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Economic Growth and Financial Development: Evidence from Panel Cointegration Tests in Emerging Countries

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Abstract

In This study analyzes the long-run relationship between economic growth (EG) and financial development (FD) in 27 emerging countries over the period 1980 to 2018 by employing the Johansen-Fisher panel cointegration method. The study also performs the vector error correction model (VECM) to determine the direction of a causal relationship among the variables. Two components of the index of financial development introduced by Svirydzenka (2016), financial markets and financial institutions indices, are employed to reveal through which channels EG has a long-term association with FD. Empirical findings show a significant long-run association between EG, the overall index of FD, and its lower-indices. Furthermore, the results from panel VECMs indicate a one-way unidirectional causality between EG and the FD index, while there is a two-way causality between EG and financial markets as well as between EG and financial institutions indices in the short run. We obtain similar results with Kao and Pedroni panel cointegration tests. We also show that financial institutions and financial markets indexes significantly affect economic growth in the long run. Thus, policy makers in emerging markets should take actions that facilitate the development of financial markets and institutions to increase GDP per capita.

Key words: Financial Development, Johansen-Fisher Panel Cointegration Test, Growth, VECM

JEL Code: C33, G10, G20

1. Introduction

Whether there is a link between economic growth (EG) and financial development (FD) has been one of the most widely debated research questions for

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a long time. Financial systems enable risk controlling, trading, allocating resources efficiently, hedging, and channeling savings to real investments that stimulate economic growth (Levine 1997, 2005; Herring and Chatusripitak, 2000; Sylla, 2003; FitzGerald, 2006; Demirguc-Kunt and Levine, 2008; Zhuang, Juzhong *et al.,* 2009; Adelakun, 2010). Besides, it allows intermediaries and markets to mobilize savings. The main aim of FD is to maintain investments and EG through the effective spread of information and effective capital allocation. Furthermore, a well-functioning financial system may expand EG in the long term by attracting foreign capital inflows, which is one of the main drivers of investments (Hunjra *et al*., 2021). FD also plays a substantial role in decisions of private investment as it provides opportunities for profitable investment and inducements (Aysan *et al.,* 2007a, 2007b). It is generally regarded that efficient financial markets can promote EG, particularly in emerging economies where access to funds to finance investments is relatively harder (Levine, 1997; Beck and Levine, 2004; Kar *et.al.,* 2011; Goren and Umutlu, 2015).

The earlier research highlighted a significant relationship between EG and FD (Ghani, 1992; King and Levine, 1993; Levine and Zervos, 1996; Levine *et al.,* 2000; Beck *et al.,* 2000; Christopoulos and Tsionas, 2004) and they concluded that FD fosters EG. However, there have been conflicting views about the role of FD. Ireland (1994) and Demetriades and Hussein (1996) supported the view that FD was also caused by the EG. Demetriades and Hussein (1996) applied causality tests and found a bi-directional causality between EG and FD. Similarly, Luintel and Khan (1999) showed bi-directional causality between FD and EG. Shan *et al.* (2001) documented mixed results on this issue. They used VAR modeling to investigate the link between EG and FD for China and nine OECD countries. They provided inconclusive results about the direction of causality between EG and FD. In this paper, we investigate the long-run relationship between the new overall FD index (as well as its two components) and EG in 27 emerging countries from 1980 to 2018. We apply the Johansen-Fisher Panel Cointegration (JFPC) method as it imposes no restrictions on the number of cointegrating vectors. In addition, we employ VECM to determine the causality and short-run dynamics among the variables. Our results display a significant long-run association between EG and the overall FD index, and EG and its two sub-indices, i.e., the index of financial markets (FM) and the index of financial institutions (FI). The empirical results of panel VECMs display a one-way causality between EG and the FD index. In addition, we detect a two-way causality between EG and financial markets as well as EG and financial institutions indices. Further tests based on the Kao and Pedroni panel cointegration tests indicate that both FI and FM indices significantly influence EG in the long run.

This study adds to the empirical studies in three respects; firstly, we use a new measure of FD introduced by Svirydzenka (2016), which captures the multi-dimensional nature of financial development. This overall FD index comprises the depth, efficiency, and access dimensions of the financial industry. We also use two components of the FD overall index, FI and FM, to answer the question of through which channels EG has a long-term association with FD. Secondly, the JFPC methodology has not been used before in the examination of the relationship between the recently proposed overall FD index and economic growth in emerging countries. Analysis of this issue is vital for developing countries where economic growth is heavily needed to reduce unemployment rates and enhance living standards. Lastly, the data set utilized in the empirical analysis comprises 27 emerging countries for a noticeably extended research period of 1980-2019.

The remainder of the study is designed as follows. Section 2 provides the theoretical background and survey of the literature; Section 3 explains the data and variables and introduces the methodology and model specifications; Section 4 debates the empirical results. The last section draws some conclusions from the findings and discusses some policy implications process of global financial and economic development has reached a varying degree...”.

2. Theoretical Background

After the global financial crisis 2008-2009, the attention was focused on the association between FD and EG has been a significant field of debate among policymakers and researchers and this relationship has been theoretically and empirically discussed in many studies. The theoretical discussions date back to Schumpeter (1911), Shaw (1973), and McKinnon (1973). Schumpeter (1911) was the first scholar who emphasized the significance of finance in the growth process and specified that financial services have a significant effect in promoting growth through their functions. However, according to McKinnon (1973) and Shaw (1973), financial markets are suppressed by regulations, especially in developing countries and these repressions adversely impact the level of savings and investment decisions. Hence, EG is hindered in developing countries. Therefore, it was also suggested that developing countries should liberalize their financial markets by applying some reforms to eliminate the vicious cycle of low levels of interest and the growth rate because low-interest rates deteriorate savings and boost ineffective investments. Furthermore, financial liberalization gives rise to competitive markets that increase product quality and technological development. Besides, in a liberalized market, legal and required reserve ratios will be maintained at the minimum level, which will reduce costs of funding and enable the banking sector to carry out its financial intermediaries more effectively. Consequently, a higher degree of FD, which may be an outcome of fiscal liberalization, induces growth.

Oppositely, researchers such as Robinson (1952), Lucas (1988), and Stiglitz (1994) had skeptical views about the role of FD in boosting EG. This line of research criticized the overemphasis of the financial system in the growth process. For instance, Robinson (1952) underlined that FD follows EG due to enhanced demand for financial services. Lucas (1988) stated that "*the significance of financial matters is very badly overstressed*". Stiglitz (1994) remarked that government interference through suppressing financial systems might decrease market distortions and develop the overall economic performance.

Four hypotheses in the literature focus on the direction of causality for the growth-finance nexus; *a*) Demand-Following Hypothesis (DFH), *b*) Supply-Leading Hypothesis (SLH), *c*) Feedback Hypothesis (FBH), and *d*) Neutrality Hypothesis (NH). DFH and SLH support the unidirectional causality running from either growth or finance. The FBH supports the bidirectional association between growth and finance. Finally, NH suggests the idea that there is no causality between growth and finance.

Patrick (1966) explained DFH and SLH as follows. DFH represents the formation of modern financial institutions providing financial services, financial assets, and liabilities in response to the demand of savers and investors in the real economy. Therefore, this perspective highlights financial services' demand side. If an economy develops, it produces further demands for these services and this causes a supply reaction in the financial system. SLH refers to the formation of financial institutions and the supply of their complementary financial services, financial assets & liabilities in advance of the demand for them. SL has two jobs: *i)* transmission of resources from traditional (non-growth) industries to the modern ones, and *ii)* fostering an entrepreneurial response in these industries. The studies such as Guidotti (1995), Abu-Bader and Abu-Qarn (2008), Jalil *et al.* (2010), Ahmed and Wahid (2011), Chen *et al.* (2012), Wu *et al.* (2010), and Enisan and Olufisayo (2009) supported the SLH stating that FD leads growth, suggesting a unidirectional causality. Conversely, Demetriades and Hussein (1996), Shan *et al.* (2001), Atndehou *et al.* (2005), Odhiambo (2004, 2008), Panopoulou (2009), Pradhan and Feridun (2011), and Kar *et al.* (2011) showed evidence in favor of unidirectional causality extending from EG to FD, supporting the predictions of DLH.

Apart from SLH and DFH, several researchers such as Huang-Yang and Hu (2000), Dritsakis and Adamopoulos (2004), Al-Yousif (2002), Fase and Abma (2003), Hou and Cheng (2010), Fawowe (2011), and Pradhan *et al*. (2015) supported FBH. More specifically, they provided evidence supporting the view that causality runs in both directions. Lastly, Lucas (1988), Stern (1989), Opoku *et al.* (2019), and Pradhan *et al.* (2013) supported NH, which states the nonexistence of a causal relationship between EG and FD.

After summarizing the theoretical background, we now proceed with the empirical literature. There have been new contributions about the role of FD in explaining EG, especially in emerging countries. Addressing this issue is also essential to comprehend how to accomplish and sustain FD that can critically influence various aspects of an economy (Umutlu *et al.,* 2020).

Pradhan *et al.* (2017) explored the association between EG and FD in ASEAN Regional Forum (ARF) countries from 1991 to 2011 by using four different composite indices of FD and applying the Pedroni panel cointegration test and panel VECMs. Amematekpor (2018) analyzed the relationship between new broad-based FD indices and EG in 25 Sub-Saharan African (SSA) countries over

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the years 1980-2015. The author used the Pedroni (1999, 2004) and the Westerlund (2005) panel cointegration methods to investigate a long-term relation. The causality tests revealed a bidirectional association between the development of financial institutions and EG for all countries. Oro and Alagidede (2018) investigated the FD and EG relationship in 30 oil producer and 30 non-oil producer countries from 2006 to 2015 by using GMM estimation and panel threshold regressions. They used different variables to measure FD; *i)* private credits and *ii)* new broad-based FD index and its sub-components. Their findings showed a nonlinear relationship between FD and EG in both groups of countries. Aysan *et al.* (2008) examined the impact of economic policies and governance institutions on private investments by employing panel data for 32 countries. Their findings supported that firms in emerging economies confront restrictions that are faced in more advanced economies. Finally, Haini (2019) analyzed the impact of FD and institutional development on EG in ASEAN countries between 1995 and 2017 in a dynamic panel estimation setting. The results indicated that the development of financial institutions positively affected EG, while financial markets are insignificant, and he concluded that FD has a substantial role in boosting EG.

Arif et. al (2022) investigated potential associations among FD, trade openness, and sustainable environmental EG in South Asian countries by using the autoregressive distributive lag method. Their findings revealed that FD has a significantly positive effect on environmental EG both in the long and short run. Song et al.(2021) studied the links among corruption, EG, and FD in 142 countries by applying panel cointegration and Panel VECM between the years 2002 to 2016. Their results indicated that there is a long-term relationship between EG, corruption and FD. Moreover, panel FMOLS results showed that EG has a positive impact on FD, whereas corruption has a negative impact. Kirikkaleli et.al (2022) examined the impact of FD and renewable energy consumption on consumption-based CO_2 emissions in Chile while controlling for economic growth and electricity consumption. The authors used ARDL and FMOLS, DOLS and shift causality tests. Their results indicated that while FD and renewable energy consumption lessened the consumption-based CO2 emissions in Chile, EG and consumption of electricity increased consumption-based carbon emissions. Shahbaz et al (2022) developed a three-regime threshold autoregressive distributed lags (TARDL) model, which accommodated the asymmetric impact of FD on EG in the top 10 developed countries. Their model was also composed of trade openness, capital formation and labor as potential indicators of EG. Their empirical outcomes demonstrated the presence of threshold asymmetric cointegration between variables.

On the other hand, Opoku *et al.,* (2019) studied the long-term association among EG, the new broad-based FD index, and its sub-indices in 47 African countries from 1980 to 2016. They deployed the frequency-domain spectral causality method. The results for most countries supported NH, suggesting that FD and EG are independent.

Most of the findings of the above-mentioned studies come from research applied in ASEAN countries, ARF countries, developed countries, and SSA countries. Consequently, more empirical evidence is needed to clarify the potential FD-EG association in emerging countries. Moreover, there are some recent advances in measuring financial development and its components. For instance, Svirydzenka (2016) proposed a new overall financial development index, which is formed by combining the financial institutions and financial markets sub-indices. We employ these sub-indices to answer the question of through which channels EG has a long-term association with FD. As far as we are aware of, there is no use of the JFPC methodology in the literature on new FD indices and EG associations in emerging countries.

3. Data and Methodology

The study is carried out for 27 emerging countries using annual data from 1980 to 2018. We define EG as GDP per capita (GDPPC), which is computed as the gross value of goods & services manufactured in a country divided by the population of the country. GDPPC is mostly used in prior work to gauge the welfare of countries based on their economic development. To measure economic growth, we use the natural logarithm of GDP per capita (lnGDPPC) expressed in the current US $. The GDP data come from the WDI database.

One of the most controversial issues in examining the association between FD and growth is how to measure FD. This is due to FD's wide scope including different dimensions. To capture different aspects of financial development, we use the overall financial development index, hereafter FDX, which is proposed by Svirydzenka (2016). Moreover, we also use two sub-indices of FDX, the index for financial institutions (FI) and the index for financial markets (FM). This multi-dimensional measure aims to reflect the extent of FD more comprehensively than the other measures. The logic behind this measure can be explained as follows. Svirydzenka (2016) formed nine indices that measure how improved financial systems are across countries. She used a three-step approach to form one summary index. In the first step, she normalized the six indices which are FMD, FMA, FME, FID, FIA, and FIE (the letters M and I signify markets and institutions, D, A, and E represent depth, access, and efficiency) to gauge how deep, accessible, and efficient financial markets and institutions are. In the second step, she aggregated sub-indices of D, A, and E separately for financial institutions (FID, FIA, and FIE) and financial markets (FMD, FMA, and FME). Next, she formed two main indices from these three sub-categories: FI and FM. FI is an index that measures the development of insurance companies, banks, mutual funds, and pensions. FM index indicates how developed bond and stock markets are. In the final step, the overall financial development index of a country is constructed from the aggregation of FI and FM.

Table 1 presents the basic statistics for all measures, comprising both dependent and independent variables utilized in the empirical analyses.

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Table 1. Basic Statistics

Indicators	Mean	Median	Std. Dev.	Maximum	Minimum	Observation
lnGDPPC	8.36	8.42	1.36	11.35	4.55	1033
FDX	0.38	0.36	0.15	0.85	0	1080
FM	0.39	0.37	0.16	0.85	0	1080
FI	0.35	0.35	0.18	0.87	0	1080

Source: Authors' calculations

If two or more time series are not stationary at their level but their linear combination is stationary, then these series are called cointegrated. (Engle and Granger, 1987) If there are cointegrated variables, there exists a long-run relationship among them (Enders, 2014). There are two types of panel cointegration methods; residual-based and maximum likelihood-based methods. The main idea behind residual-based tests that are used by Kao (1999), Pedroni (1999, 2004), Westerlund (2005), etc., is to check for the existence of a unit root in the residuals of a cointegration equation. The residual-based tests are predicated on the hypothesis that there is only a single cointegrating vector between the variables so if there is more than one cointegrating relation, this situation cannot be dealt with. The maximum-likelihood-based tests are based on the multivariate cointegration approach offered by Johansen (1988) and allow specifying the number of cointegrating vectors among the variables (Örsal, 2008). Maddala and Wu (1999) developed another method to test panel cointegration by employing the Fisher-type test. This method combines tests from individual cross-sections to obtain test statistics for the whole panel that can be used to test the null hypothesis shown in Eq.(1).

$$P = -2\sum_{i=1}^{N} ln\, p_i \;\; \Rightarrow X_{2N}^2 \qquad (1)$$

The X^2 in Eq. (1) is used as a base of the MacKinnon et al. (1999) p-values (p_i) for Johansen's trace and maximum eigenvalue tests. These two tests differ from each other in the formulation of the hypothesis. Trace tests examine more than r cointegrating vectors between the $N>r$ time-series system while maximum eigenvalue tests are used to test for exactly $r+1$ cointegrating vectors.

Johansen's (1991, 1995) method is based on VAR cointegration tests that use maximum likelihood estimates. All variables are treated symmetrically. Johansen's approach begins with estimating the VAR of order p specified by Eq. (2):

$$y_t = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t \qquad (2)$$

where A_p shows coefficients' (nxn) matrices, y_t shows the (nx1) vector of variables that are cointegrated in I(1) and ε_t is an (nx1) vector of error terms.

The VAR model can be rewritten as shown in Eq. (3).

$$\Delta y_t = \mu + \prod y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \, \Delta y_{t-i} + \varepsilon_t \tag{3}$$

where

$$\prod = \sum_{i=1}^{p} A_i - \mathrm{I} \; and \; \Gamma_i = -\sum_{j=i+1}^{p} A_j \tag{4}$$

Where $\prod$ represents the coefficient matrix. If $\prod$ has a reduced rank $r<n$, then there will be *nxr* matrices α and β each with rank *r such that* $\prod = \alpha\beta'$, $\beta' y_t$ is stationary. *r* shows the number of cointegrating relations, α is the adjustment parameter in the VECM and β is a cointegrating vector.

For a specified *r*, the maximum likelihood estimator of β denotes the combination of y_{t-i}, which yields the *r* largest canonical correlations of $\Delta y_t$with y_{t-i} after rectifying lagged differences and deterministic variables (Hjalmarsson and Österholm, 2007).

Suppose that ($\prod$)=1 and after that ln(1-λ_1) will be negative and ln(1-λ_1)=0, $\forall_i$>1.

If the eigenvalue i deviates from zero, then ln(1-λ_1)$< 0, \forall_i$>1. The largest eigenvalue has to be distinguishable from zero as others will not be significantly different from zero (Brooks, 2014). The Johansen framework employs two ratio tests: Trace and Maximum eigenvalue tests. These tests are displayed in Eq. (5) and Eq. (6), respectively.

$$\lambda_{trace}(\mathrm{r}) = -\mathrm{T} \sum_{i=r+1}^{n} \ln(1-\widehat{\lambda_\iota}) \tag{5}$$

$$\lambda_{max}(\mathrm{r,r+1}) = -\mathrm{T}\ \ln(1-\hat{\lambda}_{r+1}) \tag{6}$$

where *r* represents the number of cointegrating vectors, $\hat{\lambda}_i$ is the approximated value for i^{th} ordered eigenvalue from $\prod$. Each eigenvalue associated with a different cointegrating vector will be an eigenvector (Brooks, 2014).

Maddala and Wu (1999) adjusted the Johansen method to the panel data with the help of Fisher-type tests. The Johansen-Fisher test based on VECM takes the following form:

$$\Delta y_{it} = \prod_i y_{it-1} + \sum_{j=1}^{n} \Gamma_{ij} \, \Delta y_{it-j} + \varphi_i \, Z_{it} + \varepsilon_{it} \tag{7}$$

t=1,…,*T*, *i*=1,…,*N0*
where ε_{it} shows the error term and $\varepsilon_{it} \sim NK(0, \Omega_i)$; *n* shows the lag length of the VECM; y_{it} is an (nx1) vector of variables and cointegrated in I(1) with a rank of r_i for $0 \le r_i \ge K$. $\prod_i$ denotes the long-run cointegrating matrix. The short-run

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matrices are designated as Γ_{ij} (i=1,..,N; j=1,..n). Z_{it} indicates the vector of deterministic term, and φ_i represents the vector of coefficients. The Johansen-Fisher regression can also be estimated as in Eq. (1) by just combining p-values of the cross-section trace or maximum eigenvalue tests.

Diagnostic Checks and Model Specification

The correlation of residuals across individual series in a panel can be an issue in macro data where a group of highly connected countries are examined. Panel estimations that disregard cross-sectional dependence may lead to inconsistent conclusions. Therefore, before performing panel data estimations, we perform diagnostic checks to examine whether cross-sectional dependence exists or not. After examining whether cross-sectional dependence exists, we decide on the type of unit root tests that will be used. First generation unit root tests are used when there is no cross-sectional dependence whereas the use of second-order unit roots test is more appropriate in the presence of cross-sectional dependence. Next, we conduct relevant unit root tests to specify integration order. Finally, we employ the Johansen-Fisher panel cointegration (JFPC) method.

Pedroni (1999) and Kao (1999)'s cointegration methods are restrictive when examining the cointegration characteristics of an n-dimensional vector of $I(1)$ variables where more than one cointegrating vector between variables may emerge. Conversely, the JFPC method imposes no restrictions on the number of cointegrating vectors. Because we aim to explore through which channels EG has a long-term relationship with FDX (FM or FI) and there may be more than one cointegrating vector, we prefer to use the JFPC method. Lastly, VECM is performed to estimate the long-run and short-run dynamics among the variables used.

We deploy two separate panel cointegration regressions with the overall FD index and its sub-indices separately; Model 1 includes lnGDPPC and FDX and Model 2 contains lnGPPCD, FM, and FI.

Our basic empirical regression framework for Model 1 is shown in Eq. (8) and Model 2 is represented by Eq. (9) below:

$$lnGDPPC_{it} = \beta_0 + \beta_1 FDX_{it} + \varepsilon_{it} \quad (8)$$
$$lnGDPPC_{it} = \beta_0 + \beta_1 FM_{it} + \beta_2 FI_{it} + \varepsilon_{it} \quad (9)$$

where i=1, 2, 3…, N refers to each country in the panel and t=1, 2, 3,…, T exemplifies the years. β_1 and β_2 show the coefficients which capture long-run effects and ε_{it} denotes the error term.

We also employ the following panel VECM based equations to discover the direction of a causal relationship between our variables:

The Eq. (8) of Model 1 transforms into Panel VECMs as follows:

$$\Delta lnGDPPC_{it} = \alpha_i + \sum_{j=1}^{n} \beta_1 \, \Delta lnGDPPC_{it-j} + \sum_{j=1}^{n} \beta_2 \, \Delta FDX_{it-j} + \beta_3 ECT_{it-j} + \varepsilon_{it} \quad (10)$$

$$\Delta FDX_{it} = \alpha_i + \sum_{j=1}^{n} \beta_1 \, \Delta lnFDX_{it-j} + \sum_{j=1}^{n} \beta_2 \, \Delta lnGDPPC_{it-j} + \beta_3 ECT_{it-j} + \varepsilon_{it} \quad (11)$$

The Eq. (9) for Model 2 can be turned into panel VECMs as shown below:

$$\Delta lnGDPPC_{it} = \alpha_i + \sum_{j=1}^{n} \beta_1 \, \Delta lnGDPPC_{it-j} + \sum_{j=1}^{n} \beta_2 \, \Delta FM_{it-j} + \sum_{j=1}^{n} \beta_3 \, \Delta FI_{it-j} + \beta_4 ECT_{it-j} + \varepsilon_{it} \quad (12)$$

$$\Delta FM_{it} = \alpha_i + \sum_{j=1}^{n} \beta_1 \, \Delta FM_{it-j} + \sum_{j=1}^{n} \beta_2 \, \Delta LNGDPPC_{it-j} + \sum_{i=1}^{n} \beta_3 \, \Delta FI_{it-j} + \beta_4 ECT_{it-j} + \varepsilon_{it} \quad (13)$$

$$\Delta FI_{it} = \alpha_i + \sum_{j=1}^{n} \beta_1 \, \Delta FI_{it-j} + \sum_{j=1}^{n} \beta_2 \, \Delta LNGDPPCS_{it-j} + \sum_{j=1}^{n} \beta_3 \, \Delta FM_{it-j} + \beta_4 ECT_{it-j} + \varepsilon_{it} \quad (14)$$

Where *n* denotes lag length; Δ shows the first difference of variables; α_i indicates the constant term; β_1, β_2, β_3, and β_4 are the model parameters; ECT_{it-j} signifies the error correction term and ε_{it} is the error term. The ECTs aim to capture the long-run dynamics while differenced variables focus on describing the short-run dynamics. The causality of the short-run relationship is examined by testing the hypothesis that all short-run coefficients are jointly 0. The t-statistics of the lagged ECTs are used to explore the long-run causality. The model is eligible only when the variables are I(1).

4. Empirical Results

Empirical tests comprise four steps. First, we check the unit-roots of all variables to designate the integration order. Before applying the cointegration test, we estimate the VAR by using stationary series and find out the optimal lag length for Model 1 and Model 2. The Model 1 includes lnGDPPC and FDX and Model 2 contains lnGDPPC, FM, and FI. Second, after deciding optimal lag lengths according to Akaike information criteria (AIC) for both models, an appropriate model that includes deterministic components is chosen for regressions. In the third step, we deploy the JFPC method to identify a long-run association among the variables. Lastly, after detecting the long-run relationship, we perform panel VECM to describe short-run and long-run dynamics.

Cross-sectional Dependence and Panel Unit Root Tests Results

In panel data models, cross-sectional dependence may arise from common shocks and unobserved factors. The presence or absence of cross-sectional

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dependence determines the type of panel unit root tests to be used. Therefore, the examination of the existence of cross-sectional dependence is an important diagnostic check. In this context, we employ Breusch-Pagan LM, Pesaran Scaled LM, Bias-corrected scaled LM, and Pesaran CD tests. Table 2 presents the results of these cross-sectional dependence tests. The findings show that the null hypothesis of no cross-sectional dependence is rejected at the 1% level of significance for FDX, FM, FI and lnGDPPC.

In the presence of cross-sectional dependence, second-generation unit root tests should be used to examine stationarity. Second generation tests relax the assumption of cross-sectional independence between individual time series in the panel, which is an assumption used in the first-generation tests such as Levin, Lin and Chu (2002).

We apply Paseran's (2004) cross-sectional augmented IPS (CIPS) unit root test to check the stationarity of lnGDPPC, FDX, FI, and FM in levels across countries. The outcomes of the Paseran CIPS test in levels and 1st differences are presented in Table 2. According to the test results, all variables (LnGDPPC, FDX, FM, and FI) are non-stationary at their levels. However, they turn into stationary in their first differences at a 1% significance level So, we conclude that all variables are integrated of order one ($I(1)$) from 1980 to 2019.

Table 2. Cross-Sectional Dependence Test

Method	Breusch-pagan LM	Pesaran Scaled LM	Bias-corrected scaled LM	Pesaran CD
FDX	2551.31^{a} (0)	83.04^{a} (0)	82.70^{a} (0)	4.95^{a} (0)
FI	2587.41^{a} (0)	84.40^{a} (0)	84.06^{a} (0)	2.11^{b} (0.04)
FM	2526.45^{a} (0)	82.10^{a} (0)	81.76^{a} (0)	6.07^{a} (0)
lnGDPPC	10047.86^{a} (0)	365.98^{a} (0)	365.64^{a} (0)	99.34^{a} (0)

Note: The null hypothesis is that there is no cross-sectional dependence. ^{a}and ^{b} display the significance levels at 1%and 5%, respectively. The numbers in the body of the table denote the test statistics and the numbers in the parentheses indicate the probability.
Source: Authors' Calculations

Table 3. Second Generation Unit Root Test Results

Method	Pesaran CIPS	Peseran CIPS
	Panel A: Level	Panel B: 1st Difference
FDX	-1.73	-5.32[a]
	p>=0.10	p<0.01
FI	-1.62	-4.76[a]
	p>=0.10	p<0.01
FM	-1.54	-4.57[a]
	p>=0.10	p<0.01
lnGDPPC	-1.53	-2.86[a]
	p>=0.10	p<0.01

Source: Authors' calculations

Panel Cointegration Test Results

JFPC Test Results for Model 1

Before employing the JFPC method, an optimal lag length should be selected for the VAR-based panel model. Six criteria are used for the optimal lag length selection and the results for Model 1 are presented in Table 4.

Table 4. Lag Selection for Model 1

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-961.85	NA	0.04	2.38	2.39	2.39
1	1625.76	5156.02	6.25e-05	-4.00	-3.97*	-3.99
2	1633.73	15.86*	6.19e-05*	-4.01*	-3.96	-3.99*
3	1634.27	1.06	6.24e-05	-4.01	-3.92	-3.97
4	1636.37	4.14	6.27e-05	-4.00	-3.90	-3.96
5	1638.44	4.09	6.30e-05	-3.99	-3.87	-3.95
6	1639.66	2.40	6.35 e-05	-3.99	-3.84	-3.93
7	1640.70	2.04	6.39 e-05	-3.98	-3.81	-3.91
8	1640.97	0.53	6.45 e-05	-3.97	-3.78	-3.90

Note: * refers to the selected lag order by the criteria, LR: sequential modified LR test statistic FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.
Source: Authors' Calculations

It is seen that three of the six criteria point out that the most suitable lag is two. After deciding the optimal lag length as two, we deploy the JFPC test.

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Hypothesis for investigating whether there is a cointegrating vector(s) between variables can be stated as follows:

H_0= no cointegrating vector (r=0) and
H_1= there is at least 1 cointegrating Vector (r≤1).

The rejection criteria for both hypotheses are at the 5 % level. The empirical results of the Johansen-Fisher test, where the target variable is lnGDPPC and the independent variable is FDX, are given in Table 5.

Table 5: JFPC Results for Model 1

Null-Hypothesis	Fisher Stat. From Trace test	Prob.	Fisher Stat. From max-eigen test	Prob.
r=0	81.15[a]	0.01	79.01[a]	0.01
r≤1	55.57	0.42	55.57	0.42

Note*:* *r*: number of cointegrating vectors. Intercept (no trend) in the cointegration equation and VAR is used in the test. *a* indicates the rejection of the no cointegration hypothesis at a 1% significance level. Probabilities for panels are calculated using asymptotic chi-square distribution.
Source: Authors' Calculations

The findings in Table 5 demonstrate that both the trace and maximum eigenvalue tests reject the null hypothesis of zero cointegrating vectors (r=0) in favor of one cointegrating vector. Furthermore, the probability of at least one cointegrating vector is 0.42, which is more than 5%. This suggests that there is a single cointegration equation between lnGDPPC and FDX. Hence, the results indicate a long-run association between the two measures.

JFPC Test Results for Model 2

The test results for the optimal lag length selection for Model 2 are shown in Table 6.

Table 6: Lag Selection for Model 2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-643.95	NA	0.00	1.60	1.62	1.61
1	2761.36	6776.95	2.24e-07	-6.80	-6.73*	-6.77*
2	2773.20	23.48*	2.23e-07*	-6.80*	-6.68	-6.76
3	2777.53	8.55	2.25 e-07	-6.79	-6.62	-6.73
4	2782.18	9.15	2.28 e-07	-6.78	-6.55	-6.69
5	2787.42	10.27	2.30 e-07	-6.77	-6.49	-6.67
6	2791.60	8.15	2.33 e-07	-6.76	-6.43	-6.63

7	2792.89	2.51	2.37 e-07	-6.74	-6.36	-6.59
8	2794.23	2.60	2.42 e-07	-6.72	-6.29	-6.56

Source: Authors' Calculations

Table 6 reveals that the most suitable lag is two.Next, by conducting the JFPC method, we test the following hypotheses:

H_0= no cointegrating vector (r=0) and
H_1= there is at least one cointegrating vector (r≤1).
H_2= there are at least two cointegrating vectors (r≤2).

The results presented in Table 7 display that the hypothesis of no cointegrating vector is rejected. However, we do not reject the hypothesis of one cointegrating vector (H_1 = r≤1) with a probability of 0.11 from Trace test and 0.24 from Max-eigen test.

Table 7: JFPC Results for Model 2

Null Hypothesis	Fisher Stat. From Trace test	Prob.	Fisher Stat. From max-eigen test	Prob.
r=0	140.20[a]	0	116.50[a]	0
r≤1	67.23	0.11	61.04	0.24
r≤2	66.04	0.13	66.04	0.13

Note: *a* indicates the rejection of the no cointegration hypothesis at the 1% significance level.
Source: Authors' Calculations

Similarly, the probability of at least two cointegrating vectors ($H_2 = r \leq 2$) is 0.13 for both tests. Therefore, we do not reject the null hypothesis that there are at least two cointegrating vectors. As mentioned before, the advantage of the JFPC test is to designate whether there is more than one cointegration relationship among variables. By using this advantage, we conclude that there are two cointegration equations and all the variables are cointegrated. To sum up; lnGDPPC is cointegrated with FM and FI in the long run.

Panel VECM test Results

After confirming a long-run association between the variables, we go on with panel VECM to examine a possible causal link between lnGDPPC and FDX. In the panel VECM, all variables are treated as endogenous without the causality assumption. We aim to detect short-run adjustments of variables for the long-run equilibrium. AIC is employed for determining the optimal lag length. The long-run cointegration equation of Model 1 is shown in Eq. (15) where the dependent variable is lnGDPPC:

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$$ECT_{it-1} = 1lnGDPPC_{t-1} - 37.97429FDX_{t-1} - 6.051342 \quad (15)$$

The estimated panel VECM with lnGDPPC as the target variable is presented below:

$$\Delta lnGDPPC_t = -0.001900ECT_{it-1} + 0.194690\Delta lnGDPPC_{t-1} - 0.0922410\Delta lnGDPPC_{t-2} + 0.018944\Delta FDX_{t-1} - 0.011403\Delta FDX_{t-2} + 0.039212 \quad (16)$$

The long-run cointegration equation of Model 1 is shown in Eq. (17) where the dependent variable is FDX:

$$ECT_{it-1} = 1FDX_{t-1} - 0.026334lnGDPPC_{t-1} - 0.159354 \quad (17)$$

Similarly, the estimated panel VECM with FDX as the target variable is as follows:

$$\Delta FDX_t = -0.085284ECT_{it-1} - 0.001361\Delta FDX_{t-1} - 0.013401\Delta FDX_{t-2} + 0.014174\Delta lnGDPPC_{t-1} + 0.005154\Delta lnGDPPC_{t-2} - 0.000864 \quad (18)$$

Table 8 shows long-run and short-run results for the variables lnGDPPC and FDX.

Table 8: VECM Results for Model 1

	Independent Variables		
Dependent Variables	ΔlnGDPPC	ΔFDX	ECT_{t-1}
ΔlnGDPPC	_	0.098	[-2.22][a]
		(0.95)	(0.02)
ΔFDX	1.56	_	[-6.07][b]
	(0.45)		(0.100)

Source: Authors' Calculations

AIC is used to specify the optimal lag length. *a* (*b*) shows the rejection of the null hypothesis at the 5% (%10) significance levels. The numbers in the main body of the table show Chi-Square statistics from the Wald test. Numbers in brackets denote the t-statistics. In the parentheses is the probability.

The parameter for the speed of adjustment has to be a significantly negative number that ranges from 0 to -1 for a long-run relationship. The negative sign indicates a departure in one direction, and the correction must be pulled back to the other direction. Thus, as it is seen in Eq. (16), the coefficient of the speed of adjustment is -0.0019 and significant at 5% level (t-stat = -2.22 in Table 8), which points out that the whole system is getting back to long-run equilibrium at a speed of -0.19% annually. Therefore, the long-run causality is from FDX to lnGDPPC when ΔlnGDPPC is used as the target variable. When ΔFDX becomes the target variable, the coefficient of the speed of adjustment is -0.085284 as can be seen in

Eq. (18), and significant (t-stat = -6.07, in Table 8). This means that lnGDPPC tends to explain the changes in FDX in the long run at a 5 % level of significance. Therefore, there is bidirectional causality from FDX to lnGDPPC.

We proceed with testing the null hypothesis that all short-run coefficients are jointly equal to zero by applying the Wald test. This way, we check whether FDX granger causes the lnGDPPC in the short run and vice versa. The results in Table 8 demonstrate that the *p-value* of Chi-square is 0.95 when the ΔlnGDPPC is the dependent variable. So, we cannot reject the null hypothesis, which means that there is lack of evidence for a short-run causality from FDX to lnGDPPC. Similarly, when the dependent variable is ΔFDX Chi-square value is 1.56 with a p value of 0.45. Hence, there is no evidence of a short-term causality running from lnGDPPC to FDX too.

Panel cointegration equations for Model 2 with two cointegrating vectors are shown in Eq. (19) and Eq. (20) where the dependent variable is lnGDPPC:

$$ECT_{1,it-1} = 1lnGDPPC_{it-1} - 55.43788FI_{it-1} + 11.16812 \quad (19)$$
$$ECT_{2,it-1} = 1FM_{it-1} - 3.072012FI_{it-1} + 0.689287 \quad (20)$$

The estimated panel VECM is shown in Eq. (21)

$$\Delta lnGDPPC_{it} = -0.005210ECT_{1,it-1} + 0.096729ECT_{2,it-1} + 0.192674\Delta lnGDPPC_{it-1} - 0.093978\Delta lnGDPPC_{it-2} - 0.021176\Delta FM_{it-1} + 0.155850\Delta FM_{it-2} + 0.029137\Delta FI_{it-1} + 0.088459\Delta FI_{it-2} + 0.037826 \quad (21)$$

Next, the long-run cointegration equations for Model 2 where the FM is the dependent variable are shown in Eq. (22) and Eq. (23)

$$ECT_{1,it-1} = 1FM_{it-1} - 3.072012FI_{it-1} + 0.689287 \quad (22)$$
$$ECT_{2,it-1} = 1lnGDPPC_{it-1} - 55.43788FI_{it-1} + 11.16812 \quad (23)$$

while the estimated panel VECM with ΔFM is represented by Eq. (24):

$$\Delta FM_{it} = -0.038640ECT_{1,it-1} + 0.002787ECT_{2,it-1} + 0.001568\Delta FM_{it-1} - 0.0907783\Delta FM_{it-2} + 0.004843\Delta lnGDPPC_{it-1} + 0.008868\Delta lnGDPPC_{it-2} + 0.039256\Delta FI_{it-1} + 0.044926\Delta FI_{it-2} - 0.001042 \quad (24)$$

Lastly, the long-run cointegration equations of Model 2 where FI is the dependent variable are shown in Eq.(25) and (26), and the estimated panel VECM for ΔFI is shown in Eq. (27) as follows:

$$ECT_{1,it-1} = 1FI_{it-1} - 0.325520FM_{it-1} - 0.224377 \quad (25)$$
$$ECT_{2,it-1} = 1lnGDPPC_{it-1} - 18.04612FM_{it-1} - 1.270837 \quad (26)$$

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$$\Delta FI_{it} = -0.114169ECT_{1,it-1} + 0.000494ECT_{2,it-1} - 0.020338\Delta FI_{it-1} + 0.074523\Delta FI_{it-2} + 0.020565\Delta lnGDPPC_{it-1} - 0.000900\Delta lnGDPPC_{it-2} - 0.024998\Delta FM_{it-1} - 0.126533\Delta FM_{it-2} - 0.000604 \quad (27)$$

Table 9: VECM Results for Model 2

	Independent Variables			
Dependent Variables	ΔlnGDPPC	ΔFM	ΔFI	ECT$_{1,t-1}$
ΔlnGDPPC	_	2.69 (0.25)	1.74 (0.41)	[-3.24][a] (0.00)
ΔFM	1.18 (0.55)	_	4.15 (0.55)	[-3.17][a] (0.00)
ΔFI	1.34 (0.52)	5.62 (0.06)	_	[-6.79][a] (0.00)

Note: [a] shows the rejection of the no long-run causality hypothesis at the 1% significance level. (ECT$_{1,t-1}$) designates the error correction term of the 1st cointegration equation. The numbers in the main body of the table show Chi-Square statistics from the Wald test. Numbers in brackets denote the t-statistics. In the parentheses is the probability.
Source: Authors' Calculations

Table 9 shows both long and short-term results from VECM. The long-run causality test indicates that the causality runs from both FM and FI to lnGDPPC as the slope of the error term of the first cointegration equation is -0.00521 in Eq.(21) and significant at the 1% level (t-stat = -3.24, in Table 9). This suggests that the error term of the first cointegration equation contributes to the explanation of the changes in lnGDPPC. When FM is the target variable, Eq. (24) shows that the first cointegrated equation has a negative speed-adjustment coefficient of -0.038640 and is significant at 1 % level (t-stat = -3.17, in Table 9). This means that deviations from long-term equilibrium are reverted back at an 3.864% annual convergence speed and the long-run causality extends from lnGDPPC and FI to FM. When ΔFI is employed as the dependent variable, the coefficient of the speed of adjustment is -0.114169 as can be seen in Eq. (27), and is statistically significant at the 1% level with a t-statistic of -6.79 (Table 9). These results indicate a long-run causality running from lnGDPPC and FM to FI. In other words, changes in FI are driven by lnGDPPC and FM. In summary, there is bidirectional causality between lnGDPC and FM, and between lnGDPC and FI. Table 9 reports the results only for the first vector because the second cointegrating vector indicates that the processes are not converging in the long run. So, we primarily focus on the target model that depends on the first cointegrating vector.

To check the results of the short-run causality among the lnGDPPC, FM, and FI based on panel VECM estimates, the Wald test is used. The null hypothesis is that there is no short-run causality. The outcomes in Table 9 demonstrate that the *p-values* of Chi-Square statistics for ΔFM and ΔFI are 0.25 and 0.41 , respectively, when the ΔlnGDPPC is the dependent variable. So, we can not reject the null hypotheses of no short-run causality running from FM to lnGDPPC and from FI to lnGDPPC. Furthermore, the results in Table 9 also show no short-run causality running from lnGDPPC to FM and from FI to FM as evidenced with the p value of 0.55 for both independent variables. Finally, when ΔFI is used as the target variable, there is no evidence of short-run causality from lnGDPPC to FI (p-value is 0.52) however, there is some weak evidence for a short-run causality from FM to FI.at a 10% significance level (p-value of chi-Square is 0.06).

The overall findings reveal the presence of unidirectional causality from FD to EG and bidirectional causality among financial markets and financial institutions and EG. Conversely, there is no strong evidence of short-run causality among the variables.

Table 10: Pedroni and KAO Panel Cointegration Tests Results

	Model 1	Model 2
Panel A: Pedroni Test		
Case 1:Common AR Coefs.		
Panel v-Statistic	-3.7305	2.5119^{a}
	(0.99)	(0.00)
Panel ρ-Statistic	-1.8066^{b}	1.7089
	(0.03)	(0.95)
Panel PP-Statistic	-1.8545^{b}	03186
	(0.03)	(0.62)
Panel ADF-Statistic	-1.7075^{b}	-1.2019
	(0.04)	(0.11)
Case 2: Individual AR Coefs.		
Group ρ-Statistic	0.9100	2.9503
	(0.81)	(0.99)
Group PP-Statistic	-1.4153^{c}	1.063
	(0.07)	(0.85)
Group ADF-Statistic	-0.9839	-0.9097
	(0.16)	(0.18)
Panel B: KAO Test		
ADF	1.9571^{b}	-1.3705^{c}
	(0.02)	(0.08))

Note; Lag lengths are selected automatically by SIC. ^{a},^{b}, and ^{c} show the significance levels at 1%, 5%, and %10, respectively. Kao cointegration test includes an individual intercept (no trend) and the Pedroni test includes no intercept and trend.
Source: Authors' Calculations

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Robustness Tests

Finally, we apply Pedroni's (2004) and Kao's (1999) panel cointegration tests to explore the robustness of our results. Both tests are utilized to search the long-run association among the variables and the empirical findings are documented in Table10. In Panel A, the results of the Pedroni cointegration tests display that out of seven statistics, four statistics reject the no-cointegration hypothesis for Model 1(lnGDPPC and FDX) and one statistic rejects the null hypothesis for Model 2 (lnGPPC, FM and FI). In Panel B, the results of the Kao test display that the no-cointegration hypothesis is rejected when lnGDPPC is dependent and FDX is an independent variable. In addition, when the sub-indices FM and FI are used as independent variables, the no-cointegration hypothesis is significantly rejected again. Therefore, these findings verify a long-run relationship among the variables and are consistent with the previous JFPC test results.

5. Conclusion

We analyze the long-run association between economic growth and financial development by applying the Johansen and Fisher panel cointegration method for 27 emerging countries. We test this association by using the new overall financial development index, which is offered by Svirydzenka (2016). We also investigate two components of the financial development index (financial institutions and financial markets) to discover through which channels economic growth has a long-term relationship with financial devlopment. We prefer the Johansen-Fisher method because it is free of restrictive assumptions about the number of cointegrating vectors. The new financial development index and its sub-indices were not investigated to explain economic growth in emerging countries before. We aim to provide new evidence on which components of financial development affect the improvement in economic growth.

Our empirical analysis consists of three steps. In the first step, we conduct some diagnostic checks and panel unit root tests to find out the stationarity levels of all variables because the most important condition for the validity of the Johansen and Fisher panel cointegration test is that all variables should be stationary at order one, $I(1)$. The second step is the execution of the Johansen and Fisher cointegration method to test the presence of a long-run relationship among variables. In the third step, we perform the panel VECM to identify the direction of causality between economic growth and financial development. Moreover, we employ two different cointegration tests of Pedroni (2004) and Kao (1999) to check the robustness of our results.

Our empirical results support a long-run association between economic growth and the overall financial development index as well as between economic growth and sub-indices of financial development. Panel VECMs display a bidirectional causality running from the financial development index to economic growth. Additionally, bidirectional causality is observed between economic growth and financial markets index and between economic growth and financial institutions index. Our findings support the view that the changes in economic growth can be explained by both the development of financial markets and the development of financial institutions. In other words, both sub-indices substantially affect economic growth in the long run. The reverse is also true. The growth process also causes the development of financial markets and institutions. These results are in conformity with the implications of the feedback hypothesis, which predicts a bidirectional causality. However, the short-run tests yield no evidence for causality among variables.

The long-run association between sub-indices of financial development and economic growth documented in this study has several important implications. First, financial markets and institutions that are more developed improve companies' and individuals' ability to obtain capital more quickly and cheaply. Second, easier access to funds for project financing allows more projects to become viable, resulting in investment booms. Third, as the quantity of funds increases due to well-functioning financial markets, the cost of capital falls, causing more projects to be profitable. As a result, long-term economic development is boosted.

The result of this study have also inferences for policy makers in emerging countries, where the accumulation of capital is limited and saving rates are generally lower. For such countries, investigating the link between economic growth and financial development is particularly crucial. Emerging countries must deepen their financial systems to support economic growth, in contrast to developing countries that already have developed financial markets and institutions. As two sub-indices of financial development are found to be the drivers of economic growth, policy makers in emerging markets should take actions that facilitate the development of financial markets and institutions to increase GDP per capita.

There may be potential differences in macroeconomic structure of emerging markets. Obviously, single country analyses can provide more specific country-level results or further geographical sub-grouping of emerging markets can provide regional results at the expense of reduced sample size. We leave these issues as a direction for future research.

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