 *** (0.021)	0.088 (0.148)	−0.060 (0.145)
<i>lnroad</i>	0.015 * (0.008)	0.032 *** (0.010)	0.040 *** (0.004)	0.038 *** (0.012)	0.003 (0.010)
<i>lnindustry</i>	−0.027 (0.026)	−0.060 ** (0.029)	−0.049 *** (0.011)	−0.014 (0.042)	−0.036 (0.048)
<i>lninternet</i>	0.010 * (0.006)	0.049 *** (0.005)	0.051 *** (0.002)	0.032 *** (0.005)	0.038 *** (0.012)
<i>lngreen_land</i>	0.004 (0.007)	0.010 (0.008)	0.006 ** (0.003)	0.001 (0.008)	0.008 (0.009)
<i>lnrd</i>	0.018 *** (0.003)	0.029 *** (0.003)	0.022 *** (0.001)	0.028 *** (0.003)	0.027 *** (0.009)
Constant	−3.898 *** (0.519)	−3.054 *** (0.603)	−2.656 *** (0.143)	−2.785 *** (0.859)	−1.743 ** (0.835)
City FE	YES	YES	YES	YES	YES
Observations	3962	3906	3962	2547	1415
Adjust R ²	0.574	0.530		0.360	0.172

Note: ***, **, and * represent the significance level at 1%, 5%, and 10%, respectively. The standard errors are reported in parentheses and clustered at city level.

4.2.2. Excluding the Sample of Municipalities

There are significant differences in the administrative levels of Chinese cities, and our sample includes four super-large municipalities in China. Therefore, this study removes the samples of four municipalities, and the results are presented in Table 4, column (2). The results are with the benchmark, implying that these municipalities have not affected baseline results.

4.2.3. An Alternative Estimation Method

A feasible generalized least square (FGLS) method is performed to control the inconsistency of results caused by the heteroscedasticity and autocorrelation. The results are shown in Table 4, column (3). The coefficient of financial development on sustainable economic growth is still significantly positive, demonstrating that our results are more robust.

4.2.4. Estimation of the Different Periods

China's economy has entered the stage of new normal development, the speed of economic development has slowed down, and the quality of economic development has steadily improved since 2012. Therefore, this paper divides the sample into two time periods, from 2003 to 2011 and 2012 to 2016, for regression. The results are presented in columns (4)–(5) of Table 4. The coefficient of financial development is not significant from 2003 to 2011, while it is significantly positive from 2012 to 2016. This illustrates disparities in the effect of financial development on sustainable economic growth during different periods.

4.2.5. Instrument Variables Regression

According to the theoretical framework, improving financial development promotes sustainable economic growth. However, the continuous improvement of sustainable economic growth will also promote urban financial development. Therefore, there may be a reverse causality relationship between financial development and sustainable economic growth. And due to the availability of data, some unobservable missing variables may also cause inconsistent parameter estimation. Instrumental variable regression is employed to solve the potential endogenous problem.

In this manuscript, the appropriate instrumental variables should be highly related to financial development but not to other unobserved factors that potentially affect sustainable economic growth. Specifically, we select the lagged financial development, the average financial development in neighboring cities, and the density of banking institutions as instrumental variables for financial development. The density of banking institutions is characterized by the number of banking institutions per unit area in the jurisdiction. The number of banking institutions comes from the financial license data of the China Banking and Insurance Regulatory Commission. On the one hand, these indicators are still closely related to the current financial development and meet the correlation assumptions. On the other hand, the lagged financial development, the average financial development in neighboring cities, and the density of banking institutions will not directly affect the current sustainable economic growth and meet the exogenous assumption. The results are shown in Table 5.

Table 5. Results of instrument variables regression.

Variables	(1)	(2)	(3)	(4)
<i>lnfinance</i>	0.040 *** (0.011)	0.705 *** (0.160)	0.059 *** (0.013)	0.052 *** (0.011)
<i>lnpdensity</i>	0.129 *** (0.030)	0.152 *** (0.054)	0.166 *** (0.029)	0.127 *** (0.030)
<i>lnroad</i>	0.029 *** (0.006)	0.011 (0.011)	0.031 *** (0.005)	0.029 *** (0.006)
<i>lnindustry</i>	−0.069 *** (0.015)	0.367 *** (0.107)	−0.054 *** (0.015)	−0.062 *** (0.015)
<i>lninternet</i>	0.050 *** (0.004)	−0.021 (0.018)	0.045 *** (0.004)	0.049 *** (0.004)
<i>lngreen_land</i>	0.013 *** (0.004)	0.007 (0.008)	0.011 *** (0.004)	0.013 *** (0.004)
<i>lnrd</i>	0.027 *** (0.002)	0.031 *** (0.003)	0.029 *** (0.002)	0.027 *** (0.002)
Constant	−2.849 *** (0.180)	−4.159 *** (0.413)	−3.104 *** (0.174)	−2.856 *** (0.180)
City FE	YES	YES	YES	YES
Observations	3679	3962	3962	3679
Under identification	220.10 ***	7.36 ***	143.62 ***	638.70 ***
Weak identification	218.90 ***	7.32 ***	142.86 ***	211.63 ***

Note: *** represent the significance level at 1%. The standard errors are reported in parentheses and clustered at city level. The financial development is instrumented by lagged financial development, neighboring financial development, and banking institution density in columns (1)–(3). Column (4) incorporates all sets of these instrument variables.

The under-identification and weak identification tests reveal that the instrumental variables selected in this manuscript are effective [51]. The results of instrumental variable estimation show that no matter whether the lagged financial development, the average financial development in neighboring cities, or the density of banking institutions are used as instrumental variables, the coefficients of financial development are significantly positive. This indicates that financial development does help to achieve sustainable economic growth. The results also demonstrate that our baseline results are still valid after considering the endogenous problem.

4.3. Heterogeneity Analysis

4.3.1. Results by City Scales

Due to variations in geographical location and natural conditions, cities of different scales may significantly differ in technological innovation capabilities, resource allocation efficiency, and financial development. Financial development may have differential effects on sustainable economic growth at various scales. To investigate the impact of financial development on sustainable economic growth by city scales, we divide the 283 cities into four categories based on the number of permanent residents in the urban area, which is referred to in the *Notice on Adjusting the Standard of City Scale* issued by the State Council in 2014. Specifically, the population size of type I large cities is more than 3 million; that of type II large cities is 1–3 million; that of medium-sized cities is 500,000–1 million, and that of small cities is less than 500,000. The results are shown in Table 6.

Table 6. Results by city scale.

Variables	(1)	(2)	(3)	(4)
	Type I Large City	Type II Large City	Medium City	Small City
<i>lnfinance</i>	0.067 * (0.039)	0.037 (0.023)	0.036 ** (0.017)	0.045 (0.032)
<i>lnpdensity</i>	0.043 (0.073)	0.426 *** (0.146)	0.346 *** (0.124)	−0.076 (0.143)
<i>lnroad</i>	0.108 *** (0.022)	0.034 * (0.019)	0.038 ** (0.019)	0.017 (0.018)
<i>lnindustry</i>	−0.338 *** (0.078)	−0.016 (0.064)	−0.032 (0.046)	−0.021 (0.052)
<i>lninternet</i>	0.029 ** (0.011)	0.047 *** (0.010)	0.051 *** (0.008)	0.064 *** (0.009)
<i>lngreen_land</i>	−0.009 (0.023)	0.009 (0.013)	−0.003 (0.010)	0.017 (0.015)
<i>lnrd</i>	0.050 *** (0.006)	0.027 *** (0.004)	0.023 *** (0.004)	0.021 *** (0.006)
Constant	−1.131 * (0.659)	−4.890 *** (0.952)	−4.186 *** (0.631)	−2.011 *** (0.731)
City FE	YES	YES	YES	YES
Observations	282	1472	1460	748
Adjust R ²	0.822	0.581	0.501	0.402

Note: ***, **, and * represent the significance level at 1%, 5%, and 10%, respectively. The standard errors are reported in parentheses and clustered at city level.

The coefficients of financial development in the first and third columns are significantly positive, indicating that financial development improves the sustainable economic growth in type I large and medium cities. For type II large and small cities, financial development is not significantly related to sustainable economic growth.

4.3.2. Quantile Regression

Quantile regression provides comprehensive information about the conditional distribution and utilizes the weighted average of the absolute residual values as the objective

function to minimize [52]. These results are not easily affected by statistical outliers. Thus, quantile regression analysis is conducted to estimate the impact of financial development on sustainable economic growth by using 0.1, 0.25, 0.5, 0.75, and 0.9 as the predictor quantiles. The results are shown in Table 7. On a different quantile, financial development has a stable positive influence on sustainable economic growth.

Table 7. Results of quantile regressions.

Quantile	(1)	(2)	(3)	(4)	(5)
	0.1	0.25	0.5	0.75	0.9
<i>lnfinance</i>	0.183 *** (0.001)	0.202 *** (0.001)	0.178 *** (0.008)	0.292 *** (0.000)	0.260 *** (0.001)
<i>lnpdensity</i>	−0.028 *** (0.000)	−0.032 *** (0.000)	0.001 (0.009)	−0.015 *** (0.009)	−0.022 *** (0.001)
<i>lnroad</i>	0.041 *** (0.001)	0.071 *** (0.001)	0.057 *** (0.001)	0.072 *** (0.000)	0.162 *** (0.001)
<i>lnindustry</i>	0.371 *** (0.001)	0.277 *** (0.002)	0.156 *** (0.005)	0.101 *** (0.000)	0.075 *** (0.002)
<i>lninternet</i>	0.043 *** (0.000)	0.031 *** (0.001)	0.090 *** (0.004)	0.044 *** (0.000)	−0.052 *** (0.001)
<i>lngreen_land</i>	0.052 *** (0.001)	0.045 *** (0.001)	−0.038 *** (0.005)	−0.081 *** (0.000)	0.034 *** (0.001)
<i>lnrd</i>	0.056 *** (0.000)	0.042 *** (0.0003)	0.061 *** (0.003)	0.045 *** (0.000)	0.045 *** (0.000)
Observations	3962	3962	3962	3962	3962

Note: *** represent the significance level at 1%. The standard errors are reported in parentheses and clustered at city level.

4.4. Mechanism Analysis

The theoretical framework shows that financial development mainly affects sustainable economic growth by promoting capital deepening and enhancing urban technological innovation capabilities. We choose the urban capital deepening (*kl*) and urban innovation capability (*innovation*) as the mediator variables to test these mechanisms. The urban capital deepening is expressed by the ratio of urban capital to labor. The urban capital stock is calculated by the perpetual inventory method by Han and Ke (2016) [53], and the number of urban employees measures labor. Urban innovation capability is characterized by China Urban and Industrial Innovation Index [54]. In this study, we investigate the mechanism of financial development on sustainable economic growth by the recursive model [55]. Firstly, we examine whether the coefficients between financial development and the sustainable economic growth in the benchmark model are significant. Then, we investigate whether the coefficients of financial development on capital deepening and technological innovation are significant. Finally, capital deepening and technological innovation are added to the benchmark model to verify whether the coefficients of capital deepening and technological innovation on sustainable economic growth are significant. We have confirmed that financial development benefits the sustainable economic growth above, so the first test is omitted here. Next, we test the effects of capital deepening and technological innovation. Table 8 reports the mechanism test results.

The result of financial development is positively related to capital deepening, implying that financial development is advantageous to the deepening of urban capital. Furthermore, the coefficient of capital deepening to sustainable economic growth is significantly positive, while the result of financial development is not significant. This illustrates that urban capital deepening has promoted sustainable economic growth considerably, and capital deepening has played a completely mediating effect in financial development affecting sustainable economic growth. The coefficient of financial development to technological innovation is significantly positive at the 1% level, indicating that financial development can be favorable to the city's technological innovation. The technological innovation and

financial development coefficients are positive, with at least a 5% significance level. It shows that technological innovation has significantly promoted sustainable economic growth, and technological innovation has played a part in the mediating effect of financial development affecting sustainable economic growth.

Table 8. The mechanism results.

Variables	(1)	(2)	(3)	(4)
	<i>lnkl</i>	<i>lny</i>	<i>lninnovation</i>	<i>lny</i>
<i>lnfinance</i>	0.720 *** (0.093)	0.013 (0.013)	0.231 *** (0.051)	0.030 ** (0.013)
<i>lnkl</i>		0.034 *** (0.008)		
<i>lninnovation</i>				0.035 *** (0.006)
<i>lnpdensity</i>	1.389 *** (0.427)	0.118 (0.100)	0.055 (0.224)	0.165 (0.108)
<i>lnroad</i>	0.238 *** (0.061)	0.024 *** (0.009)	0.169 *** (0.030)	0.026 *** (0.009)
<i>lnindustry</i>	−0.893 *** (0.181)	−0.036 (0.030)	−0.009 (0.098)	−0.067 ** (0.028)
<i>lninternet</i>	0.639 *** (0.039)	0.025 *** (0.006)	0.236 *** (0.020)	0.039 *** (0.005)
<i>lngreen_land</i>	0.090 * (0.049)	0.008 (0.007)	0.032 (0.029)	0.010 (0.008)
<i>lnrd</i>	0.281 *** (0.019)	0.020 *** (0.003)	0.043 *** (0.009)	0.028 *** (0.003)
Constant	−8.264 *** (2.493)	−2.783 *** (0.584)	1.682 (1.364)	−3.128 *** (0.637)
City FE	YES	YES	YES	YES
Observations	3962	3962	3962	3962
Adjust R ²	0.797	0.552	0.481	0.539

Note: ***, **, and * represent the significance level at 1%, 5%, and 10%, respectively. The standard errors are reported in parentheses and clustered at city level.

5. Discussion and Policy Implications

The empirical findings demonstrate that financial development is advantageous to sustainable economic growth. This outcome is essentially in line with Huang and Jiang's (2019) [29] findings. Since the reform and opening-up, the bank-led financial system is progressively transitioning into a market-oriented financial system with the steady advancement of the financial system reform. Lower finance costs and increased financing effectiveness are results of the financial development [34]. As the largest developing country in the world, the empirical evidence of financial support for sustainable economic development in China has important inspiration and reference for other developing countries and emerging countries. The heterogeneity results demonstrate that in type I large and medium cities, financial expansion enhances sustainable economic growth. On the one hand, type I major cities can draw in a flow of high-quality resources with high resource allocation efficiency and technological innovation skills because of their absolute economic advantages [15]. This supports the growth of high-end service sectors, particularly the finance sector, which further strengthens sustainable economic growth. On the other hand, because of their livable qualities and strong development potential, medium-sized cities can draw the influx of high-tech skills and high-quality businesses. Therefore, financial development can help sustainable economic growth for these cities.

The findings of the mechanism test demonstrate that capital deepening completely mediated the impact of financial development on sustainable economic growth. The deepening of financial capital may lead to the lowest cost, the alteration of the conventional production model, and the rise in labor productivity, according to one explanation. Additionally, it en-

courages expansion of the economy that is of a high caliber [33]. Technology advancement has contributed to the mediated impact of financial development on long-term economic growth. The reduction of capital use costs and increased allocation efficiency of innovation funds are two probable explanations suggested by financial development [37,38]. This will enhance the city's technical innovation and support sustained economic growth [40,41].

Based on the empirical results and analysis, we propose three policy recommendations. First, the local government could encourage financial supply-side reform and increase the financial market's supportive role in sustainable economic growth. The findings indicate that financial development can support sustainable economic growth. As a result, local governments and financial institutions must collaborate to improve the scope and quality of financial development and release the financial sector's vitality to support the regional economy. On the one hand, the government must develop prudent and scientific monetary policies and fully consider their external repercussions. To foster an environment where the financial sector can effectively support the sizeable economy, platforms for financial service construction should also be reinforced. The financial sector, on the other hand, needs to actively use new technology and tools to strengthen its capacity to support the overall economy and increase its economic rewards.

Second, local governments should implement diversified financial development strategies in accordance with local realities. The size of financial development needs to be continually expanded, the business environment and financial structure need to be optimized, and the economic benefits of financial development need to be maximized in Type I major cities. Additionally, there are no clear economic advantages to the financial development of small cities. The primary cause is the poor capital allocation brought on by the imbalance between financial and economic development or the insufficient scale of financial development. To start with, type I major cities can transfer relevant supporting industries and financial facilities to neighboring small towns by fully utilizing their agglomeration of significant resources. To prevent ineffective investment and resource waste, a fair division of labor and a system of complementary advantages are created within the same area. To encourage the expansion of neighboring small cities and create sustained economic growth, precise support should be provided around industrial projects. Another benefit is that small cities can work cooperatively and amicably with big ones, utilizing the latter's top-notch financial services to boost their own economic development. To effectively serve the significant economy and achieve sustained economic growth, small cities must also modify their financial development patterns in accordance with regional realities.

Finally, the intermediary effect of critical elements such as capital deepening and technological innovation must also be given more consideration. The local government must be aware of the negative consequences of financial development faster than economic growth, such as credit expansion and increased financial operation risks, while also maximizing the positive effects of financial development on social capital accumulation, capital formation capacity, and capital allocation efficiency. On the other hand, to achieve sustainable economic growth, the government should increase investment in scientific and technological innovation, view financial support as a crucial first step, speed up the construction of a national scientific and technical financial innovation center, and support pilot projects that integrate regional technology and finance.

6. Conclusions and Limitations

The goal of China's current and future economic growth is to achieve sustainable economic growth as the country's economy transitions to a new normal. Finance, which is the lifeblood of the economy, has had a significant impact in fostering social and economic progress. This manuscript examines the effects of financial development on sustainable economic growth through capital deepening and technological innovation based on the theory of financial development and endogenous growth. By measuring the level of sustainable economic growth, panel data from 283 Chinese cities with prefecture-level or higher from the years 2003 to 2016 are used to examine the impact of financial development

on sustainable economic growth and its mechanism. According to the findings, financial development improves sustainable economic growth. The findings are supported by the outcomes of robustness tests and instrumental variable tests. Additionally, this effect differs considerably at various city scales. Financial development helps type I large and medium-sized cities achieve sustainable economic growth, but it has little impact on type II large and small cities. Financial development consistently has a beneficial impact on sustainable economic growth in various positions of the conditional distribution. The results of the mechanism test demonstrate that financial development can promote capital deepening and technical innovation to ensure sustainable economic growth.

The limitations of this article are as follows. Firstly, due to the availability of data, this study explores the impact of financial development on sustainable economic growth at the prefecture level. In the future, with data availability, relevant research can be extended to the county level. Secondly, this article mainly studies the impact of financial development on sustainable economic growth through financial deepening and technological innovation. Other potential channels through which financial development may affect sustainable economic growth should be explored. Further study can explore more impact mechanisms.

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