

Financial deepening, inclusive finance and economic growth: analysis based on endogenous growth theory

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Abstract. This article studies the relationship between financial development and economic growth from the perspectives of financial deepening and inclusive finance. The theoretical research expands the financial endogenous economic growth model, constructs the Hamiltonian function, using the first-order optimization conditions to obtain explicit relationship between economic growth and financial development under balanced path. Theoretical research shows that financial deepening and inclusive finance are significant and stable in promoting economic growth.

1. Introduction and literature review

The relationship between financial development and economic growth has always been an issue of concern and discussion by economists, the long-term research on the level of financial development is mainly based on the perspective of financial deepening, due to the difference between theoretical models and statistical methods, there are also differences in the conclusions of research on the effects of financial development to economic growth and its conduction paths. Piano (1993) earlier proposed that financial development promoted economic growth by increasing the marginal productivity of social capital. Levine (2005) proposed five possible channels that financial development influenced economic growth: (I) Providing sound investment information and enhancing capital distribution efficiency. (II) Supervising enterprises to improve management level. (III) Reducing innovation risks and enhancing enterprises' enthusiasm for technological innovation. (IV) Improving savings-investment conversion efficiency. (V) Promoting trade in goods and services. Han Tingchun (2003) mainly studied the role of financial deepening in promoting economic growth from the perspective of savings-investment conversion efficiency. James (2011) embedded the level of financial development into the R&D model and concluded that efficient financial service level promoted the emergence of new technologies. In the related literature, as a unique case, China has caused various countries' scholars to explore the relationship between financial development and economic growth. Hasan, etc. (2006) used China's inter-provincial macro data to discover that financial development had a negative impact on local economic growth, and he attributed the negative impact to the huge amount of banking credit used to support state-owned loss-making enterprises. Shao Yihang, etc. (2015) used the systematic GMM regression method to analyze the impact of financial development on economic growth in eastern and central China, the empirical research found that financial development had different effects on economic growth due to regional innovation differences.

In 2005, the United Nations officially proposed the concept of inclusive finance, which means providing effective and sustainable financial services to all society sectors with financial services



needs, and reducing the financial services gap between regions and sectors. Focusing on the purpose of inclusive finance, economists try to scientifically calculate the inclusive financial index, Beck, etc. (2007) proposed an inclusive financial index from the availability, usable and actual use status of financial services. According to the United Nations Development Programme Human Development Index (HDI), Sarma (2008) adopted the coefficient of variation method by selecting a number of financial service indicators to measure the comprehensive development index of inclusive finance in the given region. Domestic scholars Wang Jing and Hu Guohui (2013), Chen Sanmao and Qian Xiaoping (2014) used the calculation method of foreign scholars to calculate the inclusive financial index of China and various provinces and regions.

Traditional finance has gathered in economically developed regions, leading to the widespread financial exclusion for vulnerable groups. Inclusive finance emphasizes the coverage and sustainability of financial services, helps the bottom of the society to gain the ability to put into production, and offers financial services to weak enterprises which have the ability to technological innovation but also have financing constraints. At present, the research literature on the relationship between inclusive finance and economic growth is still relatively inadequate. Tita and Aziakpono (2017) found that inclusive finance in Africa played an active role in promoting poverty reduction and reducing income gap. Fan and Zhang(2017) found that inclusive finance reduced entrepreneurial financing constraints, information asymmetry and transaction costs between commercial partners, and its development would promote the formation of entrepreneurs. However, domestic scholars Li Tao, etc. (2016) used the inclusive financial panel data from 2005 of more than 180 economies in the world, the regression analysis showed that part of the inclusive financial indicators had a significant negative impact on regional economic growth, the other indicators selected had no significant impact on economic growth.

Based on the above literature, we find that domestic research on the impact of inclusive finance on economic growth is still relatively inadequate, financial structure changes will have an impact on economic growth, existing researches lack a comparison between financial deepening and inclusive finance on economic growth. The systematic endogenous growth model of financial development is not perfect enough, and the model fails to explain the inherent logic of financial development affecting economic growth. Therefore, this paper constructs a complete endogenous growth model, and uses dynamic optimization conditions to solve the relationship between economic growth rate and financial development level.

2. Theoretical model

Financial market plays an important role in the modern economy and is closely related to economic growth. The endogenous growth theory is a reliable theoretical method for studying financial development and sustainable economic growth. The model extends the endogenous growth models of James (2011) and Chou (2007), the main innovation of the model lies in the views of scholars such as Luintel and Khan (1999), Sarma and Jesim (2011), which proposed that socio-economic level promotion could stimulate financial development. Thus the model considers endogenous factors of financial development, holds the opinion that economic level and material capital accumulation have an impact on financial development. In addition, the model includes the human capital development department and uses dynamic optimization tools to solve the explicit relationship between variables. Considering a four-sector closed economy consisting of a production department, a financial department, a technology innovation department and a human resources department, in which human capital H is allocated to each department according to a certain proportion.

2.1. Final product department

The production function follows the Cobb-Douglas production function form, it could be expressed as:

$$Y = F_Y K^\alpha (A u_Y H)^{1-\alpha} \quad (1)$$

Where Y is the output level, F_Y is a fixed coefficient, K is the physical capital, A is the technical

level, and the human capital invested in the production sector is $u_Y H$.

According to the theoretical models of Han Tingchun (2003) and Chou (2007), the improvement of financial development level would increase savings-investment conversion efficiency. Therefore, the accumulation equation of physical capital is:

$$\dot{K} = \xi S - \delta K, \quad \xi = G\tau \quad (2)$$

ξ represents savings-investment conversion efficiency, which is positively related to the financial development level τ , S represents savings, its relationship with output and consumption is $S = Y - C$, and G is a fixed coefficient, δ indicates depreciation.

2.2. Financial department

The Financial Deepening Index (DFI) and the Inclusive Financial Index (IFI) represent the depth and breadth of financial development, respectively, $\tau = \tau(\text{DFI}, \text{IFI})$, and $\partial\tau/\partial\text{DFI} > 0$, $\partial\tau/\partial\text{IFI} > 0$. Some literature models directly set the financial development level τ to be exogenous, however, as mentioned above, financial development level is closely related to the socio-economic level and financial innovation technology. Therefore, this paper proposes that financial development, technical level A and material capital accumulation K are related.

$$\dot{\tau} = F_\tau (u_\tau H)^\lambda \tau^\varphi A^\varepsilon K^\nu \quad (3)$$

F_τ is a fixed coefficient, the human capital occupied by financial innovation development is $u_\tau H$, each coefficient satisfies $0 < \lambda, \varphi, \varepsilon, \nu < 1$.

2.3. Technology innovation department

Financial development, especially inclusive finance, could improve the efficiency of enterprises' technological innovation, on the other hand, reduce the capital pressure and uncertainty of application of new technologies, and accelerate the generation of new technologies. Embedding financial development into the technological innovation model, F_A is a fixed coefficient, $0 < \eta, \beta, \theta < 1$, the human capital invested in the R&D innovation sector is $u_A H$.

$$\dot{A} = F_A (u_A H)^\eta \tau^\beta A^\theta \quad (4)$$

2.4. Human resources department

The human capital allocated to the human resources department is $u_H H$, where $u_Y + u_\tau + u_A + u_H = 1$, F_H is a given exogenous coefficient.

$$\dot{H} = F_H (u_H H) \quad (5)$$

2.5. Consumer budget constraint

The consumer chooses the current consumption C_t for maximizing the utility in a lifetime, $U(C)$ is the instantaneous utility function, ρ indicates the time preference, and σ is the relative risk aversion coefficient, the maximize utility function is:

$$\Omega = \int_0^{\infty} U(C) e^{-\rho t} dt, \quad U(C) = \frac{C^{1-\sigma} - 1}{1-\sigma} \quad (6)$$

2.6. Competitive equilibrium solution

According to the above constraints, the dynamic optimization solution system of the economy at consumption level C is:

$$\left\{ \begin{array}{l} \Omega = \int_0^{\infty} U(C) e^{-\rho t} dt \\ \dot{K} = \xi S - \delta K \\ \dot{\tau} = F_{\tau}(u_{\tau} H)^{\lambda} \tau^{\varphi} A^{\epsilon} K^{\nu} \\ \dot{A} = F_A(u_A H)^{\eta} \tau^{\beta} A^{\theta} \\ \dot{H} = F_H(u_H H) \end{array} \right. \quad (7)$$

Constructing the Hamiltonian functional with equation (7), where λ_1 , λ_2 , λ_3 , λ_4 are Hamilton multipliers:

$$\Psi = U(C) + \lambda_1 \dot{K} + \lambda_2 \dot{\tau} + \lambda_3 \dot{A} + \lambda_4 \dot{H} \quad (8)$$

Optimizing first-order conditions:

$$\frac{\partial \Psi}{\partial C} = 0, \quad \frac{\partial \Psi}{\partial u_Y} = 0, \quad \frac{\partial \Psi}{\partial u_{\tau}} = 0, \quad \frac{\partial \Psi}{\partial u_A} = 0 \quad (9-12)$$

Euler equation:

$$\frac{\partial \Psi}{\partial K} = \lambda_1 \rho - \dot{\lambda}_1, \quad \frac{\partial \Psi}{\partial \tau} = \lambda_2 \rho - \dot{\lambda}_2, \quad \frac{\partial \Psi}{\partial A} = \lambda_3 \rho - \dot{\lambda}_3, \quad \frac{\partial \Psi}{\partial H} = \lambda_4 \rho - \dot{\lambda}_4 \quad (13-16)$$

Based on the equation (9) — (16), the economic growth rate under the balanced growth path is:

$$g_Y = g_C = \frac{1}{\delta} [G\tau(Au_Y H)^{1-\alpha} \alpha F_Y K^{\alpha-1} + G\tau(Au_Y H)^{1-\alpha} F_Y \frac{(1-\alpha)\nu u_{\tau}}{K\lambda u_Y} - \frac{F_{\tau}(u_{\tau} H)^{\lambda} A^{\epsilon} K^{\nu}}{\tau^{1-\varphi}} - \delta - \rho] \quad (17)$$

The relationship between economic growth rate, financial deepening and inclusive finance is:

$$\begin{aligned} \frac{\partial g_Y}{\partial \tau} &= \frac{1}{\delta} [F_Y G(Au_Y H)^{1-\alpha} (\alpha K^{\alpha-1} + \frac{(1-\alpha)\nu u_{\tau}}{K\lambda u_Y}) + (1-\varphi) \frac{F_{\tau}(u_{\tau} H)^{\lambda} A^{\epsilon} K^{\nu}}{\tau^{2-\varphi}}] > 0 \\ \frac{\partial g_Y}{\partial DFI} &= \frac{\partial g_Y}{\partial \tau} \cdot \frac{\partial \tau}{\partial DFI} > 0, \quad \frac{\partial g_Y}{\partial IFI} = \frac{\partial g_Y}{\partial \tau} \cdot \frac{\partial \tau}{\partial IFI} > 0 \end{aligned} \quad (18)$$

So far, we have solved the theoretical model and found that the two dimensions of financial development namely financial deepening and inclusive finance promote sustainable economic growth. There are two channels for financial development to influence economic growth in the model: one is to stimulate savings-investment conversion efficiency, and the other is to promote technical research and development efficiency.

3. Conclusion and suggestion

The level of financial development includes two dimensions: depth and breadth. This paper selects financial deepening and inclusive finance to study the driving effect of financial development on economic growth. By constructing the endogenous growth model of four sectors and solving it by Hamilton function, obtains the relationship between economic growth rate and financial development level. It shows that financial deepening and inclusive finance both have significant positive effects on economic growth.

According to the conclusions of theoretical model, we propose the following suggestions for the future financial development direction and policy formulation: First, continue to promote financial deepening, for mature financial market is an important component to ensure steady economic growth. Actively carry out financial innovation, and excavate the role of financial deepening in efficiently adjusting resource allocation, improving savings-investment conversion efficiency. Second, financial deepening and inclusive finance have their own advantages and emphasis, should have coordinate

sustainable development. Third, the concept of inclusive finance has not yet been perfectly constructed, but the basic idea is to provide effective and sustainable financial services for all sectors of society, fully tap the superiority of inclusive finance in solving the financing constraints of SMEs and promoting technological innovation, and provide a sound financing environment for innovation and entrepreneurship. Fourth, the development of internet technology is on the rise, internet finance and big data science have begun to play a unique role in financial innovation and inclusive finance. Technology helps reduce information asymmetry and the cost of financial services. We should make full use of internet technology to improve financial services and financial inclusion.

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