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Finance and Productivity Across Income Levels: Unveiling the Heterogeneous Effects of Financial Development

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Abstract

The effects of financial market development on improving capital productivity and economic growth have been extensively discussed through endogenous growth models in the economics literature. Financial development can effectively reduce frictions in the economic system and enhance Total Factor Productivity (TFP) growth by improving efficiency and promoting technological progress. However, the impact of financial development on capital allocation is not always positive. Optimal resource allocation can stimulate TFP growth, whereas resource misallocation can hinder it. In other words, at different stages of economic development, financial development has heterogeneous effects on TFP across countries. Therefore, the main issue addressed in this study is how the impact of financial development on TFP is influenced by countries' income levels. To this end, selected countries were classified into separate income groups, and the relationship between financial development and TFP was examined over the period 2010–2023 using the panel data econometric method in EViews software. The results of the estimated models indicate that the coefficient of the financial development variable is positive and statistically significant in high-income and middle-income countries, with values of 0.0826 and 0.0121, respectively, whereas this coefficient is statistically insignificant in low-income countries. Accordingly, financial development has not been able to improve TFP in low-income countries.

Keywords: Inancial development, Total factor productivity, Income level.

1 | Introduction

Financial development is increasingly becoming the main driving force and a core component of economic development [1]. Financial systems can effectively overcome adverse selection and moral hazard problems arising from information asymmetry and allocate funds to investment projects with high profit potential,

which in turn enhances productivity [2]. King et al. [3] incorporated the financial sector into endogenous economic growth models and suggested that more developed financial systems improve productivity and consequently accelerate economic growth.

Financial development primarily affects Total Factor Productivity (TFP) through technological advancement and capital allocation [4]. Research into the role of financial development in promoting TFP growth through technological progress originated in the endogenous growth theory proposed by Romer [5]. Since financially supported technological innovation generates significant positive externalities, investment in research and development promotes endogenous technological progress and consequently enhances TFP growth. Buera and Shin [6] suggest that financial development can effectively reduce frictions in the economic system and promote TFP growth through improvements in efficiency and technological advancement. However, the impact of financial development on capital allocation is not always positive. Optimal resource allocation can enhance TFP growth, whereas resource misallocation can constrain TFP growth. Buera and Shin [6] found that in some emerging economies or developing countries experiencing rapid economic growth, innovative small and medium-sized enterprises with advanced technologies often have short capital accumulation periods and insufficient collateral conditions, which makes financing difficult and leads to resource misallocation caused by financial constraints. Cole et al. [7] argued that inefficient capital allocation resulting from capital misallocation within the financial system prevents improvements in TFP in some countries.

The above evidence suggests that financial development has heterogeneous effects on TFP across different countries at various stages of economic development. In this regard, Rioja and Valev [8] pointed out that the relationship between financial development and TFP may not be fully explained by a linear relationship. Across countries, the role of financial development in promoting TFP growth differs significantly, and an inverted U-shaped relationship exists between them. Ruiz [9] found that although financial development has a positive effect on economic growth, such an improvement is absent in some low-income countries. Financial markets with low levels of financial development are unable to create high-productivity business sectors due to insufficient risk diversification functions, while low-productivity non-tradable sectors are more likely to survive. A developed financial system can provide diversified risk management and hedging services, effectively reduce investors' concerns regarding technological innovation within firms, and subsequently encourage firms to undertake technological advancement and innovation activities. Ruiz [9] indicated that financial development has a nonlinear effect on economic growth. Asteriou and Spanos [10] found that the impact of financial development on economic growth differs before and after financial crises.

Based on this evidence, the effect of financial development on TFP and, consequently, economic growth depends on the level of development of countries. Thus, financial development does not always lead to economic growth; once financial development exceeds a certain threshold, further financial expansion may no longer be beneficial for economic growth [11]. Specifically, moderate levels of financial development contribute positively to economic growth, whereas excessive financialization may hinder economic growth [12]. Therefore, the main research question of this study is how the impact of financial development on TFP is influenced by countries' income levels. To address this issue, selected countries are classified into separate income groups, and the relationship between financial development and TFP is examined across these groups.

2 | Theoretical Foundations and Literature Review

Financial development is a multidimensional concept that, in addition to the development of the banking sector, encompasses other dimensions such as non-bank financial sector development, monetary sector development, monetary policy-making, banking regulations and supervision, financial openness, and the institutional environment [13]. On the other hand, productivity growth is considered one of the fundamental prerequisites for enhancing the competitiveness of a sector and achieving success under increasingly intense global competition. This is because productivity improvements reduce the cost of goods produced through a decline in average production costs, leading to increased profitability of final products within production units. The consequence of such a transformation is a significant increase in demand and, more importantly,

an improvement in the competitiveness of domestic products in foreign markets. This process contributes to the expansion of production, the utilization of maximum production capacities, an increase in new investment, and subsequently the wider adoption of innovations and technological advancements. The fact that developing countries often produce below their production potential is primarily due to the low level of productivity in various production sectors. Accordingly, improving productivity can enhance the efficiency of economic sectors, increase production activities, and promote output growth. Given the importance of productivity and the conflicting empirical findings on the impact of financial development on this indicator, this study investigates the effect of financial development on TFP, while considering countries' income levels. Accordingly, this chapter initially examines the theoretical foundations of the research. First, the concept of financial development and its related indicators are discussed. Subsequently, the concept of productivity and its relevant measures are presented. In the following section, the theoretical relationship between financial development and TFP, as well as the role of countries' income levels in this relationship, is examined. Finally, the chapter reviews previous domestic and international empirical studies conducted in this field.

2.2 | Financial Development

In the dictionary of monetary and banking concepts, financial development is considered synonymous with financial deepening and refers to a situation in which the growth rate of financial assets exceeds the growth rate of non-financial assets. Under such circumstances, the ratio of financial assets to non-financial assets increases. Based on existing theoretical and empirical perspectives, developed financial systems play a fundamental role in improving financial intermediation functions by reducing monitoring, transaction, and information costs. Efficient financial systems expand investment opportunities by identifying and financing suitable business opportunities, mobilizing savings, providing risk coverage and diversification, and facilitating the exchange of goods and services. Moreover, increased efficiency in the financial system ultimately leads to higher economic growth through improved resource allocation, enhanced investment, and accelerated capital accumulation. In general, the primary function of a financial system is to transfer loanable funds from lenders (i.e., units with excess savings) to borrowers (i.e., units facing funding shortages). These funds are allocated through negotiation and transactions in financial markets, where individuals and institutions supplying funds interact with those demanding financial resources.

A financial system refers to a network of financial markets, traders, households, governments, and institutions that participate in the system, whose operations are governed by specific regulations. This system channels the flow of money, various types of deposits, securities, and monetary and capital market instruments to different groups of market participants in the real sector of the economy through its regulatory mechanisms. Accordingly, the financial sector can be regarded as vital to the real economy. Furthermore, by providing essential services related to payments, mobilizing savings, allocating credit, and creating mechanisms for managing business and production risks as well as price fluctuations, the financial system facilitates real economic activities and contributes to both quantitative and qualitative transformations within these activities.

2.2.1 | Definition of financial development

In empirical literature, financial development mainly encompasses the development of financial intermediation, stock markets, and foreign direct investment. In fact, a large body of research indicates that financial development has become an inseparable component in stimulating economic development [14]. Financial development refers to the factors, policies, and institutions that lead to effective connections with efficient financial intermediaries and markets, as well as access to capital and financial services. It is a long-term process of establishing institutions that deepen the informational foundations and analytical capabilities of the financial system and enhance the influence of financial institutions through value creation within these institutions and by expanding financial instruments, arrangements, and contracts in response to environmental changes and the needs of firms, households, and other economic agents [15]. Put simply, financial development is a set of factors, policies, and institutions that contribute to the establishment of financial markets and provide access to financial services [16].

Financial development is a process through which the quantity, quality, and efficiency of financial services and financial intermediation improve [17]. In general, the primary function of a financial system is to transfer loanable funds from lenders (i.e., units with surplus savings) to borrowers (i.e., units facing financial deficits). These funds are allocated through negotiation and transactions in financial markets, where individuals and institutions supplying funds interact with those demanding financial resources. Most of the savings flowing through the financial system are provided by households, whereas the primary borrowers within the financial system are business enterprises and governments. Some researchers consider financial development a multidimensional concept that, in addition to banking sector development, encompasses other dimensions such as non-bank financial sector development, monetary sector development, monetary policy-making, banking regulations and supervision, financial openness, and the institutional environment [13]. Others define financial development as an increase in financial services provided by financial institutions, while some consider the quantity, quality, and efficiency of financial intermediary services as the main indicators of financial development.

2.2.2 | Dimensions of financial development

Based on the theoretical foundations and literature of financial economics, financial development is examined across six dimensions. The first dimension is banking sector development. Banks constitute the core of the financial and payment systems in most economies and play an important role in the processes of mobilizing savings, identifying investment opportunities, and diversifying risks. Therefore, the size, structure, and efficiency of the banking sector are considered an independent dimension of financial development. The most important banking indicators of financial development include the share of deposits and credits provided by private banks relative to corresponding variables in the banking network, the share of credits allocated to the private sector relative to total granted credits, the ratio of assets of banks and credit institutions to the total assets of the banking system, and the ratio of reserves of banks and credit institutions to total deposits of the private sector.

The development of the non-bank financial sector is the second dimension of financial development. The non-bank financial sector includes components such as stock markets, mortgage and leasing financial institutions, securities markets, insurance companies, and pension funds. Developments in the non-bank financial sector examine the expansion of capital resources and alternative financial services. The diversity of products and markets in this sector, while creating conditions for transforming the functions of the financial system, enables firms and households to improve their financing decisions more efficiently in terms of costs, mobilize financial resources, monitor financial sector management, and distribute risks.

The development of the monetary sector and monetary policy is the third dimension of financial development. Monetary policy refers to a combination of rules and actions implemented by the central bank to achieve its objectives. In many countries, the primary objective of monetary policy is price stability. However, some central banks also pursue other objectives, such as achieving full employment, maintaining domestic financial stability, and preventing instability in the external balance of payments [18]. Financial development can indirectly affect output and inflation through monetary policy transmission channels and influence the effectiveness of monetary policy. For example, the growth of stock market transactions as a substitute for bank lending affects the money supply indirectly through money demand and interest rate reductions, thereby reducing the effectiveness of monetary policy operations [19]. Furthermore, the role of banks as intermediaries in the financial sector through the credit channel can affect monetary policy effectiveness. An increase in bank interest rates negatively affects firms' stock prices. As stock prices and firms' net worth decline due to adverse selection problems, lending to these firms to finance investment expenditures decreases. In addition, the moral hazard problem caused by the reduction in firms' net worth encourages riskier investors to obtain loans, which further reduces the effectiveness of monetary policy in influencing output and aggregate demand [20].

Banking regulations and supervision constitute the fourth dimension of financial development. Banks and financial and credit institutions, as the most important financial institutions in Iran, play a significant role in

the country's economic progress and development due to the limited expansion of financial markets on the one hand and public trust in these institutions on the other. Banks and financial institutions are considered among the indicators used to measure the level of financial development in a country. By mobilizing savings and allocating them to different economic sectors, banks and non-bank financial institutions not only facilitate commercial and trade transactions but also contribute to market expansion, economic growth, and prosperity. In other words, the development indicators of banking and non-banking financial institutions affect capital accumulation and productivity indicators, which in turn influence economic growth [21]. According to Rioja and Vale [8], financial sector development enhances the effectiveness of monetary policies and improves macroeconomic performance. They also examined the effects of central bank independence, inflation targeting, and membership in the European Monetary Union, factors widely considered by researchers, on monetary policy efficiency. The results indicated that more developed financial markets, central bank independence, inflation targeting, and membership in the European Monetary Union significantly contribute to the implementation of more effective monetary policies. In this respect, no significant difference was observed between industrialized and developing countries.

The fifth dimension of financial development is financial sector openness. Another aspect of financial development is the position and role of the domestic financial system in the cross-border movement of financial resources. In this dimension, factors such as the openness of financial markets to capital inflows and outflows, appropriate exchange rate regimes, and restrictions on transactions involving financial assets or foreign exchange instruments by foreign and domestic residents are examined. Generally, financial liberalization has increasingly been considered a tool for strengthening financial systems and transforming countries' financial structures by enhancing competitiveness. The liberalization process typically improves the efficiency of financial systems through the elimination of inefficient institutions, increasing pressure for financial infrastructure reforms, and reducing problems related to information asymmetry, such as adverse selection and moral hazard.

The institutional environment is the sixth and final dimension of financial development. The institutional environment of an economy plays a crucial role in determining a country's financial development because the financial structure consists of a set of contracts whose efficiency is enhanced or weakened through legal rights and enforcement mechanisms. From this perspective, a well-functioning legal system facilitates the operations of the financial system. The legal and political environment has a determining influence on the quality of services provided by financial institutions. For example, in some developing countries, banks are reluctant to increase lending because inefficient judicial systems or corrupt political and administrative institutions prevent loan repayment. The quality of legal institutions, property rights protection, bureaucratic quality, and government accountability affect the performance of the financial system. Therefore, the institutional environment is considered as one of the important dimensions of financial development.

2.3 | Productivity

Productivity is a comprehensive and broad concept, and its improvement has long been considered essential for enhancing living standards, increasing welfare, and promoting human comfort and well-being. Achieving these goals, which are regarded as fundamental objectives for all countries worldwide, has consistently been emphasized by economic policymakers, decision-makers, and governments. Productivity refers to maximizing the utilization of resources, human capital, facilities, and other inputs through scientific approaches, reducing production costs, expanding markets, increasing employment, and striving to raise real wages and improve living standards in a manner that benefits workers, management, and society as a whole. Due to the limitation of resources, the unlimited nature of human needs, population growth, and intense competition in the global economy, improving productivity is not merely an option but a necessity [22]. Therefore, in recent years, productivity analysis from various perspectives has been widely employed by economists and policymakers in both developed and developing countries [23].

2.3.2 | Definition of productivity

The term productivity literally refers to the “power of production, fertility, and capability of generating output.” According to the Encyclopaedia Britannica, productivity in economics is defined as the ratio of what is produced to what is required for production. Various definitions of productivity have been presented in economic literature, all of which, in one way or another, emphasize the proper and efficient utilization of resources to achieve predetermined objectives. Today, this term is among the most commonly used concepts and is applicable in almost every field of discussion.

The International Labour Organization (ILO) defines productivity as the relationship between the output generated by a production system and the inputs used in that system. The European Productivity Agency considers productivity primarily as a mindset that continuously seeks to improve the existing conditions and emphasizes that productivity requires ongoing efforts to apply new theories and methods. According to the Asian Productivity Organization (APO), productivity is calculated as the ratio of output to input and is defined as follows:

Productivity is related to the efficiency of producing goods and services and the value created through the production process. If a product is manufactured with minimum costs and high quality and can be competitively sold in the market at a price higher than its production cost, its productivity level is considered high. The objective of productivity is to maximize output while minimizing input [24]. In the 1970s, the Japan Productivity Center defined productivity as follows:

“Productivity refers to maximizing the utilization of human resources, expanding markets, and using facilities through scientific methods, or reducing production costs, increasing employment, raising real wages, and improving living standards in a manner that benefits managers, employees, and consumers.” From this center’s perspective, productivity is considered a national priority and choice that contributes to poverty reduction and the enhancement of social welfare.

Based on these definitions, productivity is a criterion and a measurement tool for evaluating the efficiency of economic activities in society. Contrary to common perception, productivity is not merely an economic and financial indicator. In its deeper meaning, productivity represents an approach toward rationalizing activities. From this perspective, productivity implies that organizations can perform their tasks and activities better than before on a continuous basis. Accordingly, a comprehensive definition of productivity can be provided as follows:

Productivity refers to the optimal allocation and utilization of resources for producing goods and services in order to achieve organizational objectives, and it consists of two dimensions: efficiency and effectiveness.

2.3.2 | Productivity indicators

Productivity indicators are defined based on economic concepts and include various measures such as labor productivity, capital productivity, TFP, material productivity, energy productivity, and others. The characteristic of these indicators is that their calculation enables comparative analyses across economic units, classes, activity groups, sectors, and economic divisions. Note that these comparative analyses can be conducted for each indicator at the national, regional, or international levels. In most of the aforementioned general indicators, the numerator represents value added or output, while the denominator consists of one or a combination of several inputs. Each of these indicators is introduced below.

Many management and economics scholars believe that among the various types of investments made to improve productivity and ultimately promote economic and social development, empowering human resources is considered the most important and profitable component of development, as human capital is the most influential factor in achieving development objectives. The labor productivity indicator is calculated as the ratio of value added to the number of employees. In this context, employees refer to all individuals who have a direct legal relationship with the company; accordingly, the total number of employees includes permanent, contractual, and temporary employees.

$$\text{Labor Productivity} = \frac{\text{Value Added}}{\text{Number of employees}}.$$

Capital, as a key factor of production, plays an undeniable role in achieving countries' development goals. Therefore, identifying the factors affecting capital productivity provides a basis for adopting appropriate policy measures to achieve economic growth and development. Accordingly, measuring the level of capital productivity, both at the national economic level and across different sectors, is necessary and highly beneficial. The capital productivity indicator is calculated as the ratio of value added to the value of productive fixed assets (considering the real value of assets rather than their book value).

$$\text{Capital Productivity} = \frac{\text{Value Added}}{\text{Value of Productive Fixed Assets}}.$$

TFP is obtained from the ratio of value added to the weighted value of total inputs. There are various methods for measuring this ratio. One of these methods, known as the direct method of measuring TFP, estimates the level of TFP without explicitly using a production function. In these methods, because the units of measurement of the inputs used in the production process are different, specific techniques are applied to aggregate different inputs, thereby constructing an index of total inputs. These methods are referred to as direct approaches. The TFP index is calculated as the ratio of the value-added index to the weighted combination of production factor indices. Considering that the production factors in the gas company consist of labor and capital, the relationship for the TFP index is expressed.

$$\text{Total factor productivity} = \frac{\text{Value Added at Base-Year Prices}}{\alpha L + \beta K}.$$

2.3.3 | Methods of measuring productivity

Improving productivity is the most effective approach to achieving growth when resources and production capacity are limited. The key to productivity improvement lies in productivity measurement and analysis. Productivity measurement assists in selecting the most economical approach for utilizing resources. The evaluation of productivity indicators provides a basis for identifying the factors that affect productivity growth, determining strengths and weaknesses, recognizing areas for improvement, forecasting future conditions by observing trends, and making decisions regarding the extent of resource utilization in different sectors, ultimately contributing to achieving appropriate economic growth. In other words, productivity analysis and measurement become meaningful when productivity changes over time are demonstrated through appropriate productivity indicators.

Therefore, achieving an optimal level of productivity requires determining the current productivity level and applying an appropriate method for its measurement. Clearly, calculating productivity levels in any organization not only enables the assessment of the current situation and comparison with past performance but also provides a roadmap for future development in order to achieve organizational objectives [25]. One of the approaches for measuring general productivity indicators is the index approach. Under this approach, the productivity indicator is defined as the ratio of the volume or value of output to the value of one or more factors used in the production process. In other words, any relationship between output and input expressed as a ratio can be considered a productivity indicator. Another approach used for calculating productivity is the production function approach. The production function method is primarily associated with economists. Through estimating the production function, economists determine the average productivity or marginal productivity of each production factor.

2.4 | Research Background

2.4.1 | Domestic Studies

Shakeri Bastanabad et al. [26] investigated the role of financial development in agricultural sector productivity growth in selected Islamic countries during the period 2000–2017. Based on the results of the cross-sectional dependence test and the Pesaran unit root test, the AMG method was employed to estimate the model. The findings indicated a positive and statistically significant effect of financial development on agricultural productivity in the selected Islamic countries. Specifically, a one percent increase in the financial development index leads to a 0.709 percent increase in agricultural sector productivity growth. The positive effect of this variable suggests that increasing the provision of credit to the private sector and facilitating financing for farmers and enterprises have reduced transaction and production costs and improved productivity.

Tahernia et al. [27] examined the role and effects of financial integration on TFP using the Autoregressive Distributed Lag (ARDL) approach during the period 1999–2020 for the Iranian economy. The model estimation results indicated, in both the short and long run, a positive and significant relationship between financial integration and productivity during the selected period. Furthermore, variables such as trade openness and domestic investment showed a positive relationship with productivity, while inflation had a negative effect on TFP.

Sepehrdoust and Afshari [28] investigated the role of financial development and bank lending on TFP in Iran's industrial sector using the ARDL approach over the period 1983–2013. To specify the econometric model, in addition to current and capital credits provided by banks, the researchers incorporated other important factors affecting TFP in Iran's industrial sector, including research and development expenditures, the capital stock-to-output ratio, and a dummy variable representing the development programs of the Islamic Republic of Iran. The results showed that capital credits had a positive effect on TFP in the industrial sector, both in the long run (0.044) and in the short run with one lag (0.027). Current credits also had a positive effect on industrial sector TFP in the short run (0.032), but they had no significant effect in the long run. In addition, research and development expenditures had a positive and significant impact on TFP in Iran's industrial sector in both the short run (0.013) and the long run (0.039). The Error Correction Coefficient (ECM) was estimated at -0.35 in the short run, indicating that 35% of short-run productivity disequilibrium is adjusted toward the long-run equilibrium path in each period.

Shahabadi and Feali [29] evaluated the impact of financial market development on Iran's TFP during the period 1961–2008. In this study, after examining various dimensions of Iran's financial system, four indicators extracted from the banking system were defined as financial development indicators. Subsequently, using a regression model, the relationship between these indicators and TFP was estimated. The results revealed a positive and significant relationship between financial development and TFP growth. Furthermore, regarding other factors affecting TFP, variables such as capital intensity, trade openness, and the real exchange rate had positive and significant effects, whereas the terms of trade variable and the Islamic Revolution dummy variable had negative and significant effects on TFP.

2.4.2 | Foreign studies

Magazzino and Santamaria [30] investigated the relationship between financial development, productivity, and economic growth across different income groups. The empirical analysis was conducted based on a sample of 130 economies over the period 1991–2019, which was classified into four sub-samples: the Organisation for Economic Co-operation and Development (OECD) countries, developing countries, least-developed countries, and net food-importing countries. Statistical analyses were performed using forecast error variance decomposition and panel Vector Autoregressive (VAR) regression estimations. The findings indicate that higher production levels stimulate economic development in the agricultural sector mainly through the productivity channel, while in the most developed economies, this occurs primarily through access to credit. Conversely, in developing and least-developed economies, the role of access to credit is

marginal. In less-developed economies, priority should be given to investment in technology and innovation, whereas financial markets are more suitable for strengthening agricultural sector development in developed economies.

Ouyedir et al. [31] examined the relationship between financial intermediary development and TFP in the Algerian economy during the period 1970–2020. The researchers developed an econometric model using the VAR approach and the granger causality test. The variables used in the study included the money supply ratio, the share of domestic credit allocated to the private sector as a percentage of GDP, trade openness, foreign direct investment, and human capital. The results of the VAR model indicate that financial development through domestic credit to the private sector and trade openness has a positive and significant effect on TFP, while other variables do not have a significant impact on TFP.

Paul et al. [32], drawing on neoclassical growth theories, examined the interaction between financial development, gender-specific human capital, and TFP growth in India using annual data from 1980 to 2019. In this study, variables such as government expenditure on education and foreign direct investment were included as control variables within the TFP growth framework. The findings indicate that while financial development enhances productivity growth in the absence of gender-specific human capital considerations, its impact differs significantly when male and female educational attainment levels are incorporated. Specifically, financial development has a positive effect on productivity growth when male education levels are high. Surprisingly, financial development hinders productivity growth when female education levels are high. These insights highlight the disproportionate effects of male versus female education on productivity growth in India. This study contributes to the literature by emphasizing the differential impacts of financial development on India's productivity growth in the presence of gender-specific human capital. The analysis highlights the role of gender dynamics in educational advancement for policymakers seeking to leverage financial development as a catalyst for productivity growth. Furthermore, policymakers in India are encouraged not to underestimate the importance of male education in strengthening financial development and enhancing productivity growth. Additionally, policymakers should examine the adverse implications of financial development on productivity growth within the context of higher levels of female education.

Li and Liao [1] investigated the heterogeneous effects of financial development on green TFP for 40 countries during the period 1991–2014. In this study, financial development was examined from three perspectives: banking, securities, and insurance development. The findings reveal that in developing countries, an inverted U-shaped relationship exists between financial development and green TFP, regardless of whether financial development occurs through banking, securities, or insurance sectors. In developed countries, banking and insurance development have adverse effects on green TFP, whereas securities market development consistently exerts a positive effect. Moreover, securities market development is more effective than banking development in improving green TFP.

Ezzahid and Elouaourti [33] examined the relationship between financial development and economic growth through the channel of TFP in African economies during the period 2004–2014. In the first stage, the researchers constructed a composite financial development index for 40 African countries. Subsequently, using a panel data methodology based on the Breusch–Pagan LM test and the Hausman test, the appropriate model was estimated and analyzed. The results indicate that financial sector development does not improve TFP in low-income and upper-middle-income countries. However, for lower-middle-income countries, the relationship between financial development and TFP is significantly positive. The researchers suggest that policymakers should design and implement financial system reforms tailored to the specific needs of each economy in order to enhance the adequacy of financial services.

Han and Shen [34] estimated the impact of regional financial development in China on TFP growth using provincial panel data for the period 1990–2009 through a nonparametric stochastic frontier data envelopment approach. The study examined how financial development contributes to productivity improvement and technological progress, which represent two components of TFP. The findings demonstrate that financial development in China plays an important role in promoting TFP growth through technological progress

rather than efficiency changes. The faster financial development occurs, the more effectively resource allocation mismatches can be corrected, thereby enhancing TFP growth. The results suggest that China should further optimize financial resource allocation and improve regional financial systems. Arizala et al. [35] investigated the effect of financial development on TFP growth at the industry level using a panel model for 77 countries, based on data from 26 manufacturing industries during the period 1963–2003. The findings indicate a significant relationship between financial development and industrial performance. The results are statistically and economically significant. TFP growth can accelerate by up to 0.6 percent annually, depending on industries' external financing needs, following a one-standard-deviation increase in financial development. This study aims to investigate the relationship between financial development and economic growth through the channel of TFP in selected countries. Accordingly, the model proposed by Izahied and Zakaria [33] will be employed as follows:

$$TFP_{it} = \beta_0 + \beta_1 * Finance Index_{it} + \sum_{k=2}^8 \beta_k * X_{it,k} + u_{it}.$$

In the above equation, i denotes the country under investigation, t represents the time period, and β_i denotes the coefficients of the explanatory variables. $FinanceIndex_{it}$ represents the financial development index, while $X_{it,k}$ denotes the vector of control variables, including the inflation rate, trade openness, population growth rate, human capital level, and government expenditure. Furthermore, to examine the moderating role of countries' income levels in the relationship between financial development and TFP, the above model is estimated separately for three groups of countries: High-income, middle-income, and low-income economies. The classification of countries into these income groups is based on the world bank's database and country income classification.

Panel data provide greater flexibility for designing and estimating more complex behavioral models than either pure cross-sectional or pure time-series data. For example, panel data provide better opportunities for examining and modeling technical efficiency. They also make it possible to identify and measure effects that cannot be readily detected using only cross-sectional or time-series data. Panel datasets are typically compiled from relatively small observational units, such as individuals, firms, or households. Many variables can be measured more accurately at these microeconomic levels, while aggregation bias arising from combining individuals or firms is substantially reduced. Another important advantage of panel data is that relying solely on cross-sectional observations may result in biased parameter estimates. However, when these cross-sectional units are repeatedly observed over time to form panel data, unbiased and consistent parameter estimates can be obtained.

4 | Data Analysis

4.1 | Stationarity Test of the Variables

Stationarity tests are among the most important tests for estimating a regression model with reliable coefficients. They are employed to prevent the occurrence of spurious regression. Various tests are available for determining the stationarity of panel data; however, the Levin–Lin–Chu (LLC) test is the most commonly used. The null hypothesis of this test indicates the presence of a unit root in the time series under investigation. Therefore, if the null hypothesis is accepted, it can be concluded that the time series contains a unit root and is non-stationary. In this study, the LLC test is used to examine the stationarity of the model variables. The results of this test are presented in *Table 1*. The variables of trade openness, population growth rate, government expenditure, human capital, and the TFP index are stationary at level in the high-income countries, whereas the financial development index, inflation rate, and investment rate become stationary after first differencing. The stationarity test for the middle-income countries indicates that the variables of population growth rate, government expenditure, human capital index, and the TFP index are stationary at level, while the financial development index, inflation rate, trade openness, and investment rate become stationary after first differencing. For the low-income countries, the stationarity test results show that the

variables of trade openness, population growth rate, government expenditure, human capital index, and the TFP index are stationary at level. In this group, the financial development index, inflation rate, and investment rate become stationary after first differencing.

Table 1. Stationarity test of the variables using the LLC method.

Variable	Test Stat	Probability	Result
High-Income Countries			
FD	-0.77	0.15	Not stationary at level
D(FD)	-3.64	0.002	Stationary at first difference
INF	3.05	0.94	Not stationary at level
D(INF)	-6.89	0.000	Stationary at first difference
OPEN	-2.09	0.04	Stationary at level
POP	-11.07	0.000	Stationary at level
GOVEXP	8.19	0.001	Stationary at level
HC	-9.73	0.000	Stationary at level
INV	-1.33	0.134	Not stationary at level
D(INV)	-12.72	0.000	Stationary at first difference
TFP	-2.03	0.04	Stationary at level
Middle-Income Countries			
FD	-0.67	0.13	Not stationary at level
D(FD)	-4.15	0.001	Stationary at first difference
INF	3.79	0.91	Not stationary at level
D(INF)	-6.74	0.000	Stationary at first difference
OPEN	-1.25	0.112	Not stationary at level
D(OPEN)	-2.09	0.04	Stationary at level
POP	-9.68	0.000	Stationary at level
GOVEXP	6.19	0.002	Stationary at level
HC	-10.34	0.000	Stationary at level
INV	-1.46	0.135	Not stationary at level
D(INV)	-9.39	0.000	Stationary at first difference
TFP	-6.49	0.001	Stationary at level
Low-Income Countries			
FD	-0.49	0.21	Not stationary at level
D(FD)	-3.26	0.03	Stationary at first difference
INF	-0.79	0.13	Not stationary at level
D(INF)	-4.69	0.003	Stationary at first difference
OPEN	-4.25	0.002	Stationary at level
POP	-7.19	0.000	Stationary at level
GOVEXP	-2.58	0.04	Stationary at level
HC	-5.34	0.03	Stationary at level
INV	-0.46	0.25	Not stationary at level
D(INV)	-7.21	0.001	Stationary at first difference
TFP	-2.38	0.04	Stationary at level

4.2 | Panel Cointegration Test

To avoid the problem of spurious regression, the existence of a cointegration relationship among the model variables is examined. Several tests with different approaches have been developed to assess panel cointegration, among which the Pedroni [36] and Kao [37] tests are the most widely used. The Kao and Pedroni tests are based on the residuals obtained from the regression model and are analogous to the Engle–Granger cointegration test applied to time-series data. In the present study, the Kao [37] cointegration test is employed to examine the existence of cointegration among the variables. The null hypothesis of this test states that the variables are not cointegrated in each cross-sectional unit, whereas the alternative hypothesis indicates that a cointegrating vector exists for each cross-sectional unit. One of the advantages of this test is that the cointegrating vectors are not required to be identical across all cross-sectional units, since they are not assumed to be strictly homogeneous. The results of the cointegration test are reported in *Table 2*, indicating that the null hypothesis is rejected for all three groups under investigation.

Table 2. Panel cointegration test results.

Test	Stat	Probability
Regression model for high-income countries	-3.16	0.03
Regression model for middle-income countries	-5.74	0.01
Regression model for low-income countries	-4.92	0.01

4.3 | Model Selection

Because the study population is divided into three groups, including high-income countries, middle-income countries, and low-income countries, the aforementioned regression model, which is designed to investigate the effect of financial development on the TFP index, is estimated separately for each group of countries. However, prior to estimation, the appropriate model specification was determined using the F-Limer test and the Hausman test.

4.3.1 | F-Limer test

The F-Limer test (chow test) is employed to determine whether the pooling method or the panel data method should be used. The null hypothesis of the F-Limer test is based on the absence of panel data (i.e., the use of pooled data). To reject the null hypothesis and confirm the use of the panel data approach, the p-value should be less than 0.05. The results of this test, conducted using EViews, are presented in *Table 3*.

Table 3. Results of the F-Limer test for selecting between the pooling and panel data models.

Regression Model	F-Stat	P-Value	Test Result
Regression model for high-income countries	4.28	0.001	Use of panel data method
Regression model for middle-income countries	9.56	0.000	Use of panel data method
Regression model for low-income countries	5.47	0.002	Use of panel data method

4.3.2 | Hausman test

As mentioned earlier, the regression models for the three groups of countries under investigation should be estimated using the panel data method. In the panel data approach, the Hausman test is employed to determine whether fixed effects or random effects should be applied. The null hypothesis of the Hausman test is based on the rejection of the fixed-effects model (i.e., the use of the random-effects model), and the hypotheses can be expressed as follows:

H0: The fixed-effects model cannot be used for estimation in the panel data method (the random-effects model should be used in the panel data method).

H1: The fixed-effects model can be used for estimation in the panel data method.

To reject the null hypothesis in favor of the fixed-effects model, the p-value should be less than 0.05. As shown in *Tables 4-6*, the significance level of the Hausman test for the regression equation in high-income countries, middle-income countries, and low-income countries is calculated to be less than 0.05 (Prob < 0.05). Therefore, the Hausman test results support the use of the fixed-effects model for all three groups of countries under investigation.

Table 4. Results of the hausman test.

Regression Model	F-Stat	P-Value	Test Result
Regression model for high-income countries	6.34	0.004	Fixed effects
Regression model for middle-income countries	11.98	0.001	Fixed effects
Regression model for low-income countries	5.27	0.004	Fixed effects

4.4 | Estimation of the Regression Models

The F-Limer and Hausman test results for all three country groups showed that the regression model for these countries is a panel data model with fixed effects. The estimates for these models are presented in *Table*

5. The results of the estimation of the research model are presented in *Table 5*. Note that since the logarithms of the variables are included in the model, the estimated coefficients represent elasticities. The P_value of the F-statistic, used to assess the overall significance of the regression model, is less than 0.05 in all three models under investigation, indicating that all three estimated regression models are statistically significant. The value of the R^2 statistic in the regression models for high-, middle-, and low-income countries is calculated as 83%, 89%, and 69%, respectively, indicating that the proposed models have the ability to explain 83%, 89%, and 69% of the variations in the TFP index in high (*Table 5*), middle-, and low-income countries, respectively (*Table 6*).

Table 5. Estimation results of the model.

Variable	Coeffi.	S.D	t-Stat	Probability
High-Income Countries				
C	2.161	0.6738	3.207	0.004
FD(-1)	0.826	0.0150	5.490	0.002
INF(-1)	0.104	0.0041	2.522	0.046
OPEN(-1)	0.258	0.1296	1.99	0.048
POP	-0.341	0.0069	4.890	0.000
GOVEXP	0.426	0.1201	3.574	0.003
HC	0.855	0.0137	6.023	0.000
INV	0.293	0.709	5.387	0.001
F statistic	10.562			0.001
R-Squared	83.24			
Number of countries	16			

Table 6. Regression results for middle- and low-income countries.

Countries with Middle Income				
C	1.815	0.7671	2.366	0.004
FD(-1)	0.0121	0.0018	6.523	0.002
INF(-1)	0.0089	0.0013	3.618	0.000
OPEN(-1)	0.138	0.0660	2.09	0.041
POP	-0.02601	0.0056	4.627	0.000
GOVEXP	0.2756	0.7468	0.369	0.748
HC	0.0042	0.0016	2.547	0.036
INV(-1)	0.0076	0.0028	2.635	0.043
F statistic	15.840			0.000
R-Squared	89.57			
Number of countries	16			
Low-Income Countries				
C	1.216	0.3230	3.764	0.003
FD(-1)	-0.0013	0.0018	-0.722	0.392
INF(-1)	0.003	0.004	0.64	0.892
OPEN	0.0023	0.0020	1.13	0.485
POP	0.0041	7.160	5.726	0.000
GOVEXP	-0.0652	0.0300	-2.169	0.043
HC	-0.0536	0.1246	-0.43	0.875
INV(-1)	0.0029	0.0011	2.481	0.043
F statistic	9.169			0.001
R-Squared	69.37			
Number of countries	11			

As shown, the coefficient of the financial development variable (FD) is positive and significant in high-income countries and middle-income countries, at 0.0826 and 0.0121, respectively. However, this coefficient is not statistically significant in low-income countries. Accordingly, financial development has not been able to improve the TFP index in low-income countries, whereas high- and middle-income countries have been able to utilize this capacity to create conditions for improving productivity.

The coefficient of the inflation rate variable (INF) is positive in all three groups of countries. However, the coefficient obtained for low-income countries is not statistically significant, whereas it is statistically significant in high-income and middle-income countries, amounting to 0.0104 and 0.0089, respectively. The coefficient of the degree of economic openness variable (OPEN) is positive in all three groups of countries. However, the coefficient obtained for low-income countries is not statistically significant, whereas it is statistically significant in high-income and middle-income countries, amounting to 0.258 and 0.138, respectively. Accordingly, economic openness in these two groups of countries has played an important role in improving the TFP index. The coefficient of the population growth rate variable (POP) indicates different effects in low-income countries compared with the two groups of high-income and middle-income countries. Specifically, this coefficient is positive and statistically significant, but small, in low-income countries, amounting to 0.004, indicating that a one-percent increase in the population growth rate in these countries leads to a 0.004 percent increase in TFP. In contrast, this coefficient is negative and statistically significant in high-income and middle-income countries.

The coefficient of the government expenditure variable (GOVEXP) is positive and statistically significant in high-income and middle-income countries, amounting to 0.426 and 0.2756, respectively, whereas the coefficient obtained for low-income countries is negative and statistically significant. The coefficient of the human capital variable (HC) is positive and statistically significant in high-income and middle-income countries, consistent with theoretical expectations, amounting to 0.0855 and 0.0742, respectively; however, this coefficient is negative and statistically insignificant in low-income countries. Accordingly, human capital has not been able to improve the TFP index in low-income countries, whereas high- and middle-income countries have been able to utilize this capacity to create conditions for improving productivity.

The coefficient of the investment rate variable (INV) is positive and statistically significant in all three groups of countries. However, the coefficient obtained is 0.0029 for low-income countries, 0.0079 for middle-income countries, and 0.0293 for high-income countries, indicating substantially different effects of the investment rate on the TFP index across these three country groups. Specifically, the effect of a one-percent increase in investment on the TFP index in high-income countries has been approximately ten times greater than that in low-income countries.

5 | Discussion and Conclusion

Financial development mainly affects TFP through technological progress and capital allocation [4]. Research on financial development to promote TFP growth through technological progress originated from the endogenous growth theory proposed by Romer [5]. Since technological innovation supported by financial resources has significant positive externalities, investment in research and development promotes endogenous technological progress and consequently leads to TFP growth. Buera and Shin [6] suggest that financial development can effectively reduce frictions in the economic system and promote TFP growth through improvements in efficiency and technological progress.

However, the impact of financial development on capital allocation is not always positive. Optimal resource allocation can promote TFP growth, whereas resource misallocation can hinder TFP growth. Buera and Shin [6] found that in some emerging economies or developing countries experiencing rapid economic growth, innovative high-tech small and medium-sized enterprises have short periods of capital accumulation and lack sufficient collateral, making financing difficult and creating resource misallocation resulting from financial constraints; consequently, financial development is not conducive to TFP growth.

Cole et al. [7] state that inefficient capital allocation resulting from capital mismatches within the financial system hinders improvements in TFP in some countries. At different stages of economic development, financial development has heterogeneous effects on TFP, particularly across different countries. Rioja and Valev [8] pointed out that the relationship between financial development and TFP may not be adequately explained by a purely linear relationship. Across different countries, the role of financial development in promoting TFP growth differs considerably, and an inverted U-shaped relationship exists between them. Han

and Shen [34] found that financial sector development may hinder TFP growth in low-, high-, and middle-income economies.

Sahay et al. [38] found that although financial development has a positive effect on economic growth, this effect is absent in some low-income countries. Financial markets with low levels of financial development are unable to form high-productivity business sectors due to inadequate risk diversification functions, whereas low-productivity non-tradable sectors are more likely to survive. A developed financial system can provide risk diversification and hedging services, effectively reduce investors' risk concerns regarding technological innovation in firms, and consequently encourage firms to undertake technological upgrading and innovation activities. Based on this evidence, it can be observed that the impact of financial development on TFP and, consequently, economic growth depends on the level of development of countries. Thus, financial development does not always lead to economic growth; once financial development reaches a certain level, further financial development may no longer be conducive to economic growth [11]. In other words, moderate financial development is beneficial to economic growth, whereas excessive financialization may hinder economic growth [12].

The results obtained from the estimation of the model in the present study, consistent with theoretical expectations and previous studies in this field, also confirm that the impact of financial development on the TFP index depends on the level of development and income level of countries. Specifically, the coefficient of the financial development variable in high-income countries and middle-income countries is positive and statistically significant, amounting to 0.0826 and 0.0121, respectively. This means that a one-percent improvement in the financial development index leads to an improvement of 0.08 percent and 0.01 percent in TFP in high-income countries and low-income countries, respectively. Another important point concerning the magnitude of the effect of financial development on TFP is that, based on the results obtained, this coefficient is considerably larger in high-income countries, which is also consistent with theoretical expectations and previous research.

On the other hand, consistent with theoretical expectations and based on the results obtained from the estimation of the model, this coefficient is not statistically significant in low-income countries. Accordingly, financial development has not been able to improve the TFP index in low-income countries, whereas high- and middle-income countries have been able to utilize this capacity to create conditions for improving productivity. Based on these results, the research hypotheses are confirmed.

5.3 | Research Suggestions

The main results based on country groups indicate that the development of the financial sector does not enhance TFP in low-income countries. The lack of an effect of financial development on TFP in these countries is attributable to the inadequacy of financial services available to economic agents. Since economic development depends more on the quality of available financial services than on their source or size [39], [40], the policy recommendation of the present study for low-income countries and even middle-income countries, in order to benefit more from the relationship between financial development and productivity, is that reforms of financial systems in these countries should be designed and implemented in a manner that enhances the adequacy of financial services to meet the needs of the economy and its level of development.

Future studies could use the human development index instead of the income-level variable to gain a deeper understanding of the relationship between the financial development index and the TFP index in relation to the level of development of countries. Furthermore, extending this study by incorporating indicators such as financial inclusion and financial innovation may contribute to strengthening the theoretical foundations in this field.

Abbreviation

TFP	Total Factor Productivity
ILO	International Labour Organization
APO	Asian Productivity Organization
VAR	Vector Autoregressive
OECD	Organisation for Economic Co-operation and Development
ARDL	Autoregressive Distributed Lag
ECM	Error Correction Coefficient
LLC	Levin–Lin–Chu

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter discussed in this manuscript.

Data Availability

All data relevant to this study are contained within the manuscript. Additional information is available from the corresponding author upon reasonable request.

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Use of Artificial Intelligence

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