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THE MULTIDIMENSIONAL EFFECT OF FINANCIAL DEVELOPMENT ON TOTAL FACTOR PRODUCTIVITY: EVIDENCE FROM CROSS-COUNTRY PANEL DATA*

Finansal Gelişmenin Toplam Faktör Verimliliği Üzerindeki Çok Boyutlu Etkisi: Ülkeler Arası Panel Verilerinden Elde Edilen Kanıtlar

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Keywords:
Financial Development, Financial Markets, Financial Institutions, Total Factor Productivity, Panel Data, Driscoll Kraay Standard Error, Developing Countries

JEL Codes:
G3, G10, G15, G18, G20, C23

Abstract

This paper estimates the impact of financial development on total factor productivity (TFP) using panel data from 2002 to 2019. Employing the Driscoll-Kraay Standard Error (DKSE) approach, we analyze the relationship between financial development and its components (financial institutions and financial markets) with TFP. The results confirm the existence of a positive and significant relationship between financial development and TFP, suggesting that financial development plays a facilitating role in TFP. It was found that financial institutions have a positive and significant effect on TFP, while financial markets do not have a significant effect on TFP. Moreover, while the effect of financial development on TFP is positive and significant in developing countries, there is no clear evidence of such an effect in developed countries. Among the control variables included in the model, trade openness, foreign direct investment, and economic growth have a positive effect on TFP, while human capital has a negative effect. Furthermore, it is confirmed that institutional quality indicators also have a positive impact on TFP when included in the model. Our results suggest that policies favouring financial development should be pursued further in order to correct the mismatch in resource allocation and thus promote TFP growth.

Anahtar Kelimeler:
Finansal Gelişme, Finansal Piyasalar, Finansal Kurumlar, Toplam Faktör Verimliliği, Panel Veri, Driscoll-Kraay Standart Hatalı, Gelişmekte Olan Ülkeler

JEL Kodları:
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Öz

Bu çalışmada finansal gelişmenin toplam faktör verimliliği (TFP) üzerindeki etkisi 2002 ile 2019 yılları için panel veri analizi ile tahmin edilmektedir. Driscoll-Kraay standart hata (DKSE) yaklaşımını kullanarak, finansal gelişme ve alt bileşenleri (finansal kurumlar ve finansal piyasalar) ile TFP arasındaki ilişki analiz edilmektedir. Finansal gelişme ile TFP arasında pozitif ve anlamlı bir ilişkinin varlığını doğrulamakta ve finansal gelişmenin TFP üzerinde arttıcı bir rol oynadığını ortaya koymaktadır. Dirençlilik analizi sonucunda finansal kurumların TFP üzerinde pozitif ve anlamlı bir etkisinin olduğu, öte yandan, finansal piyasaların TFP üzerinde anlamlı bir etkisinin olmadığı sonucuna ulaşılmıştır. Ayrıca, finansal gelişmenin TFP üzerindeki etkisi gelişmekte olan ülkelerde pozitif ve anlamlı iken, gelişmiş ülkelerde böyle bir etkiye dair net bir kanıt bulunamamıştır. Modelde yer alan kontrol değişkenleri arasında, ticaret açıklığı, doğrudan yabancı yatırımlar ve ekonomik büyüme TFP'yi pozitif yönde etkilerken, beşeri sermaye negatif bir etkiye sahiptir. Ayrıca, kurum kalite göstergelerinin modele dahil edildiğinde TFP üzerinde pozitif bir etkisi olduğu doğrulanmıştır. Bulgularımız finansal gelişmeyi destekleyen politikalara ağırlık verilmesi sonucunda, kaynak tahsisindeki uyumsuzluğun giderilerek TFP büyümesinin artırılabileceğini ortaya koymaktadır.

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1. Introduction

Total factor productivity (TFP) is vital for driving long-term economic growth and improving people's living standards within a country. In recent decades, many developing and emerging economies have witnessed notable productivity growth, largely driven by financial development. This has facilitated greater access to capital, encouraged innovation, and improved efficient allocation of resources (Levine, 2005). Financial development has been a driving force behind this progress, through strengthening of financial institutions, enhanced market liquidity, and better risk management, which have allowed firms to make more productive investments, contributing to overall economic growth (King and Levine, 1993). However, despite significant gains in the early 21st century, the trend of productivity growth seems to have slowed in recent years. As Adler et al. (2017) highlights, the pace of TFP growth has decelerated in several emerging economies, suggesting that the positive effects of financial development on productivity may be diminishing. New challenges, such as structural inefficiencies, market saturation, and global economic uncertainties, are clearly hindering further progress.

The relationship between financial development and TFP is a key topic for researchers, especially after the global financial crisis. Since then, many researchers and policymakers have directly challenged previously accepted notion that financial development is linked directly to total TFP growth. Before the crisis, it was generally accepted that financial system deepening and efficiency led to higher productivity and accelerated economic growth (King and Levine, 1993; Levine, 2005). However, in the aftermath of the crisis, this perspective has been contested by certain studies proposing that the impact of financial development on productivity is more intricate and context-specific. Specifically, unregulated expansion of financial systems and prevalence of risky lending practices resulted in deleterious effects on TFP in several countries following the crisis (Adler et al., 2017), underscoring the importance of financial stability for sustainable growth. These novel perspectives underline the necessity for a more nuanced understanding of the relationship between financial development and TFP, which may vary under different conditions.

A well-functioning financial market, which emerges because of financial development within a country, has been shown to lower transaction costs and allocate resources more effectively to high-productivity sectors. This, in turn, has been demonstrated to foster technological advancements and facilitate overall economic growth (Alfaro et al., 2009). Čihák et al. (2015) have suggested that financial development is shaped by both financial markets and institutions, with its success largely depending on their depth, accessibility, and efficiency. A robust financial system has also been shown to enhance a nation's capacity to adopt new technologies (Dabla-Norris et al., 2021).

A substantial body of empirical evidence indicates that effective financial markets enhance a country's capacity to integrate foreign technology, notably through foreign direct investment, which subsequently fosters productivity growth in the host country (Alfaro et al., 2009). Numerous countries have advocated for financial market development through reforms, including the liberalization of interest rates, enhanced credit distribution across various sectors, and extensive institutional and legal modifications. These reforms have been particularly significant in removing barriers that previously hindered the growth of the financial sector. In numerous nations, reforms have catalyzed the shift to market-based systems, reduced government intervention in financial markets, and improved the allocation of resources to the most efficient

sectors, thereby stimulating productivity growth. Following these reforms, emerging market economies have witnessed substantial financial deepening over the past decade (Sahay et al., 2015). However, recent years have brought attention to a slowdown in potential growth in certain emerging markets and developing economies (Dabla-Norris et al., 2021). This has raised critical questions about the influence of a country's financial structure and its level of development on the link between financial growth and productivity improvements.

Financial development has been identified as a significant catalyst for economic growth, enhancing the efficiency of the economic system. The positive correlation between economic growth and financial development is particularly pronounced in developing countries. Financially underdeveloped countries often find themselves entrenched in a cyclical pattern wherein inadequate financial development endangers economic performance, which in turn gives rise to further financial development challenges. In a nutshell, financial sector exerts a favourable influence on growth by mitigating poverty and augmenting welfare. Financial development facilitates entry into the credit market even for low-income households, thereby stimulating their economic activities, enhancing their ability to take advantage of investment opportunities, and promoting entrepreneurship (Wu et al., 2020: 2). The process of economic growth stems from advancements in the institutional structure of the economy, as well as from factors used in the production process and productivity improvements of these factors. The combination of productivity growth with economic growth establishes the fundamental economic foundations for sustained economic growth over time, as production becomes less dependent on inputs (Yalçınkaya, 2017: 42). TFP offers valuable insights into the supply side of the economy, encompassing strong welfare practices, technological progress measurement, competitiveness, and export performance (Bardaka et al., 2021). As a fundamental indicator used to evaluate countries' growth and development efforts, TFP explains the reasons for growth differences between countries and is also important for identifying which production factors are utilized more effectively in the production process. For countries aspiring to a higher level of welfare, exploring ways to use their resources appropriately and effectively is a common aspect of their growth efforts. In this growth effort, diversification and increase of consumption, alongside population and income growth necessitate seeking new resources on the one hand and ensuring the most efficient use of existing resources on the other (Vergil and Abasız, 2008: 160-161). Thus, achieving productivity improvements in the factors used in production is crucial for each economy. Therefore, identifying the factors influencing TFP and making improvements in these areas will increase the potential growth rate.

The aim of this study is to analyse the effect of financial development on TFP. In addition to financial development variables, six sub-headings of institutional quality indicators are included in the model. These are control of corruption, political stability, government effectiveness, regulatory quality, rule of law and absence of violence. Financial development indicators commonly used in the literature include ratios such as the ratio of money supply in circulation M2 to gross domestic product (GDP) or the ratio of credit volume to GDP, which measure the size of the financial system. However, the diversity of financial systems across countries highlights the need to consider more than one indicator to measure financial development. To this end, this study uses the broad financial development index developed by Sahay et al. (2015) and published in the IMF database, rather than the traditional development indicators generally accepted in the literature. This new index is a combination of two sub-indices: financial institutions (including banks, insurance companies, mutual funds, pension funds and

other types of non-bank financial institutions) and financial markets (mainly including stock and bond markets). The study analyses the influence of these two sub-indices on TFP, as well as the financial development index. The dataset covers the years 2002-2019 for a total of 78 developed and developing countries. The Driscoll-Kraay standard error (DKSE) approach is used to obtain empirical results. The DKSE approach is applied to panel data analysis. In the DKSE approach, the fixed effects model was selected by performing the Hausman test. DKSE is a robust approach against autocorrelation and cross-sectional dependence (CD). For the empirical results, we first analyzed the influence of financial development on TFP. Then, for the robustness analysis, we examined the impact of financial institutions and financial markets indices, which are sub-indices of financial development, on TFP. According to the findings, the financial development and financial institutions indices have significant and positive effects in almost all models. On the other hand, the financial market index is insignificant in each model. Among the control variables included in the model, trade openness, foreign direct investment, and economic growth have positive effects on TFP, while the human capital variable has a negative effect. The positive effect on TFP is also observed when institutional quality indicators are included in the model.

The remainder of the paper is organized as follows: Section 2 reviews the empirical literature. Section 3 provides a description of the data and control variables. Section 4 presents the empirical model. Section 5 explains the methodology. Section 6 discusses the empirical results, and Section 7 provides the robustness test. Section 8 concludes with the policy implications.

2. Literature Review

Endogenous growth theory posits that financial development can stimulate economic growth by promoting improvements in productivity (Guglielmo et al., 2003). However, recent research suggests that the strong correlation between financial development and growth has weakened in recent years (Sahay et al., 2015). This ambiguity surrounding the relationship between financial development and productivity growth highlights the necessity for further empirical investigation. In this study, the linkage between financial development and productivity growth in emerging market economies is re-evaluated. This section is outlined as follows: First studies examining the relationship between financial development and economic growth are reviewed; second, empirical evidence on the effect of financial development on TFP is discussed.

A considerable number of empirical studies have been conducted on the link between financial development and economic growth, yielding mixed results (Asteriou and Spanos, 2019; Botev et al., 2019). Beck et al. (2004) found that the development of the banking sector and stock markets positively affects economic growth. In a similar vein, Demirgüç-Kunt and Levine (2008) conducted a theoretically and empirically oriented examination of the effects of financial development on economic growth. The authors analysed the relationship between financial development and economic growth in greater depth by investigating the levels of financial system development and their relationship with economic growth in over 70 countries between 1960 and 2000, using regression analysis and panel data models. The results of the analysis demonstrate a positive correlation between financial development and economic growth, with this relationship being particularly pronounced in developing countries. Furthermore, the study identified financial intermediaries such as banks and capital markets, as playing a pivotal role in facilitating growth and productivity increases in various countries. Leitao (2010) conducted a study encompassing

27 EU countries and five BRICS countries between 1980 and 2006, which revealed a positive correlation between economic growth and financial development. Adusei (2013) utilized the dynamic GMM method on a dataset comprising 24 selected African countries between 1981 and 2010, thereby confirming a positive relationship between economic growth and financial development. In his study, Bölükoğlu (2021) conducted a threshold analysis of the finance-growth relationship using a fixed-effects model and a dataset covering 100 countries from 1995 to 2018. The findings show that the finance-growth relationship is significant when the level of financial development is low; however, as the level of financial development increases, this relationship becomes insignificant. Batuo et al. (2018) stated that financial development and financial liberalization positively impact financial instability, while economic growth reduces financial instability. Sepehrdoust (2018) reported that the financial development index positively affects economic growth. The financial development index includes variables such as domestic investments, oil revenues, domestic credit payments of the private sector, and M3 money supply. Other studies conducted by Luintel and Khan (1999) and Li and Marinč (2018) also proclaim that there is a causal relationship between economic growth and financial development. Aydın (2019) investigated relationship between financial development and economic growth in the Fragile Five countries using the Westerlund co-integration method for the period 1992-2016. The study reveals a long-term relationship between financial development and economic growth. Additionally, the DOLS and FMOLS estimators demonstrate a positive and significant relationship between financial development and economic growth. In their study, Dogan et al. (2020) examined indicators related to the development of the stock market and banking sector, finding that stock market development has a significant and positive impact on economic growth. However, the development of the banking sector negatively affects economic growth. Cheng et al. (2021) showed that the connection between financial development and economic growth is negative, especially in high-income countries. Sethi et al. (2020) investigated the influence of globalization, financial development, economic growth, and energy consumption on environmental sustainability. According to their findings, as globalization and financial development increase, economic performance also improves, but this negatively affects environmental sustainability. Variables such as money supply, domestic credit to the private sector by banks, the total value of banks in the stock market, and the total capital of banks were used to measure financial development.

Despite extensive research on the linkage between finance and growth in the empirical literature, there remains a paucity of empirical evidence concerning the role of financial development in productivity growth in developing countries. In recent years, as potential growth rate of the global economy has slowed while financial depth has increased, the analysis of the link between financial development and productivity growth has become more importance. King and Levine (1993), for instance, identified a strong positive link between financial development and TFP, considering the growth rates of per capita GDP and per capita capital stock. Beck et al. (2000) demonstrated that financial development positively impacts TFP, which in turn triggers economic growth. Arestis et al. (2001) examined the effects of financial development on economic growth and TFP using cross-country panel data. The study was conducted using panel data covering 16 developing countries for the period 1970-1997. The authors' results show a financial development exerts a significant and positive influence on economic growth and TFP. Specifically, it was determined that financial intermediation fosters economic growth and TFP by ensuring the efficient allocation of investments and resources. Moreover, deepening and enhanced

efficiency of financial systems in developing countries were identified as significant factors in the improvement of economic performance. Guiso et al. (2004) analyzed data from developed and developing countries to assess how different financial systems impact overall productivity. The study found that countries with more developed financial systems experienced faster productivity growth. The authors pointed out that financial development enhances productivity by improving financial market efficiency, which leads to increased investment in high-productivity sectors. Xu (2011) investigated the relationship between financial development and firm-level TFP. The study used firm-level data across multiple countries to analyze how differences in financial development impact TFP. The findings revealed that financial development enhances firm-level TFP by enabling a more efficient allocation of resources toward the most productive firms and projects. Ezzahid and Elouaourti (2018) stated that financial development is conducive to economic growth, optimises the distribution of investments, and stimulates TFP, yet has a deleterious effect on saving behavior. The results show inconsistent findings across different income levels. Specifically, the results demonstrate that while financial development positively impacts TFP in lower-middle-income countries, it does not support TFP in low-income and upper-middle-income countries. Indicators of financial development included number of commercial bank branches, M2 money supply, domestic credit provided by the banking sector, and the number of ATMs. Yang (2019) noted that financial development positively contributes to economic growth through changes in physical capital stock and TFP. Indicators such as M3 money supply, private sector credit, the total value of banks in the stock market, and the share of government final consumption expenditures in GDP were used for physical capital. Calub (2011) argued that there is a negative relationship between financial development and TFP. Rehman and Islam (2023) undertook the CS-ARDL procedure for BRICS economies from 1990 to 2019 and found a positive relationship between financial infrastructure and TFP in both the short and long runs. Le et al. (2024) conducted an industry-based study of the US economy for the years 1977-1997, examining the effect of financial development on productivity. They asserted that financial development is an essential variable for increasing productivity in stagnant industries. Furthermore, they posited that policymakers must give due importance to financial development if economies are to experience an increase in economic growth. Bolbol et al. (2005) used period of 1974 to 2002 in Egypt to explore relationship between financial development indicators and TFP. They separated the financial development indicators into two categories—bank-based and market-based—and examined the connection between the two. TFP is positively impacted when bank-based measures are linked to GDP per capita. Ezzahid and Elouaourti (2018) examined the financial development and TFP relationship for 22 African countries during the period 2004-2014. They divided the countries into income groups, but did not find a positive effect in any income group except lower-middle income African countries. Although the effect is positive in the lower-middle income group, effect is also quite low. They attribute this to the underdevelopment of the financial sector. Spiegel (2000), Neimke (2003), and Yao (2011) are among other studies investigating the relationship between financial development and TFP.

3. Data

This research uses a panel dataset covering 78 countries (Appendix I) from 2002 to 2019. The choice of 78 countries was predicated on the availability of data on our variables, ensuring the robustness and credibility of our analysis. By including a wide range of countries from

different geographical regions and income levels, we aim to provide a comprehensive picture of the global financial landscape and generate insights with broad applicability. To further enhance our understanding, subgroup analyses are conducted, stratified by income levels. The countries are divided into two income categories: developed and developing, based on World Bank classifications. The data utilised in this study is drawn from various sources. Specifically, for productivity measures, TFP indices are extracted from the Penn World Table (PWT), specifically the latest version 10.0 by Feenstra et al. (2015). Within the PWT, there are two pertinent variables for TFP levels: TFP at constant national prices (2011=1) and TFP level at current PPPs (USA=1). According to Feenstra et al. (2015), TFP at constant national prices (2011=1) offers a comprehensive empirical assessment of productivity growth over time in each country and is thus employed as a proxy for TFP levels. The broader index for financial development is sourced from the World Bank's new database on financial development, known as the Global Financial Development Database, and is used to proxy financial development (FD).

The selection and measurement of financial development indicators remain an important topic of discussion. A large body of literature largely approximate financial development with a ratio of a broad measure of monetary aggregates (i.e., M1, M2, and M3) to GDP (Choong and Chan, 2011). The diversity of financial systems across countries means that multiple indicators are required to measure financial development accurately. To address the limitations of using single indicators as proxies for financial development (such as the ratio of private credit to GDP or stock market capitalization to GDP), we follow the studies of Čihák et al. (2012) and Svirydzenka (2016), which propose the New Broad-based Index of Financial Development (Figure 1). According to Čihák et al. (2012) and Svirydzenka (2016), financial development is categorized into two components: financial institutions (FI) and financial markets (FM), which are further divided into depth, access, and efficiency. Financial institutions index include banks, insurance companies, mutual funds, and pension funds, while financial markets index encompass stock and bond markets. Financial development is characterized by the integration of depth, access, and efficiency elements. Depth is defined as the size of the market, access refers to the ability to access financial services, and efficiency is defined as low costs and high output. (Svirydzenka, 2016).

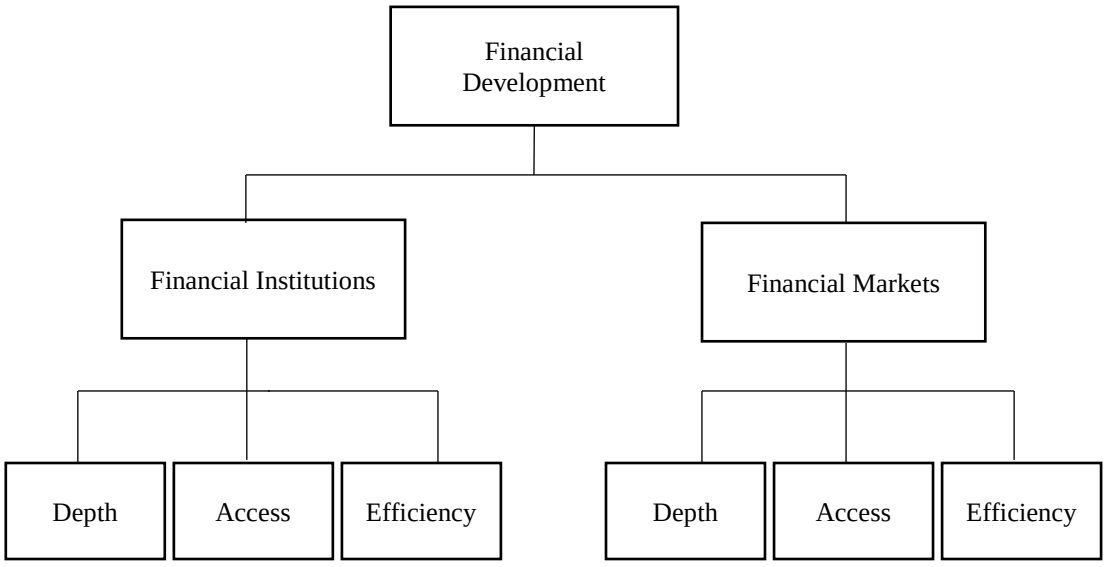

Figure 1. Financial Development Index
Source: Čihák et al. (2012).

Concerning the control variables, trade openness, patent applications, and GDP growth are extracted from the World Development Indicators (WDI) database. Additionally, the human capital index is obtained from the PWT, while foreign direct investment data is collected from the International Monetary Fund (IMF) database, as provided by Lane and Milesi-Ferretti (2007), to proxy FDI inflows. Institutional indicators, including control of corruption, government effectiveness, regulatory quality, rule of law, political stability and absence of violence, and voice and accountability, are extracted from the Worldwide Governance Indicators database (WGI) by the World Bank. Table 1 outlines the variable definitions and their respective sources.

Table 1. Definition of Variables

Variables	Notation	Descriptions	Sources
Dependent Variable			
Total Factor Productivity	TFP	$\frac{\text{Total output}}{\text{Weighted avarage of inputs}}$	Penn World Tables version 10.0
Main Variable			
Financial Development	FD	See Figure 1	World Bank (Global Financial Development Database)
Control Variables			
Trade Openness	TO	$\frac{\text{Export} + \text{Import}}{\text{GDP}}$	WDI
Human Capital	HC	Human capital index based on years of schooling and return to education.	Penn World Tables version 10.0
Innovations	INO	Numbers of patent applications submitted by the resident and non-resident people form inner and outer parts of different countries	WDI
Foreign Direct Investment	FDI	Foreign direct investment, stock (% of GDP)	Lane and Milesi-Ferretti (2007)
GDP growth	GROWTH	The annual growth rate of domestic production in percentage.	WDI
Institutional Variables			
Institutional Quality	CORR GOV REG LAW STAB VOICE	(1) control of corruption, (2) government effectiveness, (3) regulatory quality, (4) rule of law, (5) political stability and absence of violence (6) voice and accountability	World Governance Indicator (WGI), 2020 by Kaufmann et al. (2010)

4. Empirical Model

This paper investigates the nexus between financial development and TFP. The dependent variable in panel data regressions is the natural log of TFP (lnTFP) in real terms (2017=constant prices). Here, we are interested cross-country level productivity. Following Čihák et al. (2012), our explanatory variable is the financial development. For robustness, we also use the financial institutions (FI) and financial markets (FM) to examine our hypothesis.

We employ the following model to explore the influence of FD on TFP:

$$lnTFP_{it} = \alpha_{it} + \beta_1 lnFD_{it} + \beta_2 Controls_{it} + \beta_3 Institutional\ variables_{\ it} + \varepsilon_{it} \quad (1)$$

where i and t represent the country and year, respectively, and ε denotes the error term, β_1 captures the effect of FD on TFP. We incorporate a set of control variables in Eq (1) that influence TFP, including trade openness (TO), human capital (HC), innovations (INO), foreign direct investment (FDI), GDP growth (GROWTH) and six institutional indicators. All variables were included in the model by taking their logarithms.

5. Econometric Methodology

5.1. Cross-sectional Dependence Test

Prior to studying panel data models, one of the most crucial things to look into is cross sectional dependency (CD), as this will determine which econometric techniques are most suited. (Le and Sarkodie, 2020). The underlying premise of the first-generation panel unit root tests is cross-sectional independence of nations. In actuality, though, this assumption is limited. Dependence of cross-sectionality and the macroeconomic time series of several nations may have been impacted by a single event (Munir et al., 2020). The LM test was proposed by Breusch and Pagan (1980) to test the null hypothesis that there is no CD in the panel data and to investigate CD in the data. Large cross section units in panels, however, might not be a good fit for the LM test. In order to address this shortcoming, Pesaran (2004) built the CD test using the subsequent statistic:

$$\mathrm{D} = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(T-k)\hat{p}_{ij}^2 - E\left[(T-k)\hat{p}_{ij}^2\right]}{var\left[(T-k)\hat{p}_{ij}^2\right]} \quad (2)$$

where $\hat{p}_{ij}$ is taken as the sample of the pairwise distrubition coefficient of OLS residuals (Munir et al., 2020).

5.2. CADF Unit Root Test

One of the most important points of panel data analysis is stationarity. Unit root tests are performed to measure the stationarity of the series. The stationarity measurement varies depending on whether the data has CD. If there is CD, the second generation unit root test should be performed. In the current study, the second generation unit root test was applied. The most common tests for the second generation unit root test are the Cross-sectionally Augmented Dickey-Fuller (CADF) and CIPS test developed by Pesaran (2007). The reason for applying these tests is that the first generation unit root test does not make sense and is inefficient in the presence of a cross sectional dependence. Equation (3) contains the expression of the CADF test:

$$\Delta \mathrm{y}_{\mathrm{i,t}} = \alpha_i + \mathrm{b_i} \mathrm{y}_{\mathrm{i,t-1}} + \mathrm{c_i} \bar{\mathrm{y}}_{\mathrm{t-1}} + d_i \Delta \bar{\mathrm{y}}_{\mathrm{t}} + \varepsilon_{i,t} \quad (3)$$

where α_i is a deterministic term, $\bar{\mathrm{y}}_{\mathrm{t}}$ is the cross-sectional mean at time t, and $\bar{y}_{t-1}$ is the lagged level of the cross-section averages; i and t represent the country and year, respectively. Based on the average of the observed individual cross-section CADF statistics, Pesaran creates the CIPS test, a modified version of the IPS (Im Pesaran and Shin) t-bar test. The following is a derivation of the CIPS statistic according to Pesaran's (2007) notations:

$$CIPS = N^{-1}\sum_{\text{İ}=1}^{N} CADF \quad (4)$$

5.3 Driscoll-Kraay Standard Errors (DKSE)

The fixed effect with DKSE technique is used in this study. DKSE are robust to heteroscedasticity, autocorrelation, and general types of CD, so they are widely preferred in cases with CD (Hoechle, 2007). The DKSE method performs better than methods dealing with N>T approaches. By calculating changes across countries, it creates estimates using fixed-effect models that solve the problem of heterogeneity bias. DKSE is a method that allows using non-parametric, unbalanced and balanced panel data (Driscoll and Kraay, 1998; Ridwan et al., 2024). There are two steps when applying the fixed effect estimator. In the first stage, all model variables are processed by transforming them into $z_{it} \in \{y_{it}, x_{it}\}$:

$$\bar{z}_{it} = z_{it} - \bar{z}_i + \bar{\bar{z}} \quad (5)$$

It is mentioning that within-estimator relates to OLS estimator of $\tilde{y}_{it} = \tilde{x}'_{it}\emptyset + \tilde{\varepsilon}_{it}$ is the second step. Pooled OLS estimator is used to estimate the transformed regression model in Equation (5) (Rehman and Islam, 2023; Ridwan et al., 2024).

6. Empirical Results and Discussion

6.1. Descriptive Statistics and Pairwise Correlations

The descriptive statistics presented in Table 2 offer valuable insights into the variables under consideration, based on 1404 observations. LNTFP shows a mean of 0.001, with a standard deviation of 0.108, indicating smallest coefficient of dispersion (0.108) demonstrating its minimal variability.

Table 2. Descriptive Statistics

Variables	Mean	SD	Min.	Max.
LNTFP	0.001	0.108	-0.567	0.752
LNFD	-0.906	0.586	-2.617	-0.003
LNTO	4.321	0.513	3.017	6.080
LNHC	1.029	0.213	0.292	1.470
LNINO	7.557	2.330	0.693	14.248
LNFDI	11.186	1.981	4.041	16.162
GROWTH	3.522	3.575	-15.136	26.170
LNCORR	3.985	0.601	-0.636	4.605
LNSTAB	3.776	0.751	0.005	4.605
LNGOV	4.095	0.476	1.455	4.605
LNREG	4.095	0.476	1.455	4.605
LNLAW	3.978	0.686	-0.756	4.605
LNVOICE	3.976	0.649	0.853	4.605
Observations	1404	1404	1404	1404

LNFD, with a mean of -0.906 and a standard deviation of 0.586, displays considerable variation among the included countries. LNTO, with a mean of 4.321 and a standard deviation of

0.513, suggests relatively stable trends across the years and sampled economies. LNHC, with a mean of 1.029 and a standard deviation of 0.213, exhibits less variability within the sample over the years. LNINO, with a mean of 7.557 and a standard deviation of 2.330, reveals a significant variability over the years and among sampled economies. LNFDI, with mean and standard deviation values of 11.186 and 1.981 respectively, suggests a high degree of FDI mobility across both time and countries. GROWTH, with mean and standard deviation values of 3.522 and 3.575 respectively, implies high mobility of growth across the years and sampled countries.

Table 3 presents the pairwise correlation matrix of the variables under analysis. Notably, all explanatory variables, except LNHC, exhibit significant and positive correlations with LNTFP. Specifically, the correlation coefficient between LNFD and LNTFP is positive, measuring 0.067, suggesting that financial development may correspond to increased TFP, in line with prior research. LNTO and LNTFP display a positive association with a coefficient of 0.008, indicating a weak but positive relationship, implying that greater trade openness might be linked to elevated levels of TFP. Conversely, LNHC exhibits a negative correlation with LNTFP, with a coefficient of -0.083, indicating that higher human capital levels may potentially lead to reduced TFP. On the other hand, LNFDI demonstrates a positive correlation with LNTFP, recording a coefficient of 0.086, suggesting that countries with increased foreign direct investment levels may also experience higher TFP. Moreover, the positive correlation between GROWTH and LNTFP suggests that heightened economic growth could correspond to elevated TFP levels. Additionally, the positive correlations observed between institutional quality variables (LNCORR, LNSTAB, LNGOV, LNREG, LNLAW, LNVOICE) and LNTFP imply that nations with higher institutional quality might also exhibit higher levels of TFP.

Table 3. Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
LNTFP (1)	1.00												
LNFD (2)	0.067	1.00											
LNTO (3)	0.008	0.121	1.00										
LNHC (4)	-0.083	0.564	0.260	1.00									
LNINO (5)	0.078	0.520	-0.402	0.290	1.00								
LNFDI (6)	0.086	0.552	0.050	0.474	0.598	1.00							
GROWTH (7)	0.013	0.238	0.037	-0.266	-0.040	-0.187	1.00						
LNCORR (8)	0.021	0.438	0.266	0.484	0.084	0.375	-0.176	1.00					
LNSTAB (9)	0.010	0.391	0.373	0.535	-0.090	0.237	-0.166	0.658	1.00				
LNGOV (10)	0.114	0.441	0.313	0.581	0.213	0.480	-0.205	0.880	0.601	1.00			
LNREG (11)	0.164	0.521	0.333	0.518	0.097	0.388	-0.150	0.810	0.586	0.860	1.00		
LNLAW (12)	0.188	0.521	0.291	0.496	0.096	0.380	-0.163	0.890	0.609	0.885	0.879	1.00	
LNVOICE (13)	0.182	0.366	0.133	0.482	-0.023	0.193	-0.286	0.563	0.495	0.537	0.555	0.521	1.00

6.2. Results of Diagnostic Tests

6.2.1. Results of Cross-sectional Dependence)

To examine cross-sectional correlation, the CD test method proposed by Pesaran (2004) was employed using the relevant data. Table 4 suggests that except for regulatory quality (REG) at the 10% level, there's substantial CD across all variables, indicating that shocks in one nation impact the entire panel, prompting the need for additional second-generation tests.

The analysis, aiming to assess the correlation among cross-sectional variables, involved examining the p-values and test statistics for each explanatory variable. Rejecting the null

hypothesis of no CD indicates that variables are cross-sectionally dependent if their p-values fall below one of three significance levels (1%, 5% and 10%). According to Table 4, all variables except regulatory quality (REG) exhibit significant CD at the 1% level, signifying that shocks in one nation affect the entire panel.

Table 4. Test for Cross-sectional Dependence in Panel Time-series Data.

Variables	Pesaran CD-test	p-value	corr	abs (corr)
LNTFP	21.73***	0.000	0.093	0.556
LNFD	70.27***	0.000	0.302	0.512
LNTO	37.32***	0.000	0.163	0.498
LNHC	195.65***	0.000	0.842	0.915
LNINO	4.49***	0.000	0.024	0.466
LNFDI	197.02***	0.000	0.847	0.877
GROWTH	83.00***	0.000	0.358	0.395
LNCORR	2.88***	0.004	0.012	0.347
LNSTAB	6.87***	0.000	0.030	0.333
LNGOV	5.52***	0.000	0.028	0.285
LNREG	1.86*	0.063	0.008	0.374
LNLAW	7.52***	0.000	0.032	0.383
LNVOICE	4.37***	0.000	0.019	0.332

Note: *p <0.1, **p <0.05, ***p < 0.01.

6.2.2. Panel Unit Root Test

In present of cross-sectional correlation, this study performs a unit root test for each variable to verify data stationarity. Table 5 displays the unit root results obtained from the CIPS test by Im et al. (2003) and the CADF test by Pesaran (2007). These tests, employed to investigate the integration levels of the variables, offer insights into their stationarity properties. The findings indicate that LNTFP exhibits unit root (non-stationarity) both at constant and trend levels. Similarly, LNTO and LNINO demonstrate non-stationarity at both constant and trend levels according to the CIPS test, suggesting first-order or I(1) integration for these variables. The CIPS test reveals that, except for LNHC at the trend level, all explanatory variables are stationary at both constant and trend levels. Meanwhile, the CADF test indicates that all variables, except LNTO, LNSTAB, LNREG, LNLAW, and LNVOICE, are stationary at the constant level. Moreover, LNFD, LNFDI, and LNGOV are stationary at the trend level according to the CADF test. These findings are consistent between the CIPS and CADF tests, indicating a mixed order of integration across the variables.

Table 5. Results of the CIPS and CADF Panel Unit Root Tests.

Panel A: Results of the CIPS Panel Unit Root Test				
Variables	**Constant**		**Constant and Trend**	
	Levels	**Δ**	**Levels**	**Δ**
LNTFP	-1.183	-3.060***	-1.754	-3.564***
LNFD	-2.641***	-4.605***	-3.058***	-4.650***
LNTO	-1.137	-3.187***	-2.191	-3.315***
LNHC	-2.398***	-4.623***	-1.948	-2.269**
LNINO	-1.848	3.810***	-2.352	-3.797***
LNFDI	-2.583***	-3.458***	-2.672**	-3.551***
GROWTH	-2.653***	-4.840***	-3.032***	-4.802***
LNCORR	-2.255***	-4.225***	-2.557**	-4.139***
LNSTAB	-2.029*	-4.509***	-2.698**	-4.575***
LNGOV	-2.535***	-4.408***	-3.027***	-4.314***
LNREG	-2.014*	-4.474***	-2.775***	-4.476***
LNLAW	-2.124**	-4.355***	-2.505*	-4.427***
LNVOICE	-2.084**	-4.454***	-2.921***	-4.429***
Panel B: Results of the CADF Panel Unit Root Test				
LNTFP	-0.901	-2.073**	-1.744	-2.540**
LNFD	-2.093**	-3.268***	-2.667**	3.409***
LNTO	-1.118	-2.561***	-1.993	-2.710***
LNHC	-2.619***	-4.378***	-1.846	-2.835***
LNINO	-2.015*	-2.736***	2.343	-2.919***
LNFDI	-2.265***	-2.900***	-2.808***	-2.894***
GROWTH	-2.006*	-3.167***	-2.465	-3.146***
LNCORR	-2.081**	-2.762***	-2.275	-2.905***
LNSTAB	-1.678	-2.904***	-2.020	-3.289***
LNGOV	-2.331***	-3.404***	-2.729***	-3.461***
LNREG	-1.605	-2.727***	-2.159	-2.813***
LNLAW	-1.968	-2.819***	-2.128	2.932***
LNVOICE	-1.474	-2.848***	-2.400	-2.967***

Note: *p <0.1, **p <0.05, ***p <0.01.

6.3. Results of Regressions Estimations and Discussion

This section presents the findings from the regression analysis for all countries included in analysis. Also, for robustness check, the analysis is conducted for both developed and developing countries. Table 6 illustrates the results of DKSE, investigating the impact of FD on TFP along with control variables such as TO, HC, INO, LNFDI, GROWTH and institutional quality variables (CORR, STABILITY, GOVERN, REG, LAW, VOICE).

Table 6. Results of Fixed Effect with DKSE (Overall Countries)

Dependent Var. LNTFP	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7
Main Variable							
LNFD	0.090***	0.103***	0.100***	0.090***	0.104***	0.105***	0.103***
	(0.019)	(0.014)	(0.018)	(0.017)	(0.017)	(0.017)	(0.017)
Control Variables							
LNTO	0.032***	0.025**	0.022**	0.023**	0.016*	0.020*	0.017*
	(0.012)	(0.012)	(0.009)	(0.010)	(0.009)	(0.011)	(0.009)
LNHC	-0.278***	-0.309***	-0.357***	-0.329***	-0.350***	-0.360***	-0.381***
	(0.039)	(0.033)	(0.029)	(0.036)	(0.026)	(0.025)	(0.029)
LNINO	-0.005	-0.005	-0.002	-0.004	-0.003	-0.003	-0.002
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
LNFDI	0.026***	0.028***	0.031***	0.029***	0.030***	0.030***	0.033***
	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
GROWTH	0.003***	0.003***	0.003***	0.004***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional Variables							
LNCORR	0.060***	0.075***					
	(0.018)	(0.014)					
LNSTABILITY	0.013***		0.017***				
	(0.000)		(0.003)				
LNGOVERN	0.057**			0.085***			
	(0.023)			(0.019)			
LNREG	-0.005				0.030**		
	(0.012)				(0.013)		
LNLAW	-0.004					0.024**	
	(0.010)					(0.011)	
LNVOICE	0.003						0.012
	(0.026)						(0.021)
Cons.	-0.565***	-0.309***	-0.057***	-0.353***	-0.083	-0.059	-0.010
	(0.096)	(0.090)	(0.042)	(0.123)	(0.085)	(0.080)	(0.089)
Obs.	1218	1218	1218	1218	1218	1218	1218
N	75	75	75	75	75	75	75
R -squared	0.219	0.207	0.188	0.202	0.185	0.185	0.182
F-ind (all u_i=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CDTest (Pesaran, 2004)	7.176 (0.000)	11.008 (0.000)	11.860 (0.000)	7.300 (0.000)	8.325 (0.000)	7.345 (0.000)	13.092 (0.000)
Hausman Test	138.36***	80.95***	48.93***	119.43***	84.26***	91.82***	63.43***
Autocorrelation							
Modified Bhargava et al. DW	0.175	0.174	0.163	0.169	0.161	0.161	0.160
Baltagi-Wu LBI	0.472	0.469	0.471	0.471	0.464	0.467	0.469
Heteroskedasticity							
Modified Wald chi2 (75)	63461.94***	74438.00***	98768.26***	47482.57***	1.2e+05***	2.3e+05***	91895.38***
Multicollinearity							
VIF	4.09	2.32	2.15	2.47	2.25	2.25	2.12

Notes: Robust standard errors are in parentheses. *** p <0.01, ** p <0.05, and * p < 0.1

The outcomes of the DKSE for the baseline regressions described in Equation 1 are presented in Table 6, which displays the coefficients of each variable and their standard errors (in parentheses). In the study, seven different models (Model-1 to Model-7) were estimated. Model-

1 comprises the all variables and shown with in the second column. The other models (Model-2 to Model-7) consider the effect of financial development on TFP, along with the control variables and the individual effect of each institutional variable. According to the findings of DKSE, the effect of financial development on TFP is positive and significant at a 5 % significance level for all models. For example, in Model-1, the coefficient value of FD is 0.090, which revealed that a 1 % increase in FD will increase TFP by 0.090 %. The positive coefficient means that FD increases TFP by transferring resources to the right places and making them efficient (Han and Shen, 2015). Financial development can be achieved through the development of bank-based financial systems. One of the reasons underlying the positive influence of FD on TFP is the provision of financial services that can promote productivity (Ezzahid and Elouaourti, 2018). The promotion of financial intermediation with a private sector focus and the provision of increased market access to domestic and international financial intermediaries are further reasons why FD benefits TFP (Guillaumont Jeanneney et al., 2006).

The effect of TO on TFP is positive and significant, indicating that TO enhances TFP. Our empirical results are in line with economic theory and confirm the general assertion that there exists a positive and significant relationship between trade openness and TFP growth for the economy as a whole. This positive impact is mainly explained by trade theory, which maintains that trade results in a positive and sustained effect on economic growth due to increased efficiencies in the allocation of resources and economies of scale (Grossman and Helpman, 1991; Obstfeld and Rogoff, 1996). According to the international trade theory, greater trade implies higher openness, which facilitates the adoption of more efficient production techniques, ultimately leading to faster growth in TFP. This finding aligns with the pioneering research of Miller and Upadhyay (2000) and Abizadeh and Pandey (2009).

Regarding HC, we found that human capital coefficient is statistically significant but has a negative sign, suggesting that a higher level of human capital leads to a lower TFP growth. Contrary to endogenous growth theories (Romer, 1990; Aghion and Howitt, 1992), which describe human capital as the engine of growth through innovation, several studies, however, find no evidence that human capital is an important positive determinant of TFP growth in developing countries (e.g., Falvey et al., 2007; Madsen et al., 2010). These findings prove the hypothesis of Vandenbusscheet al. (2006). The hypothesis of Vandenbussche et al. (2006) addresses the role of human capital in economic growth and TFP. In this study, the authors argue that the contribution of human capital to a country's economic growth is primarily driven by innovation and imitation, which are facilitated by highly educated individuals. Vandenbussche et al. (2006) also suggest that lower levels of education in developing countries may limit the implication of human capital on TFP. In other words, an economy composed of individuals with only basic education may lack the capacity to innovate and adopt technological advancements, leading to a limited effect on TFP. Previous studies by Ezzahid and Elouaourti (2018) support the existence of a negative relationship between HC and TFP. Kijek and Kijek (2020) speculate that this inverse relationship may be due to over investment in human capital. Similarly, according to Miller and Upadhyay (2000), TFP and human capital are negatively correlated in low-income nations.

The coefficient of innovation (INO, patent applications) is negative and not significant. Contrary to expectations, several factors can explain the insignificance of the innovation coefficient. First, there may be a nonlinear relationship between innovation and TFP. The existing literature believed that the influence of innovation on TFP improvement and economic growth may be nonlinear, depending upon several relevant factors such as financial support, human

capital, etc. (Nicholas, 2009; Dabla-Norris et al., 2012; Zanello et al., 2016; Brown et al., 2017; Park, 2018). Second, innovation may have heterogeneous effects on TFP. As the research of Zhao and Liu (2011) shows, there are obvious differences in the effects of invention patents and non-invention patents on TFP under different innovation levels.

The empirical results show that foreign FDI contributes to TFP positively. The positive effect of FDI can be explained by the fact that FDI encourages the use of new technologies thanks to capital deployment and thus can have an impact on TFP (Arısoy, 2012). The positive relationship between FDI and TFP is supported by the earlier studies including Damijan et al. (2007), Herzer (2011) and Herzer (2012).

We examine the impact of each institutional quality indicator (IQ) on TFP both jointly and separately. To address potential multicollinearity issues that may arise when using all institutional indicators together (Model-1), we also estimate individual models (Model-2 to Model-7) that consider the influence of each institutional indicator separately. The results of Model-1 show that all variables, except REG, LAW, and VOICE, are positive and statistically significant. The positive relationship between STAB and TFP is reported in the literature by Altun (2016) and Uddin et al. (2017). Alam et al. (2017) find a significantly positive effect of GOVERN on economic growth. Apart from Model-1, when examining the effects of each institutional indicators individually, we find strong evidence confirming a positive impact, except for Model-7, which includes the VOICE coefficient. Several recent studies have demonstrated that institutional factors can boost productivity development by guaranteeing resource reallocation efficiency and promoting a favorable economic climate for investment, even when reverse causality is possible. (Hall and Jones, 1999; Acemoglu and Johnson, 2003; Acemoglu et al., 2004; Easterly 2006).

The Hausman tests conducted for each model lead to rejection of the null hypothesis, favoring the fixed effects model in all instances. However, inference from panel data might suffer from biases stemming from CD, heteroscedasticity, or serial correlation. Hence, diagnostic tests are employed to assess these issues and determine the model's robustness. Specifically, Modified Wald test, Modified Bhargava, Franzini, and Narendranathan Durbin Watson, and Baltagi-Wu LBI tests are utilized to test for heteroscedasticity and auto-correlation assumptions in fixed effects models. Pesaran CD tests are employed to identify CD. The null hypothesis of the heteroscedasticity test posits the absence of heteroscedasticity, while the alternative hypothesis suggests its presence. As presented in Table 6, the fixed effects model rejects the null hypothesis of no heteroscedasticity via the modified Wald test. In a word, heteroscedasticity issues are detected across all models (1 to 7). To examine autocorrelation in the model, both the Durbin-Watson test by Bhargava, Franzini, and Narendranathan, and the locally best invariant (LBI) test by Baltagi-Wu are utilized. Both the Modified Bhargava et al. Durbin Watson and Baltagi-Wu LBI tests assess the hypothesis that the autocorrelation coefficient equals zero ($p = 0$). If the value is less than 2, it suggests that there is a positive autocorrelation. In all models, the test values fall below 2, indicating the presence of autocorrelation in the fixed effects model. The Pesaran (2004) CD test results indicate the presence of correlation between countries. To address these challenges, robust estimators are recommended. The Driscoll and Kraay estimator is chosen for this study due to its solid empirical support and its effective handling of cross-sectional dependency, autocorrelation, and heteroscedasticity issues. Additionally, the Variance Inflation Factor (VIF) values in Table 6 are all below 10, suggesting that the models do not suffer from severe multicollinearity, in accordance with established literature. Diagnosis tests reveal the

satisfactory fitness of the chosen models. In the following, we conduct two robustness checks on the main specification used in this study.

7. Robustness Checks

7.1. Financial Development Sub-index (Financial Institutions and Financial Market)

Tables 7 and 8 present the results of a robustness check, where the estimates of Equation (1) are replicated using the components of financial development (financial institutions, financial markets) to check for alternative financial development indicators. As can be seen, results remain very stable for financial institutions (FI) variable in Table 7. The diagnosis statistics do not significantly differ from those reported in the previous table.

Table 7. Results of Fixed Effect with DKSE (Overall Countries)

Dependent Var. LNTFP	**Model-1**	**Model-2**	**Model-3**	**Model-4**	**Model-5**	**Model-6**	**Model-7**
Main Variable							
LNFI	0.118***	0.130***	0.131***	0.120***	0.136***	0.136***	0.135***
	(0.018)	(0.019)	(0.021)	(0.017)	(0.020)	(0.020)	(0.020)
Control Variables							
LNTO	0.043**	0.038**	0.003**	0.035***	0.030***	0.034**	0.031***
	(0.014)	(0.013)	(0.011)	(0.011)	(0.011)	(0.013)	(0.011)
LNHC	-0.309***	-0.342***	-0.388***	-0.362***	-0.376***	-0.388***	-0.411***
	(0.039)	(0.031)	(0.026)	(0.033)	(0.027)	(0.022)	(0.026)
LNINO	-0.007	-0.007	-0.005	-0.006	-0.006	-0.006	-0.005
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
LNFDI	0.021***	0.023***	0.025***	0.023***	0.023***	0.024***	0.026***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
GROWTH	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional Variables							
LNCORR	0.054***	0.069***					
	(0.016)	(0.013)					
LNSTABILITY	0.012***		0.016***				
	(0.003)		(0.003)				
LNGOVERN	0.047**			0.074***			
	(0.021)			(0.018)			
LNREG	-0.001				0.034***		
	(0.011)				(0.011)		
LNLAW	-0.003					0.025**	
	(0.009)					(0.010)	
LNVOICE	0.007						0.017
	(0.024)						(0.020)
Cons.	-.479***	-0.222**	0.022	-0.238**	-0.027	-0.006	-0.037
	(0.058)	(0.105)	(0.059)	(0.102)	(0.092)	(0.098)	(0.064)
Obs.	1218	1218	1218	1218	1218	1218	1218
R- squared	0.238	0.229	0.212	0.223	0.212	0.211	0.209
F-probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	75	75	75	75	75	75	75

Notes: Robust standard errors are in parentheses. *** p <0.01, ** p <0.05, and * p < 0.1

According to the results, FI is significant at the 1% significance level and has a positive effect on TFP in the model that includes all countries. FI variable is an important indicator for

TFP. Supporting this result, Iqbal and Daly (2014) argues institutions are indispensable for the economy and that the less corruption there is, the more the economy is linked to growth. Acemoglu et al. (2001) argues countries with bad institutions will have poor economic performance. According to Ugur (2010), FI is also a good indicator in terms of economic sustainability and adds FI has a positive effect on TFP.

Table 8 presents the analysis where the financial development variable is replaced by the financial market (FM) variable. Looking at the results, it can be observed that the FM variable is insignificant in all models. While TO is significant and positive in all models, HC is significant and negative, as seen in other analyses. INO remains insignificant. FDI and GROWTH are again significant and positive. Among the institutional variables, CORR, STAB, and GOVERN were significant and positive in Model-1, while REG, LAW, and VOICE were found to be insignificant. Except for VOICE in Model-7, all institutional variables were significant.

Table 8. Results of Fixed Effect with DKSE. (Overall Countries)

Dependent Var. LNTFP	**Model-1**	**Model-2**	**Model-3**	**Model-4**	**Model-5**	**Model-6**	**Model-7**
Main Variable							
LNFM	0.009	0.011	0.009	0.009	0.008	0.009	0.009
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)
Control Variables							
LNTO	0.038***	0.031***	0.028***	0.029***	0.022***	0.025**	0.023***
	(0.011)	(0.010)	(0.007)	(0.009)	(0.007)	(0.009)	(0.007)
LNHC	-0.257***	-0.290***	-0.336***	-0.305***	-0.331***	-0.343***	-0.365***
	(0.045)	(0.041)	(0.035)	(0.045)	(0.031)	(0.030)	(0.035)
LNINO	-0.002	-0.002	-0.000	-0.001	-0.000	-0.000	-0.000
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
LNFDI	0.033***	0.036***	0.038***	0.035***	0.038***	0.038***	0.041***
	(0.002)	(0.003)	(0.005)	(0.003)	(0.004)	(0.004)	(0.004)
GROWTH	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional Variables							
LNCORR	0.057***	0.077***					
	(0.018)	(0.014)					
LNSTABILITY	0.016***		0.021***				
	(0.004)		(0.004)				
LNGOVERN	0.075**			0.100***			
	(0.025)			(0.021)			
LNREG	-0.005				0.032**		
	(0.012)				(0.014)		
LNLAW	-0.009					0.023*	
	(0.010)					(0.013)	
LNVOICE	0.010						0.018
	(0.025)						(0.020)
Cons.	-0.844***	-0.541***	-0.299***	-0.614***	-0.322***	-0.289***	-0.268***
	(0.104)	(0.104)	(0.049)	(0.145)	(0.088)	(0.080)	(0.078)
Obs.	1218	1218	1218	1218	1218	1218	1218
R- squared	0.198	0.177	0.159	0.180	0.154	0.154	0.152
F-probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	75	75	75	75	75	75	75

Notes: Robust standard errors are in parentheses. *** p < 0.01, ** p < 0.05, and * p < 0.1

7.2. Different Income Groups (Developed and Developing Countries)

To evaluate the robustness of the main estimate, we re-estimated the regression separately for different income groups to validate the interpretation of the findings. Table 9 and Table 10 show the estimation results for developed and developing countries, respectively.

Table 9 includes models with 31 developed countries. In the analysis that includes only developed countries, the FD variable is significant only in Model-2, Model-3, Model-4, and Model-7, while it is insignificant in Model-1, Model-5, and Model-6. On the other hand, TO and GROWTH are significant and positive. While HC is negative and significant, INO is insignificant. Among the institutional variables, REG and LAW are positive and significant, whereas the CORR variable is negative and significant. However, STAB, GOVERN, and VOICE are insignificant. When the institutional variables are included separately, they all exhibit a significant and positive effect on TFP.

Table 9. Results of Fixed Effect with DKSE (Developed)

Dependent Var. LNTFP	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7
Main Variable							
LNFD	0.035 (0.042)	0.085** (0.041)	0.087* (0.045)	0.085** (0.041)	0.049 (0.041)	0.051 (0.038)	0.085* (0.043)
Control Variables							
LNTO	0.113*** (0.023)	0.099*** (0.030)	0.089** (0.036)	0.009** (0.033)	0.115*** (0.027)	0.108*** (0.025)	0.090*** (0.032)
LNHC	-0.180*** (0.051)	-0.103* (0.060)	-0.181*** (0.053)	-0.142** (0.066)	-0.151** (0.058)	-0.153** (0.062)	-0.147* (0.077)
LNINO	-0.025*** (0.004)	-0.025*** (0.006)	-0.021*** (0.005)	-0.025*** (0.006)	-0.024*** (0.005)	-0.026*** (0.004)	-0.022*** (0.005)
LNFDI	-0.002 (0.006)	0.002 (0.006)	0.007 (0.007)	0.003 (0.007)	0.001 (0.006)	-0.002 (0.006)	0.006 (0.007)
GROWTH	0.003*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.003*** (0.000)	0.002*** (0.000)
Institutional Variables							
LNCORR	-0.084* (0.044)	0.260*** (0.050)					
LNSTABILITY	0.014 (0.016)		0.042* (0.021)				
LNGOVERN	-0.006 (0.059)			0.383*** (0.094)			
LNREG	0.144* (0.059)				0.406*** (0.071)		
LNLAW	0.596*** (0.105)					0.617** (0.073)	
LNVOICE	-0.041 (0.064)						0.133** (0.052)
Cons.	-2.853*** (0.330)	-1.278*** (0.290)	-0.258 (0.187)	-1.783*** (0.507)	-1.968*** (0.341)	-2.818*** (0.420)	-0.704*** (0.254)
Obs.	529	529	529	529	529	529	529
R- squared	0.468	0.248	0.212	0.294	0.310	0.455	0.214
F-probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	31	31	31	31	31	31	31

Notes: Robust standard errors are in parentheses. *** p <0.01, ** p <0.05, and * p <0.1

Table 10 includes models with 44 developing countries. According to the estimation results, FD, INO, FDI, GROWTH, CORR, STAB, and GOVERN are significant and positive in every model in which they are included. Huang and Lin (2009) also obtained a similar result for FD. On the other hand, HC appears to be significant but negative in every model. Furthermore, the REG, LAW, and VOICE variables were not found to be significant in any model they were included in.

Table 10. Results of Fixed Effect with DKSE (Developing)

Dependent Var. LNTFP	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7
Main Variable							
LNFD	0.102***	0.119***	0.121***	0.111***	0.127***	0.127***	0.125***
	(0.029)	(0.021)	(0.025)	(0.023)	(0.023)	(0.023)	(0.027)
Control Variables							
LNTO	0.023	0.016	0.009	0.010	0.004	0.005	0.005
	(0.025)	(0.023)	(0.025)	(0.021)	(0.020)	(0.022)	(0.021)
LNHC	-0.374***	-0.398***	-0.447***	-0.423***	-0.463***	-0.469***	-0.475***
	(0.041)	(0.040)	(0.044)	(0.042)	(0.037)	(0.041)	(0.041)
LNINO	0.010**	0.010**	0.010**	0.009**	0.010**	0.010**	0.010**
	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
LNFDI	0.033***	0.033***	0.035***	0.034***	0.035***	0.036***	0.037***
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
GROWTH	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional Variables							
LNCORR	0.058**	0.060***					
	(0.016)	(0.013)					
LNSTABILITY	0.012***		0.012*				
	(0.004)		(0.003)				
LNGOVERN	0.038*			0.056***			
	(0.021)			(0.014)			
LNREG	-0.012				0.008		
	(0.016)				(0.009)		
LNLAW	-0.014					0.004	
	(0.011)					(0.010)	
LNVOICE	0.004						0.008
	(0.029)						(0.024)
Cons.	-0.396**	-0.221	0.009	-0.182	0.064	0.075	0.051
	(0.180)	(0.146)	(0.105)	(0.128)	(0.116)	(0.137)	(0.164)
Obs.	688	688	688	688	688	688	688
R- squared	0.243	0.233	0.217	0.224	0.214	0.214	0.214
F-probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	44	44	44	44	44	44	44

Notes: Robust standard errors are in parentheses. *** p <0.01, ** p <0.05, and * p < 0.1

8. Conclusion and Policy Recommendations

This paper explores the critical role of financial development in driving TFP. Financial systems, encompassing both financial institutions and markets, play essential role in fostering economic growth by improving resource allocation, facilitating access to capital, and supporting innovation. Despite significant progress in financial development in many emerging economies, challenges remain in fully realizing the potential of financial systems to drive productivity growth.

This study outlines key policy recommendations aimed at enhancing the impact of financial development on TFP.

In this paper, we use a cross-country panel data model and conduct an empirical study on the effect of financial development on TFP growth in 78 developed and developing countries. With CD present, DKSE approach was used in panel data analysis. In the DKSE approach, the fixed effects model was selected by performing the Hausman test. In the empirical analysis stage, we first analyzed the effect of financial development on TFP. Then, for the robustness analysis, we examined the effect of financial institutions and financial markets variables, which are sub-indexes of financial development, on TFP. The conclusions are drawn as follows: (1) In general, financial development has a significantly positive effect on TFP growth, and the test results show good robustness for different financial development indexes; (2) In terms of components of financial development, financial institutions have a positive and significant effect on TFP growth, while financial markets do not have a significant effect on TFP; (3) Between the control variables included in the model, trade openness, foreign direct investment, and economic growth have a positive effect on TFP, while the human capital variable has a negative effect on TFP. Furthermore, it has been found that institutional quality indicators have a positive effect on TFP when included in the model; (4) Our empirical findings are strongly robust across for different income groups countries namely, developed and developing.

The above-mentioned results have significant implications for policymaking. According to the findings of this paper, financial development plays a crucial role in enhancing TFP in emerging economies, serving as a key driver for long-term economic growth (King and Levine, 1993; Beck et al., 2007). By adopting policies that expand financial access, improve market efficiency, strengthen financial institutions, and support human capital development, governments can create a financial system that fosters innovation and effective resource allocation. Additionally, financial sector reforms and strategic public-private partnerships can accelerate productivity growth (Čihák et al., 2012). Ultimately, these policies can maximize the influence of financial development on TFP, contributing significantly to sustainable economic development in emerging markets.

Another policy recommendation can be made regarding institutional indicators. According to the generally accepted view, high institutional quality tends to boost productivity in the economy (Acemoglu et al., 2004). However, the extent to which this occurs may vary depending on the variables used and the country groups included in the model. Based on the results, the following policies are suggested to achieve this productivity increase: (1) If institutional quality is strong, it will attract foreign investment due to the presence of robust institutions. This increase in foreign investment can create job opportunities, boost economic activities, and foster economic growth. (2) Establishing rule of law that ensures fair contracts will support economic growth and enhance productivity. This will also encourage entrepreneurship and provide an environment conducive to increased productivity. (3) A transparent environment should be created by combating corruption and reducing or eliminating bureaucratic obstacles. As a result of these policies, economic growth and productivity increases can be achieved.

Finally, this study has some limitations that will give us future research directions. In this study, we used TFP for dependent variable. But we can test the robustness of our baseline model specification using an alternative dependent variable, such as; TFP growth and TFP obtained from parametric and non-parametric techniques. Also, we used only a few macroeconomic

determinants of TFP, but ignored many macroeconomic variables affect TFP such as; inflation, geopolitical risk, exchange rate volatility, unemployment rate, government expenditure, etc. Thus, possible future research can include these variables to examine TFP.

Declaration of Research and Publication Ethics
This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researcher's Contribution Rate Statement
The authors declare that they have contributed equally to the article.

Declaration of Researcher's Conflict of Interest
There is no potential conflicts of interest in this study.

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APPENDIX

Table A1. Country Samples

Developed		**Developing**	
Australia	Slovak Republic	Argentina	Mexico
Austria	Slovenia	Bolivia	Morocco
Belgium	Spain	Botswana	Namibia
Canada	Sweden	Brazil	Nigeria
Cyprus	Switzerland	Bulgaria	Panama
Czech Republic	United Kingdom	Cameroon	Peru
Denmark	United States	Chile	Philippines
Finland		China	Poland
France		Colombia	Qatar
Germany		Costa Rica	Romania
Greece		Croatia	Russian Fed.
Iceland		Dominican Republic	Rwanda
Ireland		Ecuador	Saudi Arabia
Israel		Egypt	Senegal
Italy		Guatemala	South Africa
Japan		Hungary	Sri Lanka
Korea, Rep.		India	Thailan
Latvia		Indonesia	Tunisia
Lithuania		Jamaica	Türkiye
Luxembourg		Jordan	Ukraine
Netherlands		Kazakhstan	Uruguay
New Zealand		Kenya	Venezuela
Norway		Malaysia	Zambia
Singapore		Mauritius	

Source: Own elaboration based on the IMF (2023).