Research Article / *Araştırma Makalesi*

FINANCIAL DEVELOPMENT AND INCOME INEQUALITY IN THE EU-27 COUNTRIES: TESTING THE FINANCIAL KUZNETS CURVE HYPOTHESIS USING A PANEL DATA APPROACH

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ABSTRACT

This study examines the relationship between financial development and income inequality for the 27 member countries of the European Union (EU-27) during the period 2009-2022, thereby testing the validity of the Financial Kuznets Curve (FKC) hypothesis. The dependent variable in the study is the Gini coefficient, the ratio of private sector credit to GDP as an indicator of financial development, and real GDP per capita as a measure of economic growth. The analysis applied to the panel data set includes cross-sectional dependence tests, unit root analyses, panel cointegration tests, and the Augmented Mean Group (AMG) method to estimate the long-term relationship. This study contributes to the literature by providing country-specific evidence for the EU-27 economies in the post-2008 crisis period through the application of the AMG estimator. The findings indicate that the FKC hypothesis holds true in countries such as Malta, Portugal, and Slovenia, meaning that financial development initially increases income inequality but reduces it once a certain threshold is crossed. On the other hand, a U-shaped relationship between financial development and income inequality was observed in Austria, Cyprus, the Czechia, Lithuania, Romania, and Slovakia, which contradicts the FKC hypothesis. No significant relationship was found in other countries. Additionally, it was determined that the impact of economic growth on income distribution varies across countries. Overall, the findings show that the impact of financial development on income inequality varies depending on country-specific structural and institutional characteristics, and reveal that targeted financial inclusion policies are needed across the EU-27 rather than uniform policy approaches.

Keywords: Financial Development, Income Inequality, Financial Kuznets Curve, Panel Data Analysis
JEL Classification Codes: O15, G21, C33

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AB-27 ÜLKELERİNDE FİNANSAL GELİŞME VE GELİR EŞİTSİZLİĞİ: PANEL VERİ YAKLAŞIMIYLA FİNANSAL KUZNETS EĞRİSİ HİPOTEZİNİN TESTİ

ÖZET

Bu çalışma, 2009-2022 döneminde Avrupa Birliği'ne üye 27 ülke (AB-27) için finansal gelişme ile gelir eşitsizliği arasındaki ilişkiyi inceleyerek Finansal Kuznets Eğrisi (FKC) hipotezinin geçerliliğini test etmektedir. Çalışmada bağımlı değişken olarak Gini katsayısı, finansal gelişmenin göstergesi olarak özel sektöre verilen kredilerin GSYH'ye oranı ve ekonomik büyümeyi temsilen kişi başına reel GSYH kullanılmıştır. Panel veri setine uygulanan analizlerde, kesit bağımlılığı testleri, birim kök analizleri, panel eşbütünleşme testleri ve uzun dönemli ilişkiyi tahmin etmek üzere AMG (Augmented Mean Group) yöntemi kullanılmıştır. Bu çalışma, AMG tahmincisinin uygulanması yoluyla 2008 küresel kriz sonrası dönemde AB-27 ekonomileri için ülkeye özgü kanıtlar sunarak literatüre katkı sağlamaktadır. Bulgular, FKC hipotezinin Malta, Portekiz ve Slovenya gibi ülkelerde geçerli olduğunu, yani finansal gelişmenin başlangıçta gelir eşitsizliğini artırdığını ancak belirli bir eşiği aştığında eşitsizliği azalttığını göstermektedir. Öte yandan, Avusturya, Kıbrıs, Çekya, Litvanya, Romanya ve Slovakya'da finansal gelişme ile gelir eşitsizliği arasında U-şekilli bir ilişki olduğu görülmektedir; bu durum FKC hipoteziyle çelişmektedir. Diğer ülkelerde ise anlamlı bir ilişki bulunamamıştır. Ayrıca, ekonomik büyümenin gelir dağılımı üzerindeki etkisinin ülkelere göre değiştiği saptanmıştır. Genel olarak bulgular, finansal gelişmenin gelir eşitsizliği üzerindeki etkisinin ülkeye özgü yapısal ve kurumsal özelliklere bağlı olarak değiştiğini göstermekte ve AB-27 genelinde tek tip politika uygulamaları yerine hedeflenmiş finansal kapsayıcılık politikalarına ihtiyaç olduğunu ortaya koymaktadır.

Anahtar Kelimeler: *Finansal Gelişme, Gelir Eşitsizliği, Finansal Kuznet Eğrisi, Panel Veri Analizi*

JEL Sınıflandırması: *O15, G21, C33*

1. Introduction

Income inequality continues to be one of the main issues discussed on a global scale with both economic and social dimensions. Rising income inequality not only triggers economic instability but also poses serious threats to social integration, social justice and sustainable development goals (Stiglitz, 2012). In this context, the importance of theoretical and empirical studies to explain the dynamics of income inequality is increasing day by day. Especially with the rapid growth of financial markets with the globalization process and the increasing impact of the financial system on economic life, the role of financial development on income distribution has become more evident (Claessens & Perotti, 2007). Although it is generally accepted that an active and well-established financial system that supports the national goals of countries such as having a market-oriented, dynamic and competitive economy will also encourage the desired level of investment and economic growth (Azam & Raza, 2018:89). However there is no consensus on its impact on income inequality, as it is unclear how the increased wealth as a result of financial development is reflected in different income brackets (Destek, et al. 2017: 155).

Simon Kuznets (1955), in his hypothesis to explain the relationship between economic growth and income inequality, argued that income inequality increases in the early stages of economic development, but decreases after the level of development reaches a certain threshold.

According to him, in the early stages of economic development, because of industrialization, urbanization and structural transformations, high-income groups benefit more from economic growth because they have easier access to capital accumulation and investment opportunities. In this phase, when capital is scarce, low-income groups are excluded from the financial system and do not benefit sufficiently from growth. This leads to wider gaps in income distribution. However, at later stages of development, low-income groups can gain a larger share of growth due to the wider diffusion of factors of production, higher levels of education, higher labor productivity and wider access to financial services. Thus, the initially increasing income inequality decreases over time and the economic growth process contributes to a more balanced income distribution in the long run. In this context, Kuznets graphically characterized the relationship between economic growth and income inequality in an inverted U-shape. This approach has been an important reference point for both theoretical and empirical studies in understanding the trends observed in inequality indicators over time (Kuznets, 1955: 16).

The FKC hypothesis was introduced to the literature with a theoretical model developed by Greenwood & Jovanovic (1990). In their study, the authors modeled the relationship between the development of financial markets, economic growth and income inequality. According to this model, the process of financial development initially increases income inequality because only wealthy individuals have access to financial services. However, over time, as the financial system becomes more inclusive, low-income individuals also gain access to credit and other financial instruments. Thus, the initially increasing inequality starts to decrease with the level of development. Greenwood & Jovanovic expressed this relationship as an inverted U-shaped curve between income inequality and financial development and thus laid the theoretical foundation of the FKC. Subsequently, Banerjee & Newman (1993) and Galor & Zeira (1993) made important contributions to the theoretical underpinnings of the FKC, namely that financial development may have non-linear effects on income inequality.

The FKC hypothesis argues that the predominant use of the financial system by large firms and high-income groups increases income inequality in the initial phase, but over time, as financial intermediaries and lending systems become more widespread, income inequality can be restored (Honohan, 2004; Beck et al., 2007). However, it should not be overlooked that this relationship may differ across economies and may be affected by structural factors.

The FKC hypothesis has continued to be tested both theoretically and empirically in subsequent studies. Rajan & Zingales (2003) emphasized the effects of financial development on inequality by explaining how financial development is shaped by political power structures and why low-income individuals are excluded from the financial system. Similarly, Beck et al., (2007) conducted a comprehensive empirical analysis covering 72 countries to measure the effects of financial development on income distribution. In this study, it is concluded that in countries with well-developed financial intermediation systems, low-income groups have access to more financial resources, thereby reducing income inequality. In more recent studies, the FKC hypothesis has been tested both with nonlinear threshold models (Kim & Lin, 2011; Bolarinwa & Akinlo, 2021) and panel data analyses (Jauch & Watzka, 2016; Khatatbeh & Moosa, 2023), and a significant number of these tests have supported the validity of the hypothesis for different country groups.

Existing studies generally focus on a global sample or Asian countries, while analyses on European Union countries have been limited. Moreover, the effects of financial development on inequality in the post-2008 period have not yet been sufficiently investigated. To address this gap, this study tests the validity of the FKC hypothesis for 27 European Union member countries for the period 2009-2022 using the panel data method and analyzes the structure of the relationship between financial development and income inequality in detail using econometric methods.

This study contributes to the literature in several important ways. First, it focuses on the post-crisis period, which has been relatively understudied in the FKC hypothesis literature, and presents current empirical findings for the EU-27 economies. Second, unlike most studies that report only average panel effects using homogeneous panel estimators, this research uses the AMG estimator, thereby taking into account long-term dynamics between countries and cross-sectional differences. Furthermore, by clearly distinguishing between inverted-U, U-shaped, and statistically insignificant relationships at the country level, the study offers a more comprehensive and differentiated perspective on the impact of financial development on income inequality. In this respect, the study contributes to a more realistic and policy-relevant assessment of the finance–income inequality relationship within the European Union context.

2. Literature Review

The effects of financial development on income inequality have been discussed and attracted attention in the economics literature for many years. The relationship in question was first analyzed in a theoretical framework with the views emerging in the 1990s, and then this theory started to be tested empirically in the following studies. In this section, studies examining the validity of the FKC hypothesis are discussed based on both the theoretical framework and empirical findings.

The FKC hypothesis was first introduced to the literature by Greenwood & Jovanovic (1990) through a dynamic equilibrium model analysis based on Kuznets' (1955) Kuznets curve, which defines the non-linear relationship between economic growth and income inequality as an inverted U-shape. According to the model, financial development initially increases inequality by working in favor of high-income individuals, but over time, as financial inclusion increases, inequality decreases as low-income individuals are included in the system. Galor & Zeira (1993) and Banerjee & Newman (1993) extend this model theoretically and emphasize the equal opportunity creating aspects of financial development. In this context, Galor & Zeira (1993) established a link between human capital investments and income distribution and underlined that the credit access constraints of capital markets limit investments in education and that financial development would facilitate the financing of productive investments in this field and reduce inefficiency due to inequality, Banerjee & Newman (1993) argue that individuals' choice of occupation in developing countries depends on access to capital and credit, that in the presence of information asymmetry and lack of collateral in financial markets, low-income individuals cannot become entrepreneurs and remain as workers, which leads to structural inequality, and that as financial development increases, low-income individuals can start their own businesses and this will increase income mobility and reduce inequality over time. Aghion & Bolton (1997) explain that capital market imperfections and moral hazard problems may

increase income inequality in the early stages of the capital accumulation process, but this inequality tends to decrease over time. In contrast, Rajan & Zingales (2003) point out that financial development is not only an economic process but also a political one. They emphasize that financial development may regress due to pressure from interest groups, which suggests that inequality may increase if institutional quality is weak. In this respect, the study brings an important institutional perspective to the literature on the FKC hypothesis. These studies have taken their place in literature as pioneering studies that strengthen the theoretical foundations of the FKC hypothesis and paved the way for the empirical research that would follow them.

In empirical literature, there are numerous studies testing the FKC hypothesis. These studies can be analyzed within the framework of linear and nonlinear model approaches. In this context, some of the studies using linear models are Li et al. (1998), Clarke et al. (2006), Nikoloski (2013), Park & Shin (2017), Baiardi & Morana (2018), Topuz & Dağdemir (2016), Kar (2019), Kavya & Shijin (2020), Sayar et al. (2020), Koçak (2021), Özdemir (2021), Zungu & Greyling (2021), Khatatbeh & Moosa (2023), Öndes & Kızılgöl (2024) tested the FKC hypothesis using panel data models and generalized method of moments (GMM) with multi-country data. The findings reveal different effects of financial development across countries.

First, Li et al. (1998) used panel data analysis and cross-sectional regression for 49 developed and developing countries for the period 1960-1995 and concluded that financial development and political-social factors have significant effects on income inequality. Clarke et al. (2006) examined the relationship between financial development and income distribution with a panel data analysis covering 83 developed and developing countries for the period 1960-1995 and concluded that income inequality may increase to a certain extent in the initial stages of financial development, but inequality will decrease with the continuation of development in the long run. Nikoloski (2013), in his study covering 75 developed and developing countries based on panel data analysis, tested the relationship between financial development and income inequality with the GMM method and emphasized the cross-country differences by revealing that the FKC hypothesis is valid in developing countries, but this relationship is weaker in developed countries. Using the same method, Baiardi and Morana (2018) analyzed the 1980-2011 period for the Euro area and found that the FKC hypothesis is valid in an inverted U-shape. On the other hand, Park & Shin (2017) analyzed 162 countries, mainly developing Asian economies, for the period between 1960 and 2011. Using fixed effects models and panel regression with instrumental variables, they observed a U-shaped relationship between financial development and income inequality, indicating that inequality increases after a certain threshold. Topuz & Dağdemir (2016) examined the relationship between financial development and income inequality using data for 94 countries between 1995 and 2011 and found that financial development has a decreasing effect on income inequality in high-income countries and an increasing effect in low-income, low-middle-income and upper-middle-income countries. Kar (2019), in a study covering BRICS and other developing countries for the period 1990-2015, found that this relationship was supported in some country samples, but was not statistically significant in others. Similarly, Kavya & Shijin (2020) analyzed a panel of 85 countries (comprising 28 high-, 41 middle-, and 16 low-income economies) between 1984 and 2014. They found no conclusive evidence supporting the assumption that economic and financial development reduce income inequality. Sayar et al. (2020) investigated the validity of the FKC hypothesis for 23 emerging market economies between 1990 and 2013. They stated that the effect of financial development

on income inequality is not linear and is affected by democratic structures and human capital levels. In contrast, Koçak (2021) analyzed the effect of economic growth and financial development on income inequality in emerging market economies between 2013 and 2017 using the panel co-integration method. Although the study confirmed the validity of the Kuznets Curve for these countries, the FKC hypothesis was not supported. Özdemir (2021) pointed out that contrary to the inverted U-shaped FKC hypothesis, the hypothesis has a U-shaped structure, that is, there is a negative relationship between financial development and income distribution in 27 OECD countries for the period 1990-2017. Zungu & Greyling (2021), in their study based on data for 21 African countries for the period between 1994 and 2015, used the panel smooth transition regression model and found that income inequality decreases at low levels of financial development (up to 19% of GDP), but income inequality increases after the threshold level is exceeded. Khatatbeh & Moosa (2023) obtained similar results in their study covering 20 developed and developing countries for the period 1990-2021. Öndes and Kızılgöl (2024) examined the inverted-U relationship with FMOLS (Fully Modified Ordinary Least Squares) and GMM panel data models for the period 1985-2019 in ten newly industrializing countries, including Turkey, and concluded that both the classical Kuznets curve and the FKC hypothesis are valid.

While these studies generally consider the impact of financial development on inequality linearly, there are also studies that examine this relationship with non-linear econometric models. Kim & Lin (2011) emphasize that the effect of financial development on income distribution is neither uniform nor unidirectional for all countries. They argue that this effect varies according to the level of financial system development; therefore, employing non-linear models is more effective in revealing structural differences in this relationship. In this context, the data set of Beck et al. (2007), covering the period 1960-2005, is based on 72 countries and financial development is measured using both banking sectors (e.g. private sector loans, liquid liabilities) and capital market indicators (e.g. market capitalization, trading volume). Using the Instrumental Variable Threshold Regression (IVTR) model developed by Caner & Hansen (2004), the study finds that the FKC hypothesis is generally valid, but the impact of financial development on income inequality varies according to the level of financial depth and structural characteristics of countries. Using the same methodology, Chakroun (2020) measured financial development through both banking sector and capital market indicators in 60 developed and developing countries for the period between 1980 and 2009 and found that there is a significant and systematic non-linear relationship between financial development and income inequality. In terms of the banking sector, it is stated that inequality increases when financial development is low, but developments above the threshold level have a decreasing effect on inequality, indicating an inverted-U-shaped relationship in line with the FKC hypothesis. On the other hand, capital market development has an increasing effect on inequality even above the threshold level. These results emphasize the importance of not only financial depth but also access to and inclusiveness of the financial system. Bolarinwa & Akinlo (2021) tested the relationship between financial development and income inequality using the dynamic panel threshold model developed by Seo & Shin (2016) and Seo et al. (2019) with data from 1999-2015 for 40 African countries selected from high-income, medium-low and low-income countries. The findings of the study indicate that financial development reduces income inequality in low- and middle-income countries, while it increases it in high-income countries. Mushtaq et al. (2025) examined the relationship between the components of the financial system (financial development, financial institutions and financial markets) and income inequality with a panel data set for the peri-

od 1991-2019 covering eight EAGLE (Emerging and Growth-Leading Economies) countries. In this context, to test the non-linear relationship between the variables, the FKC hypothesis was tested by including the square terms of financial variables in the model. According to the results, there is an inverted-U relationship between the components of the financial system and income inequality. The study also tests the nonlinear functional structure using FGLS (Feasible Generalized Least Squares) and PCSE (Panel-Corrected Standard Errors) estimation methods and emphasizes the stabilizing effect of the financial system on inequality in the long run. Nadabo et al. (2024) tested the FKC hypothesis for Nigeria for the period 1986–2022, employing a nonlinear functional structure within the ARDL bounds test framework. They concluded that the relationship between financial development and inequality is nonlinear; specifically, financial development initially increases inequality but reverses this effect after a certain level of development.

A review of the literature reveals that there is an increasing number of studies on the FKC hypothesis, but this hypothesis has not been sufficiently tested for homogeneous country groups such as the European Union. Moreover, the effects of financial regulations on income inequality after the 2008 global crisis have been analyzed in a limited way. This study aims to fill this gap with a panel data analysis covering the period 2009-2022 on EU-27 countries and to reveal the impact of financial development on income distribution in detail.

To present the literature discussed above in a more systematic manner, theoretical studies are summarized in Table 1, while empirical studies are summarized in Table 2. These tables present the sample, period, methods used, and key findings of the relevant studies in a comparative framework.

Table 1: Theoretical Studies

Author(s)	Year	Main Argument	Theoretical Contribution
Greenwood & Jovanovic	1990	Financial development initially increases inequality by favoring high-income individuals, but over time, as financial inclusion increases, inequality decreases as low-income individuals are included in the system	First introduction of FKC hypothesis through a dynamic equilibrium model based on Kuznets curve; defines an inverted U-shaped relationship between financial development and income inequality
Galor & Zeira	1993	Credit access constraints of capital markets limit investments in education; financial development facilitates financing of productive investments and reduces inefficiency due to inequality	Establishes a link between human capital investments and income distribution; emphasizes equal opportunity creating aspects of financial development
Banerjee & Newman	1993	Individuals' occupational choice depends on access to capital and credit; information asymmetry and lack of collateral prevent low-income individuals from becoming entrepreneurs, leading to structural inequality	As financial development increases, low-income individuals can start businesses, increasing income mobility and reducing inequality over time

Table 1. continue

Aghion & Bolton	1997	Capital market imperfections and moral hazard problems may increase income inequality in the early stages of the capital accumulation process	Inequality tends to decrease over time as capital accumulation progresses; provides a dynamic perspective on the relationship between financial markets and distribution
Rajan & Zingales	2003	Financial development is not only an economic process but also a political one; may regress due to pressure from interest groups	Introduces an institutional perspective to the FKC literature; argues that inequality may increase if institutional quality is weak and vested interests obstruct financial development

Table 2: Empirical Studies

Author(s)	Year	Country / Period	Method	Main Findings	FKC Hypothesis Validity
Li et al.	1998	49 developed & developing countries / 1960–1995	Panel Ordinary Least Squares; cross-sectional regression	Financial development and political-social factors significantly affect income inequality	Mixed Evidence
Clarke et al.	2006	83 developed & developing countries / 1960–1995	Ordinary Least Squares; Instrumental Variable regression	Inequality may increase in early stages of financial development but decreases in the long run	Supported
Beck et al.	2007	72 developed & developing countries / 1960–2005	Instrumental Variable Threshold Regression	FKC generally valid; impact varies by financial depth and country characteristics	Supported
Nikoloski	2013	76 developed & developing countries / 1962–2006	System Generalized Method of Moments	FKC valid in developing countries; weaker in developed countries	Mixed Evidence
Topuz & Dağdemir	2016	94 countries (high-, upper-middle-, lower-middle-, and low-income) / 1995–2011	Panel Ordinary Least Squares; Fixed Effects; Random Effects	Financial development decreases inequality in high-income countries; increases it in low- and middle-income countries	Mixed Evidence
Park & Shin	2017	162 countries (broad global sample, mainly developing economies) / 1960–2011	Fixed Effects; Random Effects; Instrumental Variable regression	U-shaped relationship: inequality increases after a certain financial development threshold	Not Supported

Table 2. continue

Baiardi & Morana	2018	19 Euro area countries / 1985–2013	Time-Varying Parameter model; Generalized Method of Moments	Inverted U-shaped relationship confirmed for the Euro area	Supported
Kar	2019	BRICS countries and other developing countries / 1990–2015	Fixed Effects; System Generalized Method of Moments	FKC supported in some country samples; not statistically significant in others	Mixed Evidence
Kavya & Shijin	2020	85 countries (28 high-,41 middle-, 16 low-income) / 1984–2014	System Generalized Method of Moments; threshold regression	No conclusive evidence that financial development reduces income inequality	Not Supported
Chakroun	2020	60 developed & developing countries / 1980–2009	Instrumental Variable Threshold Regression	Banking sector: inverted U-shaped (FKC valid). Capital markets: increases inequality even above threshold	Mixed Evidence
Sayar et al.	2020	23 emerging market economies / 1990–2013	System Generalized Method of Moments with interaction terms	Effect of financial development on inequality is non-linear; conditioned by democratic structures and human capital	Mixed Evidence
Bolarinwa & Akinlo	2021	40 African countries (high-, medium-low-, and low-income) / 1999–2015	Dynamic Panel Threshold Model	Financial development reduces inequality in low- and middle-income countries; increases it in high-income countries	Mixed Evidence
Zungu & Greyling	2021	21 African countries / 1994–2015	Panel Smooth Transition Regression	Inequality decreases at low financial development levels (up to 19% of GDP); increases after threshold	Mixed Evidence
Koçak	2021	Emerging market economies / 2013–2017	Panel Cointegration; Panel Causality Tests	Kuznets Curve confirmed; FKC hypothesis not supported	Not Supported
Özdemir	2021	27 OECD countries / 1990–2017	Fixed Effects; System Generalized Method of Moments; Fully Modified Ordinary Least Squares	U-shaped relationship between financial development and income inequality	Not Supported

Table 2. continue

Khatatbeh & Moosa	2023	20 developed & developing countries / 1980–2015	Fully Modified Ordinary Least Squares; Unobserved Components Model	Both inverted U-shaped and U-shaped results found across countries; no uniform effect of financialisation on income inequality	Mixed Evidence
Nadabo et al.	2024	Nigeria / 1986–2022	Nonlinear Autoregressive Distributed Lag bounds test	Financial development initially increases inequality; reverses the effect after a certain development level	Supported
Öndes & Kızılgöl	2024	10 newly industrializing countries / 1985–2019	Panel Autoregressive Distributed Lag; Panel Generalized Method of Moments	Both classical Kuznets Curve and FKC hypothesis confirmed; inverted U-shaped relationship	Supported
Mushtaq et al.	2025	8 EAGLE countries (Emerging and Growth-Leading Economies) / 1991–2019	Feasible Generalized Least Squares; Panel-Corrected Standard Errors	Inverted U-relationship between financial system components and income inequality; stabilizing effect in the long run	Supported

3. Methodology And Empirical Findings

3.1. Model Definition and Variables

In this study, the validity of the FKC hypothesis in EU-27 countries for the period 2009-2022 is tested by panel data analysis. In the model, Gini coefficient (lnGINI) is used as the dependent variable representing income inequality, real GDP per capita (lnGDP) as the control variable and the ratio of private sector credit to GDP (FD) representing financial development. Data on these variables were obtained from the World Bank and SWIID databases.

The model used in the empirical analysis is defined as follows:

$$lnGINI_{it} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 FD_{it} + \beta_3 FD_{it}^2 + \varepsilon_{it} \tag{1}$$

Where i = 1, 2,..., 27 refers to each country in the panel while t = 2009,..., 2022 is the period. β_0 is the constant term; β_1, β_2, and β_3 are the slope parameters of the explanatory variables, and ε_{it} is the error term. In order to test the non-linear relationship in the model, the square of the FD variable (FD²), which is an indicator of financial development, is also added to the model as an independent variable. Thus, the existence of the inverted U-shaped relationship predicted by the FKC hypothesis can be tested. Since the Financial Kuznets Curve has the square of the independent variable on the right-hand side, it has a non-linear (inverted U)

structure. $\beta_2\beta_3$ For the FKC hypothesis to be valid, it should have positive and negative signs. $\beta_2\beta_3$ If they have negative or positive signs, income inequality first decreases and then increases as financial development increases.

3.2. Horizontal Cross-Section Dependence

In panel data analysis, the probability of within-country shocks affecting other countries is measured by horizontal cross-section dependence tests. This dependency is of critical importance as it affects the choice of the appropriate estimation method in the model. In this context we apply CD and LM test for cross section dependency (hereafter CSD). This situation is analyzed with the tests developed by Breusch & Pagan (1980), Peseran (2004) and Peseran et al. (2008).

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \quad LM_{adj} = \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{\vartheta_{Tij}^2}} \tag{2}$$

In the Lagrange Multiplier (hereafter LM) test, and (Breusch and Pagan, 1980, Peseran et al. 2008).

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)} \sum_{i)1}^{N-1} \sum_{j=i+1}^{N} (T\hat{\rho}_{ij}^2 - 1)} \tag{3}$$

$$CD = \sqrt{\frac{2T}{N(N-1)} \sum_{i)1}^{N-1} \sum_{j=i+1}^{N} T\hat{\rho}_{ij}^2} \tag{4}$$

In CD tests, test statistics are calculated as and (Peseran, 2004). In CSD tests, the null hypothesis states that there is no cross-sectional dependence among the panel units, while the alternative hypothesis indicates the presence of cross-sectional dependence. It is necessary to determine whether carbon emissions and other institutional factors have been affected by economic shocks in the 2002-2022 period and, if so, whether this effect has been eliminated. The Smith et al. (2004) "bootstrap" panel unit root test (hereafter PUR) obtains critical values by bootstrap method compared to other PUR tests. $\overline{LM} = N^{-1} \sum_{i=1}^{N}$ The test statistics (LM) is and LM is the arithmetic mean of the test statistics. The CD, LM and bias-adjusted LM tests developed by Breusch & Pagan (1980), Pesaran (2004) and Pesaran et al. (2008) are applied to test for cross-sectional dependence and homogeneity of slope coefficients across countries in the panel data set.

Following the obtained horizontal cross-section dependence results, the panel cointegration test developed by Westerlund (2008) is used to determine whether there is a long-run relationship between the variables in the model. This test evaluates the cointegration relationship with four different statistics (Group_tau, Panel_tau, Group_alpha, Panel_alpha) by testing whether the error correction term is zero. Following the cointegration test, the panel Augmented Mean Group (AMG) estimator is employed to obtain long-run parameter estimates, taking into account cross-sectional dependence and heterogeneity.

$$\alpha_i(L)\Delta y_{it} = \delta_{1i} + \delta_{2i}t + \alpha_i(y_{it-1} - \hat{\beta}_t x_{it-1}) + \gamma_i(\dot{L})\vartheta_{it} + \varepsilon_{it}$$

(5)

The Westerlund (2008) test examines the existence of cointegration by evaluating the error correction term in the following equation, $\alpha_i=0$ If there is no cointegration in the model. The panel Augmented Mean Group (AMG) estimation is performed in two stages.

$$\delta Y_{it} = \varphi_i + \delta_i \delta X_{it} + \theta_i f_t + \sum_{t=2}^{T} \pi_i \delta D_t$$

(6)

$$\hat{\delta}_{AMG} = N^{-1} \sum_{i=1}^{N} \hat{\delta}_i \ \varphi_i \ f_t \hat{\delta}_{AMG}$$

(7)

In the first stage and in the second stage where is the constant term, Y_{it} and X_{it} are the dependent and independent variables, the heterogeneous components, and AMG are the estimators (Westerlund & Edgerton, 2008, Eberhardt & Bond, 2009).

Table 3. CSD and Homogeneity

	lnGINI	LnGDP	FD	Model CSD		Homogeneity	
CD$_{lm}$	107.672	58.532	109.746	LM	114.847	$\tilde{\Delta}$	12.120
	(0.07)*	(0.99)	(0.08)*		(0.00)***		(0.00)***
CD$_{lm}$	3.124	-2.407	1.390	CDlm	-2.383	$\tilde{\Delta}_{adj}$	14.778
	(0.00)***	(0.00)***	(0.08)*		(0.00)***		(0.00)***
CD	-3.492	-3.451	-3.428	CD	-1.721		
	(0.00)***	(0.00)***	(0.00)***		(0.02)**		
LM$_{adj}$	-1.190	-1.375	-0.848	LMadj	-2.008		
	(0.88)	(0.91)	(0.80)		(0.97)		

Notes: p<0.01 ***, p<0.01 *

Table 3 presents the results of cross-sectional dependence and heterogeneity tests. lnGINI shows cross-sectional dependence at 1% significance level in CD, lnGDP and CD$_{lm}$ tests shows cross-sectional dependence at 1% significance level in CD tests, FD variable shows cross-sectional dependence at 10% significance level in CD$_{lm}$ tests and at 1% significance level in CD test. According to the results obtained in regression (1), there is horizontal cross-section dependence (CSD) in the panel data set. In addition, the fact that the parameters of lnGDP and FD variables differ across countries indicates that the model has a heterogeneous structure.

In panel data analysis, the potential of economic shocks in one country to affect other countries is revealed by horizontal cross-section dependence tests. The existence of this dependence plays a critical role both in interpreting the empirical results and in determining the estimation method to be used.

As a matter of fact, there are many studies in literature explaining the reasons for such dependencies. For example, Stockhammer (2010) argues that increased integration in global markets has strengthened economic interdependence across countries. Reinhart & Rogoff (2010), Erkan et al. (2011), Şahbaz et al. (2014) state that the 2008 global economic crisis and the volatility in commodity prices affect the same macroeconomic variables in different countries.

3.3. Panel Unit Root Test: Smith et al. (2004) Bootstrap PUR Method

Table 4 presents the results of Smith et al. (2004) Bootstrap panel unit root test to test whether the variables in the model are stationary

Table 4. Smith et al. (2004) "Bootstrap" PUR

	Constant		Constant and Trend	
Levels	**Statistic**	**Bootstrap p-value**	**Statistic**	**Bootstrap p-value**
lnGINI	-1.049	0.91	-1.933	0.74
LnGDP				
FD	-1.432	0.48	-1.802	0.78
First difference				
lnGINI	-3.725	0.00***	-4.174	0.00***
LnGDP	-3.972	0.00***	-4.032	0.00***
FD	-2.714	0.00***	-3.030	0.051*

Notes: Probability values are obtained from 5000 bootstrap distribution. p<0.1 *, p<0.01 ***

According to the results of the Smith et al. (2004) panel unit root test in Table 4, lnGINI, lnGDP and FD variables in the model have unit roots at their level values but become stationary when their first differences are taken. This finding indicates that the variables are subject to random fluctuations over time and are affected by their past values. Especially lnGINI is affected by long-term structural factors (education, population, tax reforms, social policies) rather than short-term fluctuations. This suggests that the income inequality indicator does not tend to return to a certain average overtime, i.e. it has a random walk feature.

3.4. Panel Cointegration Test: Westerlund (2008) Approach

In this section, Westerlund (2008) panel cointegration test is applied to determine whether there is a long-run relationship between the variables in the model.

In the Error Correction Model (ECM) test, the null hypothesis is that lnGDP, FD and FD^2 variables have an effect on lnGINI in the long run, while the opposite is not true in the LM bootstrap test. In the ECM test, the null hypothesis of no cointegration is accepted ac-

cording to all test statistics in the fixed model. In the model with trend, there is a cointegration relationship at the 1% significance level in the asymptotic probability value of the group tau test statistic, but there is no long-run relationship in other alternative test statistics. In the LM test, cointegration is found asymptotically in the fixed model. In the model with trend, there is asymptotic cointegration at the 5% and 1% significance levels, although not at the 10% significance level.

Table 5. Panel Cointegration

Tests	Constant			Constant and Trend		
	Statistic	**Asymptotic p-value**	**Bootstrap p-value**	**Statistic**	**Asymptotic p-value**	**Bootstrap p-value**
ECM						
Group_tau	0.296	0.616	0.940	-10.396	0.00***	0.390
Group_alpha	0.908	0.818	0.910	0.913	0.819	0.920
Panel_tau	0.575	0.718	0.830	1.678	0.953	0.830
Panel_alpha	-0.026	0.490	0.860	-0.137	0.445	0.830
LM bootstrap						
LM_N^+	2.716	0.26	0.00***	5.243	0.09*	0.00***

Notes: p<0.1 *, p<0.01 ***

3.5. Estimation of Long Run Coefficients: AMG Method

In this part of the study, in line with the existence of a panel cointegration relationship, the Augmented Mean Group (AMG) estimator developed by Eberhardt & Bond (2009) is applied to analyze the long-run relationship between variables.

Table 6 shows the long-run coefficients estimated by the AMG method for the EU-27 economies. The fact that the coefficient of the FD variable is positive in some countries and negative in others indicates that the relationship between financial development and income inequality varies across countries. Similarly, the significance of the FD² term indicates that the inverted U-shaped relationship may be valid only in certain countries. The effect of the lnGDP variable also varies across countries, indicating that the effect of economic growth on inequality is not homogeneous.

To improve the clarity of the country-level results, Table 7 summarizes the classification of EU-27 economies based on the AMG estimates reported in Table 6.

Based on the AMG coefficients presented in Table 6 and summarized in Table 7, the FKC hypothesis is not valid in the economies of Belgium, Bulgaria, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Luxembourg, Netherlands, Poland, Spain and Sweden because the coefficient signs of the FD and FD² variables in these countries are consistent with the FKC structure, but the variables are mostly not

statistically significant (p> 0.10). The fact that the FD and FD² variables are not statistically significant in these countries indicates that no significant relationship regarding the FKC hypothesis can be detected. Therefore, it is possible that income inequality in these countries may be affected by other variables such as welfare state policies, education level, tax systems or institutional structure rather than financial development. However, since these variables were not analyzed in this study, it is not possible to draw a definite conclusion.

Table 6. **AMG Parameter Estimates by Country**

Country	Constant	LnGDP	FD	FD²
Austria	2.476 (0.00)***	0.1228 (0.18)	-0.0541 (0.01)**	0.0003 (0.01)**
Belgium	3.009 (0.07)*	-0.1406 (0.28)	0.0031 (0.77)	-0.00003 (0.71)
Bulgaria	3.019 (0.02)**	-0.1053 (0.23)	-0.0068 (0.73)	0.00002 (0.88)
Croatia	1.472 (0.25)	-0.0147 (0.87)	0.0034 (0.77)	-9.57e-06 (0.92)
Cyprus	1.893 (0.00)***	-0.0307 (0.61)	-0.001 (0.00)***	3.25e-07 (0.00)***
Czechia	3.968 (0.00)***	0.0486 (0.48)	-0.1256 (0.01)**	0.0012 (0.01)**
Denmark	2.334 (0.00)***	-0.0365 (0.40)	-0.0048 (0.13)	0.00001 (0.17)
Estonia	-1.429 (0.53)	0.2315 (0.23)	0.0123 (0.16)	-0.0006 (0.18)
Finland	2.100 (0.04)**	0.0223 (0.72)	-0.0192 (0.17)	0.0001 (0.18)
France	0.842 (0.56)	0.0863 (0.45)	-0.0067 (0.40)	0.00002 (0.47)
Germany	3.149 (0.04)**	-0.1015 (0.45)	-0.0089 (0.57)	0.0004 (0.60)
Greece	1.922 (0.00)***	-0.0333 (0.22)	-0.0009 (0.17)	8.46e-06 (0.03)**
Hungary	2.106 (0.02)**	-0.0689 (0.43)	0.0069 (0.12)	-0.00008 (0.08)*
Ireland	3.317 (0.00)***	-0.1566 (0.04)**	-0.0006 (0.32)	3.01e-06 (0.27)
Italy	1.872 (0.24)	-0.0722 (0.50)	0.0132 (0.23)	-0.00007 (0.23)
Latvia	-0.055 (0.94)	0.1441 (0.04)**	0.003 (0.1)	-0.00002 (0.02)**
Lithuania	5.820 (0.00)***	-0.3095 (0.02)**	-0.0374 (0.00)***	0.0003 (0.00)***
Luxembourg	2.130 (0.13)	-0.0001 (0.99)	-0.0145 (0.34)	0.00008 (0.29)
Malta	-0.178 (0.81)	0.1403 (0.03)**	0.0048 (0.09)*	-0.0002 (0.08)*
Netherlands	2.779 (0.34)	-0.1448 (0.45)	0.0071 (0.69)	-0.0003 (0.70)
Poland	6.061 (0.00)***	-0.0394 (0.00)***	0.0064 (0.75)	-0.0001 (0.61)
Portugal	0.261 (0.78)	0.0723 (0.35)	0.0071 (0.00)***	-0.00002 (0.00)***
Romania	2.825 (0.00)***	-0.0713 (0.14)	-0.0315 (0.00)***	0.0004 (0.00)***
Slovakia	4.729 (0.03)***	-0.2058 (0.22)	-0.0385 (0.02)**	0.0003 (0.04)**
Slovenia	1.046 (0.00)***	0.0197 (0.54)	0.0042 (0.00)***	-0.00003 (0.00)***
Spain	3.314 (0.00)***	-0.1462 (0.08)*	-0.0002 (0.91)	1.43e-0 (0.83)
Sweden	-2.294 (0.42)	-0.0243 (0.80)	0.0598 (0.17)	-0.0002 (0.18)
Panel	2.167 (0.00)***	-0.0432 (0.10)	-0.0081 (0.18)	0.00008 (0.11)

Notes: p<0.1 *, p<0.05 **, p<0.01 ***

Table 7. Classification of EU-27 Countries Based on FKC Hypothesis Results

Relationship Type	Countries
Inverted-U (FKC Valid)	Malta, Portugal, Slovenia
U-Shaped Relationship	Austria, Cyprus, Czechia, Lithuania, Romania, Slovakia
Statistically Insignificant	Belgium, Bulgaria, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Netherlands, Poland, Spain, Sweden

In the economies of Austria, Cyprus, Czechia, Lithuania, Romania, Slovakia, Romania, Lithuania, Romania, Slovakia, the coefficient of FD is found to be negative and FD^2 is found to be positive and significant, suggesting that income inequality first decreases and then increases, i.e. there is a U-shaped relationship in the opposite direction to FKC. On the other hand, in Malta, Portugal and Slovenia, FD is positive and FD^2 is negative and significant, suggesting that the FKC hypothesis is valid. In these economies, an inverted U relationship emerges when the volume of credit to the private sector is above a certain threshold.

Increased financial deepening facilitates the access of more economic actors to services such as credit, insurance and investment through the diversity of instruments in financial markets, which in turn facilitates the integration of low-income groups into the financial system.

In line with the Greenwood & Jovanovic (1990) model, although financial development initially focuses on dominant firms and high-income individuals and increases income inequality, overtime, financial inclusion and easier access to credit reduce income inequality. Especially in transition economies and economies with low per capita income, this process is faster (Honohan, 2004).

With financial inclusion, the validity of the financial Kuznets curve can be ensured by providing access to financial markets, especially for individuals with low per capita income. Although financial development initially focuses on dominant firms and high-income individuals and increases income inequality (Greenwood & Jovanovic, 1990), over time, financial inclusion and easier access to credit reduce income inequality. This process is particularly rapid in transition economies and economies with low per capita income (Honohan, 2004). On the other hand, financial innovations both reduce financial costs and facilitate access to financial services, helping financial markets to operate more efficiently and financial innovations contribute positively to income distribution (Philippon, 2016). The fact that financial markets in these economies are still developing or in transition shows that financial development has a direct impact on income distribution. In these economies, financial development initially increases income inequality, but over time, increased access to credit for the masses and the expansion of financial services through financial innovations reduce income inequality. In addition, in Austria, Latvia, Malta, Portugal, Slovenia, the income inequality-reducing effect of GDP growth indicates that economic growth is more inclusive. In the economies of Cyprus, Czechia, Ireland, Lithuania, Poland, Romania, Slovakia and Spain, GDP increases increase income inequality. In these economies, output growth is concentrated in certain sectors and the social welfare brought by output growth is spread to a more limited segment (Yenişehirlioğlu et al. 2020; Stiglitz, 2012).

4. Results and Discussion

This study examines the validity of the FKC hypothesis and explores the complex relationship between income inequality, growth and financial development in the EU-27 economies between 2009 and 2022. The Gini coefficient, gross domestic product and the ratio of loans to the private sector to gross domestic product as an indicator of financial development are used in the model. In empirical analyses, the modeling is performed using horizontal cross-section dependence, panel unit root test and Augmented Mean Group parameter estimation method. These analyses are preferred to accurately reveal the relationships between the variables in the model and to take into account the interaction between the countries in the panel. For these reasons, the study makes important contributions to the analysis of the impact of financial markets on income distribution. The CSD results provide strong evidence of positive/negative economic shocks and economic policy interactions among the EU-27 economies. This is a common result of many factors such as globalization and increased foreign trade, short-term capital flows, common monetary and fiscal policies, and integration of the financial system. This result calls for a more collective approach to empirical analysis and policy recommendations rather than an individual country approach. The PUR results show that all three variables are affected by economic shocks at the level and experience a trend change over time. This suggests that each variable does not have a constant mean in the long run and is therefore affected by past values. The AMG estimator examines the relationship between FD and lnGINI in the context of the FKC hypothesis in EU economies. The FKC hypothesis predicts that FD initially increases lnGINI (limited access to credit for economic agents and the focus of financial services on certain segments), but above a certain threshold it can reduce income inequality. In the economies of Malta, Portugal and Slovenia, the FKC hypothesis holds, with the FD initially increasing and then decreasing lnGINI. This suggests that FD initially creates income inequality by increasing the marginal utility of groups with access to capital, but through financial innovations, it brings financial services to a wider audience, thus ensuring fairness in income distribution.

There is no statistically significant evidence that the FKC hypothesis is valid in Belgium, Bulgaria, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Spain and Sweden. This is due to the fact that although the coefficient signs of the FD and FD^2 variables in these economies coincide with the hypothesized direction, the statistical significance is insufficient. In these countries, the effects on lnGINI may be shaped by different parameters rather than financial development. The fact that the effect of lnGDP variable on lnGINI varies across countries reveals that the effect of economic growth on income distribution is not homogeneous.

Economic growth distorts income distribution in some economies (Cyprus, Czechia, Ireland, Lithuania, Poland, Romania, Slovakia, and Spain), while it ensures income fairness in others (Austria, Latvia, Malta, Portugal, Slovenia). The different results in each country are closely related to the source of economic growth, the sectoral structure of production, the dependence of production on imported inputs and how social welfare is shared.

The variation in findings across country groups indicates that policy recommendations should also be tailored to each country. In economies where the inverse-U relationship holds, such as Malta, Portugal, and Slovenia, financial deepening in its early stages can increase income inequality. Therefore, strengthening social transfer mechanisms and redistribution poli-

cies in the early stages of financial development is important in these countries. In contrast, in Austria, Cyprus, the Czechia, Lithuania, Romania, and Slovakia, where a U-shaped relationship has been identified, the potential for financial development to increase inequality in the long term is more pronounced. This situation demonstrates that financial deepening alone is not sufficient; institutional quality, equal access to credit, and inclusive financial regulations are vital.

In countries where no statistically significant relationship was found, the impact of the financial sector on income distribution appears to be limited, and in these economies, it may be necessary to focus more on labor market and social policy tools to reduce inequality. Some policy recommendations can be made based on the empirical findings. Firstly making financial markets more integrated, facilitating access to credit for economic actors (especially those with low incomes), and providing financial literacy training can support fairness in income distribution. Training and skill development training should be provided in the process of labor force adaptation to work. Increasing the quality of human capital will contribute positively to income distribution. In addition to these aid within the framework of the social welfare state approach should be increased and progressive tax systems should be implemented to ensure income justice. Also reorganization of the institutional structure can ensure fairness in income distribution. This study analyzes EU economies for the period 2009-2022. Future studies may yield different results based on different periods and different country groups. In addition, the use of alternative indicators related to income distribution and financial development may contribute to a more detailed analysis. Furthermore, although the AMG estimator is a sufficient solution for CSD, it may not fully capture the endogeneity problem. Different estimators can be used to capture the economic shocks and structural transformations that occurred during the analysis period.

Contribution Statement of Researchers
The contribution to the study belongs to the author only.
Ethics Committee Approval
This research does not have a part that needs approval of the ethics committee.
Conflict of Interest Statement
I declare that there is no conflict of interest in this work.

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