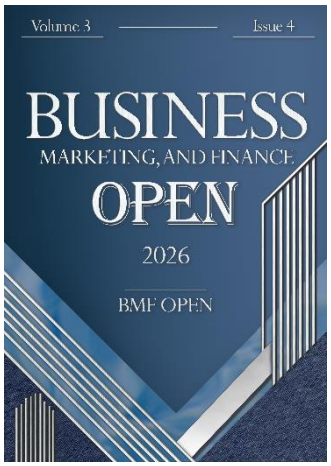
Threshold Effects of Financial Development in the Relationship Between Unemployment Rate and Economic Growth Across Provincial Regions



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Mohammad Taghi Behari [1], Mohammad Khezri [2,*] and Fatemeh Zandi [3]

[1] Department of Economics, ST.C., Islamic Azad University, Tehran, Iran;
[2] Department of Economics, ST.C., Islamic Azad University, Tehran, Iran;
[3] Department of Economics, ST.C., Islamic Azad University, Tehran, Iran;

* Correspondence: Khezri380@iau.ac.ir

Abstract: This study examines the threshold effects of financial development in the relationship between the unemployment rate and economic growth across provincial regions over the period 2006–2024. The research is applied in nature and follows a descriptive–correlational design. Panel data were analyzed using the Panel Smooth Transition Regression (PSTR) approach with a logistic transition function. The main variables include provincial Gross Domestic Product (GDP), income inequality index (WTOP), financial development index measured through household credit provision (FAC), domestic credit to the private sector by banks (FD), education level (EDU), provincial government expenditures (GOV), provincial inflation (CPI), and provincial unemployment rate (UNE). Initially, panel unit root tests, including the Levin–Lin–Chu (LLC) test and Im–Pesaran–Shin (IPS) test, were conducted to assess the stationarity of the variables. Subsequently, the Kao cointegration test confirmed the existence of a long-run relationship among the variables. Diagnostic tests for panel model selection, linearity, threshold effects, and parameter stability were also performed. The results indicate that the relationship between financial development, income inequality, and economic growth is nonlinear, and a PSTR model with a single threshold provides the best specification. The findings reveal that financial development has a positive and statistically significant effect on economic growth, whereas income inequality and unemployment exert negative and significant effects on provincial economic growth. The estimated threshold coefficient for the financial development index is 0.96, and once this threshold is exceeded, the positive impact of financial development on economic growth intensifies. Tests for autocorrelation and heteroskedasticity confirm that the classical assumptions of the model are satisfied, and parameter stability across regimes is also verified. Overall, the results highlight the critical role of financial development in mitigating the adverse effects of income inequality and unemployment on economic growth across provinces. Furthermore, improving the financial development index can enhance the effectiveness of economic policies.

Keywords: Financial development, economic growth, unemployment rate, income inequality

1. Introduction

Economic growth remains a central objective of macroeconomic policy, particularly in developing and emerging economies where structural imbalances, labor market inefficiencies, and financial system constraints interact in complex ways. Among the most critical determinants of sustainable economic growth are financial development,

income distribution, and labor market conditions. Theoretical and empirical literature increasingly emphasizes that financial development is not merely a facilitator of capital accumulation, but a multidimensional mechanism that shapes income distribution, employment opportunities, and overall economic performance. In this context, understanding the nature of the relationship between financial development, unemployment, and economic growth—particularly in a nonlinear or threshold-dependent framework—has become a priority for both policymakers and researchers [1, 2].

Financial development, broadly defined as the improvement in the efficiency, depth, access, and stability of financial systems, plays a fundamental role in mobilizing savings, allocating resources, and facilitating investment. In developing economies, where capital markets are often underdeveloped, banking systems and financial intermediaries serve as the primary channels for funding productive activities. Empirical studies have consistently shown that financial development contributes positively to economic growth by reducing transaction costs, improving capital allocation efficiency, and fostering innovation [3, 4]. However, the relationship is not necessarily linear; rather, it may exhibit threshold effects whereby the impact of financial development on growth changes depending on the level of financial deepening [1].

One of the key channels through which financial development influences economic growth is its interaction with income inequality. On the one hand, financial inclusion can reduce inequality by providing marginalized groups with access to credit, enabling entrepreneurship, and promoting inclusive growth [5, 6]. On the other hand, in the absence of equitable access, financial development may exacerbate inequality by disproportionately benefiting higher-income groups who have better access to financial resources and investment opportunities. This duality has led to increasing interest in nonlinear models that capture the asymmetric and threshold-dependent effects of financial systems on economic outcomes [2].

Income inequality itself has significant implications for economic growth. High levels of inequality can reduce aggregate demand, limit human capital accumulation, and generate social instability, thereby hindering long-term economic performance. Furthermore, inequality interacts with financial systems in complex ways, influencing both the supply and demand for credit and investment. Studies have demonstrated that reducing inequality can enhance the effectiveness of financial development policies and improve growth outcomes [7, 8]. In this regard, the role of governance, institutional quality, and policy frameworks becomes critical in ensuring that financial development translates into inclusive and sustainable growth [9].

Another critical dimension of economic performance is the unemployment rate, which reflects labor market conditions and the capacity of an economy to generate productive employment. High unemployment rates not only reduce income and consumption but also create long-term structural challenges, including skill erosion and social inequality. The relationship between unemployment and economic growth is often explained through Okun's law, which suggests an inverse relationship between output growth and unemployment. However, this relationship can be influenced by various factors, including financial development, fiscal policy, and structural characteristics of the economy [10, 11].

Financial development can affect unemployment through multiple channels. By facilitating access to credit and investment, it can stimulate business expansion, entrepreneurship, and job creation. Conversely, financial instability or unequal access to financial resources may exacerbate unemployment by limiting economic opportunities for certain segments of the population. Empirical evidence from developing economies indicates that financial development can reduce unemployment rates, particularly when accompanied by supportive institutional and policy frameworks [12]. Moreover, fiscal policy and macroeconomic stability also play important roles in

shaping labor market outcomes, as demonstrated in studies examining the interaction between inflation, unemployment, and economic growth [13, 14].

In addition to domestic factors, external influences such as remittances, technological change, and globalization also interact with financial systems to shape economic outcomes. For instance, remittances have been shown to have asymmetric effects on financial development, potentially enhancing financial inclusion while also creating dependency effects [15]. Similarly, technological advancements, particularly in information and communication technologies (ICT), can influence labor market dynamics and productivity, thereby affecting the relationship between financial development and economic growth [16]. These factors highlight the importance of considering a comprehensive framework that integrates financial, structural, and institutional dimensions.

Furthermore, issues such as corruption, informal economic activities, and tax evasion can undermine the effectiveness of financial development and economic policies. Corruption can distort resource allocation, reduce investment efficiency, and increase unemployment, thereby negatively affecting economic growth [10, 17]. Similarly, tax evasion reduces government revenues and limits the capacity for public investment in infrastructure, education, and social services, which are essential for sustainable growth [18]. Addressing these challenges requires coordinated policy efforts that enhance transparency, accountability, and institutional quality.

Recent studies have also emphasized the importance of considering threshold effects in the analysis of financial development and economic growth. Traditional linear models may fail to capture the complex and nonlinear relationships that exist among economic variables. Threshold models, such as the Panel Smooth Transition Regression (PSTR) model, allow for the identification of different regimes in which the impact of financial development on growth may vary depending on the level of financial development or other key variables. This approach provides a more nuanced understanding of economic dynamics and can inform more effective policy interventions [1, 2].

In the context of regional economies, such as provinces within a country, disparities in financial development, income distribution, and labor market conditions can lead to heterogeneous growth patterns. Regional analysis is therefore essential for identifying localized challenges and designing targeted policies. Studies focusing on provincial or regional data have highlighted the importance of financial inclusion, infrastructure development, and human capital in promoting balanced regional growth [3, 19]. Such analyses also reveal that the effectiveness of financial development policies may vary across regions, depending on structural and institutional differences.

Overall, the existing literature suggests that financial development, income inequality, and unemployment are interconnected factors that jointly influence economic growth. However, the nature of these relationships is complex and may involve nonlinearities, threshold effects, and interactions with other economic variables. Despite significant progress in empirical research, there remains a need for studies that integrate these dimensions within a unified analytical framework, particularly in the context of regional economies.

Therefore, the aim of this study is to investigate the threshold effects of financial development in the relationship between income inequality, unemployment, and economic growth across the provinces of the country using a Panel Smooth Transition Regression (PSTR) approach.

2. Methodology

This study investigates the impact of financial development on the linkage between income inequality and economic growth across the provinces of the country. The study period spans from 2006 to 2024 and is conducted using the Panel Smooth Transition Regression (PSTR) approach. This research is applied in nature and follows a

descriptive–correlational design, in which statistical methods are employed to test the research hypotheses. To estimate the model, stationarity and cointegration tests are first conducted, and ultimately, the economic growth model across provinces is estimated using the PSTR method. The provinces included in this study are East Azerbaijan, West Azerbaijan, Ardabil, Isfahan, Alborz, Ilam, Bushehr, Tehran, Chaharmahal and Bakhtiari, South Khorasan, Razavi Khorasan, North Khorasan, Khuzestan, Zanjan, Semnan, Sistan and Baluchistan, Fars, Qazvin, Qom, Kurdistan, Kerman, Kermanshah, Kohgiluyeh and Boyer-Ahmad, Golestan, Gilan, Lorestan, Mazandaran, Markazi, Hormozgan, Hamedan, and Yazd.

In the present study, following prior research such as Krofeh et al. (2023), Merino (2022), Chen et al. (2021), and Akif Destek et al. (2020), the threshold effects of financial development in the relationship between unemployment rate and economic growth across provinces are examined.

$$LGDP_{i,t} = \alpha_0 + \beta_1 LWTOP_{i,t} + \beta_2 LFD_{i,t} + \beta_3 LEDU_{i,t} + \beta_4 LGOV_{i,t} + \beta_5 LFAC_{i,t} + \beta_6 LCPI_{i,t} + \beta_7 LUNE_{i,t}$$
$$+\left(\theta_1 LWTOP_{i,t}+\theta_2 LFD_{i,t}+\theta_3 LEDU_{i,t}+\theta_4 LGOV_{i,t}+\theta_5 LFAC_{i,t}+\theta_6 LCPI_{i,t}+\theta_7 LUNE_{i,t}\right)F(S_{i,t},\gamma,c)+u_{i,t}$$

The transition function $F$is defined as:

$$F(\gamma, s_t, c) = (1 + \exp\{-\gamma(s_t - c)\})^{-1}, \gamma > 0$$

To examine the properties of the PSTR model with a logistic transition function based on the model proposed by Van Dijk (1999), it is assumed that the dependent variable $LGDP$is solely a function of its lagged values. Under the assumption of a two-regime transition function, the following relationship is obtained:

$$LGDP_t = \left(\theta_0 + \theta_1 LGDP_{t-1} + \cdots + \theta_p LGDP_{t-p}\right) + \left(\phi_0 + \phi_1 LGDP_{t-1} + \cdots + \phi_p LGDP_{t-p}\right)G(LGDP_t,\gamma,c) + u_t$$
$$G(LGDP_t,\gamma,c) = \frac{1}{1+\exp\{-\gamma(LGDP_t - c)\}}$$

The results of this model are referred to as a two-regime PSTR model, where the location parameter $c$represents the transition point between the two extreme regimes, defined by $G(LGDP_t,\gamma,c) = 0$and $G(LGDP_t,\gamma,c) = 1$, with $G(LGDP_t,\gamma,c) = 0.5$. The parameter γindicates the speed of transition between regimes, and higher values of γimply a faster regime shift.

The variables used in the study include provincial Gross Domestic Product (GDP), financial development index through household credit provision (FAC), domestic credit to the private sector by banks as a percentage of GDP (FD), education level (EDU), income inequality index measured by the Gini coefficient (WTOP), government expenditures (provincial budget) (GOV), provincial inflation (CPI), and unemployment rate (UNE).

3. Findings and Results

Initially, the stationarity properties of the research variables are examined. Unit root tests must first be conducted for all variables to ensure their stationarity over the study period, as non-stationary variables may lead to spurious regression results. A large number of economic time series are non-stationary, and regressions among them are often spurious or misleading (Granger & Newbold, 1974). Traditionally, tests such as the Dickey–Fuller (DF), Augmented Dickey–Fuller (ADF), and Phillips–Perron (PP) have been used to detect unit roots in time series data. Since panel data incorporate a time dimension, panel unit root tests are generally more powerful and reliable than their time series counterparts (Levin & Lin, 1992).

Compared to time series unit root tests, which often involve complex asymptotic distributions, panel unit root tests provide statistics that follow standard normal distributions (Baltagi, 2005). Among various panel unit root tests, the Levin–Lin–Chu (LLC) test and Im–Pesaran–Shin (IPS) test are the most widely used (Levin et al., 2002; Im et al., 2003). These tests are based on the Augmented Dickey–Fuller (ADF) specification:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + X'_{it}\delta + \varepsilon_{it}$$

where $i$denotes the cross-sectional unit and $t$represents time. $p_i$is the number of selected lags, and $X'_{it}$is a vector of exogenous variables. The LLC test assumes a homogeneous autoregressive coefficient αacross cross-sections. The null and alternative hypotheses are:

$$H_0: \alpha = 0 (\text{unit root exists})$$
$$H_1: \alpha < 0 (\text{no unit root})$$

The IPS test, in contrast, allows heterogeneity in autoregressive coefficients across cross-sections:

$$\Delta y_{it} = \alpha_i y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + \mu_{it}$$
$$H_0: \alpha_i = 0 \forall i$$
$$H_1: \begin{cases} \alpha_i = 0 & i = 1, \dots, N_1 \\ \alpha_i < 0 & i = N_1 + 1, \dots, N \end{cases}$$

Thus, rejection of the null hypothesis implies that at least a subset of cross-sections is stationary.

Prior to conducting the panel cointegration test to identify long-run relationships among the main variables, the LLC unit root test is applied.

Table 1. Results of Panel Unit Root Test (LLC)

Variable	LLC W-Statistic	Probability	Stationarity Level
LCPI	-8.79945	0.0000	I(0)
LEDU	-5.46642	0.0000	I(0)
LFAC	-3.46504	0.0003	I(0)
LFD	-4.65414	0.0000	I(0)
LGDP	-6.89551	0.0000	I(0)
LGOV	-14.21490	0.0000	I(0)
LUNE	-6.15248	0.0000	I(0)
LWTOP	-20.00200	0.0000	I(0)

The results presented in Table 1, based on the calculated statistics and their associated probability values, indicate that all research variables are stationary at level $I(0)$.

Most economic theories express the long-run relationship among variables in level form. To ensure the existence of a long-run relationship among the variables included in the model, those variables must be stationary; otherwise, if they are non-stationary, they must be integrated of the same order. Therefore, in order to identify the existence of a long-run relationship among the variables, their stationarity or cointegration should be examined using different tests. On this basis, if the residuals obtained from the estimated regressions are identified as $I(0)$or stationary, one may conclude that a long-run relationship exists among the variables. In the present study, the Kao panel cointegration test was employed to verify the existence of a long-run equilibrium relationship.

Table 2. Results of the Kao Cointegration Test

Test Statistic	Corresponding Probability
ADF: $\mathbf{-8.630618}$	0.0000

As shown in the above table, the panel cointegration test confirms the existence of a relationship among the estimated variables in the regression model for the provinces of the country. In the cointegration test, the hypotheses are defined as follows:

H_0: No cointegration exists

H_1: Cointegration among the variables is confirmed

Given that the significance level is lower than 0.05, the null hypothesis of no cointegration among the variables is rejected. Therefore, the variables are cointegrated in the long run, and a long-run relationship exists among them.

Diagnostic Test:

Various tests are used to determine the optimal model type for pooled data. The most common among them is the Chow test, which is used to choose between a panel data model and an estimation based on pooled data.

Fixed Effects Significance Test (F):

If the linear panel regression is specified as follows:

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k Z_{kit} + e_{it}$$

where $Y_{it}$is the value of the dependent variable for unit $i$in period t, and $X_{jit}$is the value of the j-th explanatory variable for unit $i$in period t. Differences across cross-sectional units are captured by α_i, which is assumed to remain constant over time. If the null hypothesis assumes that $\alpha_i$is identical for all provinces, the OLS method provides efficient and consistent estimates of $\alpha$and β. However, if differences are assumed to exist across cross-sectional units, the panel data method is used for estimation. For this test, the hypotheses $H_0$and $H_1$are expressed as follows:

H_0: The intercept is identical across all cross-sectional units

H_1: At least one cross-sectional unit has a different intercept

To determine whether separate intercepts exist for each cross-sectional unit, the F-statistic below is used. This test is a simple Chow test.

$$F_0 = \frac{(RRSS - URSS)/(N-1)}{URSS/(NT - N - K)} \sim F_{(N-1,\, N(T-1)-K)}$$

In the above equation, URdenotes the unrestricted model, and Rdenotes the restricted model with a common intercept term for all groups. $K$is the number of explanatory variables included in the model, $N$is the number of cross-sectional units, and Tdenotes the time period. If the calculated F-statistic is greater than the critical F-value with degrees of freedom $N-1$and $N(T-1)-K$, the null hypothesis is rejected. Consequently, the restricted regression is not valid, and different intercepts should be incorporated in the estimation. Another fundamental question that arises is whether the difference in intercepts operates in a fixed manner, or whether different behaviors can explain these differences across units more clearly. The results of the Limer test are presented in the following table.

Table 3. Results of the Model Selection Test for the Return on Assets Model

Type of Test	Test Result	Model Selection
Limer test		Panel data
Test Statistic	Degrees of Freedom	Probability
12.285513	(30, 551)	0.0000
301.665982	30	0.0000

According to the above table, and because the calculated probability is less than 0.05, the null hypothesis that the model should be estimated using the pooled data method is rejected; therefore, the research model is selected as a panel data model.

To examine whether the relationship among the model variables is linear or nonlinear, it must be determined whether m(the number of regime parameters) equals one. It should be noted that, in the following tests, the null hypothesis assumes a linear model, whereas the alternative hypothesis corresponds either to a logistic PSTR model ($m = 1$)or to an exponential PSTR model ($m = 2$). The diagnostic test results reported in Table 4 indicate that the null hypothesis of linearity is rejected. Therefore, a nonlinear relationship exists for the effect of financial development on the linkage between income inequality and economic growth in the provinces under study, and accordingly, the PSTR method should be used to estimate the model parameters.

Table 4. Results of the Model Linearity Hypothesis Test (BBC Test)

Provinces of the Country	Null Hypothesis Test	F-Statistic	Significance Level
	Wald test	3.785	0.000
	Fisher test	2.638	0.001
	LRT test	2.957	0.012

As is evident from the results reported in Table (4), the hypothesis of linearity in the relationship among variables is rejected; therefore, the possibility of a linear relationship among the variables is ruled out. It should also be noted that the proposed Panel Smooth Transition Regression (PSTR) model, with the financial development index selected as the transition variable, is identified as the optimal model for estimation across the provinces. For this purpose, the null hypothesis of a PSTR model with a single transition function is tested against the alternative hypothesis of a PSTR model with at least two transition functions. The results are presented in Table (5). The findings indicate that the null hypothesis—suggesting the sufficiency of a single transition function—is not rejected under both one- and two-threshold scenarios; therefore, a single transition function is sufficient to specify the effect of financial development on the relationship between income inequality and economic growth across provinces.

Table 5. Test of Nonlinear Relationship (Remaining Nonlinearity Test)

Model Specification	LR Statistic	LMf Statistic	LMw Statistic
Two thresholds (M = 2)	1.297 (0.802)	1.362 (0.751)	1.425 (0.675)
One threshold (M = 1)	1.432 (0.654)	1.471 (0.630)	1.352 (0.743)

With the confirmation of a nonlinear relationship among the variables and the adequacy of a single transition function to capture nonlinear behavior, the optimal specification between a one-threshold and two-threshold transition function must be determined. For this purpose, the PSTR model corresponding to each case is estimated, and based on the criteria of the sum of squared residuals, Schwarz, and Akaike information criteria, the PSTR model with a single threshold is selected as the optimal model. Accordingly, a PSTR model with one transition function and one threshold is chosen to examine the nonlinear behavior among the variables under study.

Using a PSTR model in which the transition variable is the financial development index, the functional relationship between financial development, income inequality, and economic growth across provinces is modeled. Given the confirmation of the nonlinear model, the analysis focuses on the nonlinear component of the model.

According to the estimation results, the coefficient of the financial development index in the nonlinear part is equal to 0.393667, indicating a direct effect of this variable on provincial economic growth. The corresponding probability value is 0.0201, which confirms statistical significance at the 95% confidence level.

The coefficient of the income inequality variable in the nonlinear part is equal to -0.433451, with a probability value of 0.0218, indicating a negative and statistically significant effect on provincial economic growth.

The effect of the unemployment rate on provincial economic growth, based on the nonlinear estimation results, is also negative and statistically significant, with a coefficient of $-0.582868$and a probability value of 0.0149.

Table 6. Estimation Results Using the PSTR Model (Economic Growth Model)

Linear Component Estimation

Variable	Coefficient	Std. Error	t-Statistic	Probability
CONSTANT	0.329059	0.136048	2.418698	0.0234
LWTOP	-0.158886	0.075984	-2.091051	0.0419
LFD	0.212527	0.090308	2.353357	0.0356
LEDU	0.096233	0.026454	3.637702	0.0003
LGOV	0.120704	0.060604	1.991677	0.0487
LFAC	0.204690	0.089165	2.295631	0.0300
LCPI	-0.022717	0.010298	-2.205968	0.0274
LUNE	-0.235516	0.085117	-2.762255	0.0053

Nonlinear Component Estimation

Variable	Coefficient	Std. Error	t-Statistic	Probability
CONSTANT	0.016839	0.006021	2.796881	0.0049
LWTOP	-0.433451	0.159418	-2.718959	0.0218
LFD	0.393667	0.142781	2.757139	0.0201
LEDU	0.496421	0.175702	2.825358	0.0069
LGOV	0.197885	0.085146	2.324058	0.0201
LFAC	0.642607	0.230948	2.782475	0.0200
LCPI	-0.097980	0.028983	-3.380603	0.0008
LUNE	-0.582868	0.239013	-2.438640	0.0149
Threshold (c)	0.964102	0.158623	6.077495	0.0000
Slope Parameter ($\boldsymbol{\gamma}$)	6.675325	2.934622	2.274678	0.0284

$$R^2_{adj} = 0.88$$

The comparison of coefficients across the two regimes is conducted based on the transition variable and its values. The value of the transition variable determines the transition function and, consequently, the prevailing regime. In the present estimation, the transition variable is the financial development index, and the estimated threshold value for this variable is 0.96. Depending on the deviation of the financial development index from this threshold value, the model follows two distinct regimes. A comparison of coefficients across the two regimes indicates that once the financial development index surpasses the threshold value of 0.96(i.e., transition from the linear to the nonlinear regime), the responsiveness of provincial economic growth to changes in this variable increases substantially. In other words, as the financial development index improves, its effectiveness intensifies with a stronger reaction.

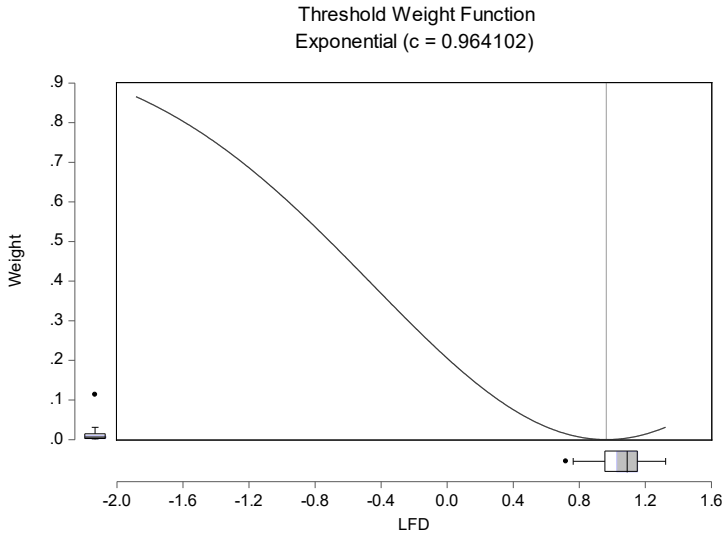

Figure 1: Relationship Between the Transition Function and the Financial Development Index as the Transition Variable

In the present study, the Durbin–Watson test is used to examine autocorrelation.

Table 7. Autocorrelation Test Results

Provinces	F-Statistic	Probability	Durbin–Watson
	1.235	0.690	2.036

As shown in the table above, the Durbin–Watson test results indicate no autocorrelation among the error terms. Therefore, the classical assumption of no autocorrelation is not violated, and the estimators possess the desired properties of efficiency and minimum variance.

Another classical assumption is homoskedasticity. In this study, the Breusch–Pagan–Godfrey test is employed.

Table 8. Heteroskedasticity Test Results

Provinces	F-Statistic	Probability	Breusch–Pagan–Godfrey
	1.298	0.556	1.327

As observed in the table, the test results indicate the absence of heteroskedasticity.

Another important criterion for evaluating the quality of the estimated model is examining the stability of coefficients across regimes. If the estimated model is appropriate, the coefficients are expected to remain stable despite regime changes.

Table 9. Results of Smooth Transition Parameter Stability Test

Provinces	Null Hypothesis	F-Statistic	Probability
	$b_1 = b_2 = b_3 = b_4 = 0$	0.745	0.754
	$b_1 = b_2 = b_3 = 0$	0.798	0.712
	$b_1 = b_2 = 0$	0.821	0.695
	$b_1 = 0$	0.836	0.674

As indicated in the table, the results of the coefficient stability test across the two regimes show that the coefficients do not change as a result of regime shifts.

4. Discussion and Conclusion

The results of the present study provide robust empirical evidence on the nonlinear and threshold-dependent relationship between financial development, income inequality, unemployment, and economic growth across the provinces. The estimation of the Panel Smooth Transition Regression (PSTR) model reveals that financial development exerts a positive and statistically significant effect on provincial economic growth, while income inequality and unemployment rates have negative and significant impacts. Furthermore, the existence of a threshold effect—identified at a financial development index value of approximately 0.96—indicates that the magnitude of these relationships varies across different regimes, thereby confirming the presence of nonlinear dynamics in the growth process.

The positive and significant effect of financial development on economic growth is consistent with a large body of theoretical and empirical literature emphasizing the role of financial systems in mobilizing savings, improving capital allocation, and facilitating productive investments. In particular, the findings align with studies demonstrating that financial deepening enhances economic performance by reducing transaction costs and promoting efficient resource distribution [3, 4]. Moreover, the observed strengthening of this effect beyond the estimated threshold supports the argument that financial development yields increasing returns once a certain level of maturity is achieved. This result is in line with the threshold hypothesis proposed in the literature, which suggests that the benefits of financial development become more pronounced after surpassing critical levels of financial infrastructure and institutional quality [1].

The nonlinear nature of the relationship also corroborates findings from threshold-based analyses, which highlight that financial development does not exert uniform effects across different economic conditions. The identification of a single transition function as sufficient for capturing the nonlinear behavior further indicates that the financial development–growth nexus operates through gradual regime shifts rather than abrupt structural breaks. This is consistent with the empirical evidence provided by [2], who demonstrates that the impact of financial development on macroeconomic variables, including income inequality, varies depending on the level of financial system development.

The negative and statistically significant effect of income inequality on economic growth observed in this study is also supported by existing literature. High levels of inequality can hinder economic performance by reducing aggregate demand, limiting access to education and opportunities, and increasing social and political instability. The results align with findings that emphasize the adverse effects of inequality on sustainable growth, particularly in developing economies where institutional mechanisms for redistribution are often weak [7, 8]. Additionally, the stronger negative effect observed in the nonlinear regime suggests that inequality becomes more detrimental as financial systems evolve, potentially due to unequal access to financial resources and credit markets.

Similarly, the results indicate that unemployment has a negative and significant impact on economic growth, which is consistent with theoretical expectations and empirical findings. High unemployment rates reduce labor utilization, decrease income levels, and constrain consumption, thereby negatively affecting aggregate demand and economic output. The findings are in agreement with studies that document the inverse relationship between unemployment and economic growth, as well as the role of labor market inefficiencies in hindering economic performance [10, 11]. Furthermore, the stronger negative effect in the nonlinear regime suggests that unemployment becomes increasingly harmful in contexts where financial development is more advanced, possibly due to structural mismatches and skill-biased technological changes.

An important implication of the findings is the interaction between financial development and labor market outcomes. The results suggest that financial development can mitigate the adverse effects of unemployment on growth, particularly when it exceeds the identified threshold. This is consistent with empirical evidence indicating that improved access to finance facilitates entrepreneurship, business expansion, and job creation, thereby reducing unemployment and enhancing economic performance [12]. Moreover, the role of financial development in supporting inclusive growth is further reinforced by studies showing that financial inclusion can promote economic participation and reduce poverty [5].

The findings also highlight the importance of complementary factors such as governance, institutional quality, and macroeconomic stability in shaping the effectiveness of financial development. For instance, the presence of corruption, tax evasion, and weak institutional frameworks can undermine the positive effects of financial development by distorting resource allocation and reducing investment efficiency. This is consistent with evidence showing that corruption and institutional inefficiencies negatively impact both employment and economic growth [17, 18]. Similarly, the interaction between inflation, unemployment, and financial development underscores the importance of stable macroeconomic conditions for achieving sustainable growth outcomes [13, 14].

In addition, the role of external factors such as remittances, technological progress, and globalization cannot be overlooked. The asymmetric effects of remittances on financial development and economic performance, as highlighted in previous studies, suggest that external financial flows may influence the effectiveness of domestic financial systems [15]. Likewise, technological advancements, particularly in ICT, can alter labor market dynamics and productivity patterns, thereby influencing the relationship between financial development and growth [16]. These factors indicate that the impact of financial development is context-dependent and shaped by a wide range of structural and institutional variables.

Furthermore, the findings contribute to the literature on regional economic disparities by demonstrating that the effects of financial development vary across provinces. This heterogeneity underscores the importance of adopting region-specific policies that account for differences in financial infrastructure, institutional quality, and economic structure. The results are consistent with studies emphasizing the role of financial inclusion and regional development strategies in promoting balanced economic growth [19]. Additionally, the interaction between financial development and entrepreneurial activity highlights the importance of fostering innovation and business creation as key drivers of growth [6].

Overall, the results of this study confirm that financial development plays a critical role in shaping economic growth, but its effects are nonlinear and contingent upon reaching certain threshold levels. The findings also highlight the importance of addressing income inequality and unemployment as key constraints on economic performance. By integrating these dimensions within a unified analytical framework, the study provides a more comprehensive understanding of the complex interactions among financial, social, and economic variables.

One limitation of the present study is related to the availability and quality of provincial-level data, which may constrain the precision of the estimated relationships and limit the inclusion of additional relevant variables such as institutional quality, governance indicators, and sectoral composition. Another limitation is the reliance on a specific nonlinear modeling approach, which, although appropriate for capturing threshold effects, may not fully account for all forms of structural heterogeneity and dynamic interactions among variables. Furthermore, the study focuses on a single country context, which may restrict the generalizability of the findings to other economies with different institutional and structural characteristics.

Future research could extend the present analysis by incorporating additional variables related to governance, institutional quality, and technological development to provide a more comprehensive understanding of the determinants of economic growth. Moreover, comparative studies across different countries or regions could be conducted to assess the robustness and generalizability of the threshold effects identified in this study. The application of alternative nonlinear modeling techniques, such as dynamic panel threshold models or machine learning approaches, may also provide new insights into the complex relationships among financial development, inequality, and growth. Additionally, future studies could explore the role of sectoral dynamics and structural transformation in shaping the financial development–growth nexus.

From a policy perspective, the findings of this study suggest that enhancing financial development should be a key priority for promoting economic growth and reducing the adverse effects of income inequality and unemployment. Policymakers should focus on improving access to financial services, strengthening financial institutions, and promoting inclusive financial systems that benefit all segments of society. In addition, efforts should be made to reduce income inequality through targeted social and economic policies, as well as to address labor market inefficiencies through education, training, and employment programs. Ensuring macroeconomic stability and improving governance and institutional quality are also essential for maximizing the benefits of financial development and achieving sustainable and inclusive economic growth.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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References

[1] K. B. Luintel, G. Li, and M. Khan, "The threshold effect of finance on growth: Reassessing the burden of evidence," *Open Economies Review,* pp. 1-67, 2024.

[2] J. Thornton and C. Vasilakis, "The impact of finance on income inequality: A threshold analysis," *Economics and Business Letters,* vol. 13, no. 2, pp. 104-111, 2024.

[3] A. Ghorishvandi Irag, M. Sufi Majidpour, S. Ghoveydel Doustkouei, and M. Mahmoudzadeh, "Investigating the Effects of Financial Inclusion on Economic Growth: A Generalized Method of Moments and Quantile Approach," 2025. [Online]. Available: https://civilica.com/doc/2311693.

[4] K. Li, E. B. Nketia, Y. Kong, and M. Appiah, "An introspective analysis of inclusive growth in Africa, with an eminence on the influence of governance and financial development interaction," *SAGE Open,* vol. 13, no. 2, 2023, doi: 10.1177/21582440231166341.

[5] M. C. Blanco-Arana and M. J. Angulo-Guerrero, "Financial development and poverty reduction in developing countries: The role of entrepreneurial activity," *Panoeconomicus*, 2024, doi: 10.2298/PAN220310015B.
[6] M. Mohammadi Khiyareh and H. Amini, "The Effect of Financial Development on Entrepreneurship in Developing Countries," Aliabad, 2024. [Online]. Available: https://civilica.com/doc/2134860.
[7] M. Shahbaz, A. C. Nuta, P. Mishra, and H. Ayad, "The impact of informality and institutional quality on environmental footprint: The case of emerging economies in a comparative approach," *Journal of Environmental Management*, vol. 348, p. 119325, 2023.
[8] A. Khoshniat and M. Zarei, "The functions of development banks in poverty alleviation in economically disadvantaged areas of I.R.I," *Bi-quarterly Journal of Religion, Management & Governance*, vol. 2, no. 1, pp. 52-69, 2023.
[9] M. Ronaghi and E. Scorsone, "The impact of governance on poverty and unemployment control before and after the Covid outbreak in the United States," *Journal of Poverty*, pp. 1-21, 2023, doi: 10.1080/10875549.2023.2173708.
[10] K. U. Rahman, "Impact of corruption, unemployment and inflation on economic growth evidence from developing countries," *Quality & Quantity*, vol. 57, no. 3, pp. 2759-2779, 2023.
[11] A. Moridian, M. Radulescu, P. Kumar, M. T. Radu, and J. Mohammad, "New insights on immigration, fiscal policy and unemployment rate in EU countries: A quantile regression approach," *Heliyon*, vol. 10, no. 13, 2024.
[12] O. Adeli and Z. Sabzpour, "Investigating the Effect of Financial Development on the Unemployment Rate of Iran's Provinces Using a Panel Data Model," Tehran, 2023. [Online]. Available: https://civilica.com/doc/1832803.
[13] N. Ebrahimi, M. Pedram, and M. H. Mousavi, "The Effect of Fiscal Policy on Unemployment Rate and Inflation Rate in the Provinces of Iran: A GVAR Approach," 2021. [Online]. Available: https://civilica.com/doc/1859880.
[14] M. Tajik Norouzi, F. Pourvahedi, and A. Farazandeh Nia, "Investigating the Effect of Inflation and Unemployment Rates on Purchasing Power and Priorities of Financial Resource Allocation," 2025. [Online]. Available: https://civilica.com/doc/2391539.
[15] D. Ozyakisir, M. Akca, and S. Camkaya, "Do remittances have an asymmetrical effect on financial development? Empirical evidence from Turkey," *The Journal of International Trade and Economic Development*, 2023, doi: 10.1080/09638199.2023.2203784.
[16] K. Sohag, M. B. Mesut, W. Ameer, and Š. Vilamová, "Does ICT diffusion validate skill-biased technological change hypothesis? Evidence from the post-Soviet countries," *Technology in Society*, vol. 76, p. 102450, 2024.
[17] J. F. L. Ngono, "Corrupting politicians to get out of unemployment: Empirical evidence from Africa," *Journal of the Knowledge Economy*, vol. 14, no. 2, pp. 1004-1032, 2023.
[18] R. Mohammadzadeh Foulad and M. Khorramabadi, "Investigating the Effect of Tax Evasion on the Economy of Developing Countries," Mashhad, 2024. [Online]. Available: https://civilica.com/doc/2130311.
[19] R. Pirayandeh, A. Khanzadi, and A. Falahati, "Investigating the Relationship Between Energy Poverty and Economic Growth in MENA Member Countries," 2025. [Online]. Available: https://civilica.com/doc/2343778.