

Koçak, Emrah; Uzay, Nisfet

Article

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The effect of financial development on income inequality in Turkey: An estimate of the Greenwood-Jovanovic hypothesis

Emrah Koçak,¹ Nisfet Uzay²

Abstract: This paper is the first to examine the linear and nonlinear effect of financial development on income inequality in Turkey over the period of 1980-2013. Financial development is represented by disaggregated and aggregated indicators. In this way, the effects of various financial indicators on income inequality are explained. Maki (2012) structural breaks co-integration test, and Stock and Watson (1993) dynamic ordinary least squares (DOLS) methods are followed for empirical analysis. Finally, the fully modified least squares (FM-OLS) regression analysis method developed by Philips and Hansen (1990) is used for robustness check. The estimation results of the linear relationship indicate that financial development is a mitigating effect on income inequality. These results support the inequality-narrowing hypothesis. The non-linear relationship results show that financial development first increases income inequality but after financial development reaches a certain level, this effect is reversed and financial development reduces income inequality. These results support the Greenwood-Jovanovic hypothesis. All the results strongly suggest that financial development is a mitigating or improving effect on income inequality over the long-run.

Keywords: Financial development, Income inequality, Greenwood-Jovanovic hypothesis, Turkey.

JEL Classification:

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Introduction

There is a tremendous literature on the relationship between financial development and economic growth. Levin (2005) provides a broad literature review on the theoretical and empirical framework for the link between financial development and economic growth. It is emphasized that an advanced financial system reduces capital/borrowing costs, allocates capital to more efficient channels, and drives economic growth. While the relevant literature provides important evidence for the relationship between financial development and economic growth, there is a lack of research on how financial

¹ Erciyes University, Faculty of Economics and Administrative Sciences, Department of Economics, Kayseri, Turkey, emrahkocak@erciyes.edu.tr

² Erciyes University, Faculty of Economics and Administrative Sciences, Department of Economics, Kayseri, Turkey, uzay@erciyes.edu.tr

development affects poverty and inequality (Fowowe and Abidoye 2013; Pardo and Sánchez Santos 2014; Akinboade et al. 2014). On the other hand, rising global income inequality has become a widespread concern (Sutter 2009, 2010; Wallerstein et al. 2015, Lee and Lee 2018). The literature has recently begun to draw attention to the effect of financial development on income inequality (Haan and Sturm 2017). The current literature presents three disparate hypotheses regarding the relationship between financial development and income inequality. The first is the inequality-widening hypothesis that indicates that financial development is a cause of an enhancing / expanding influence on income inequality. This hypothesis emphasizes that in countries with particularly weak institutions, people with rich and good connections might benefit from the process of financial development. The financial system generally directs funds to people that are rich, easily able to offer collateral and are more likely to pay credits. As the financial sector continues to grow, the rich get more funding from this sector. However, the poor, who do not offer collateral, are neglected and may not receive credit or debt from this sector. As a result of this tendency, poor people do not get adequate financial services. For this reason, it is much harder for the poor to migrate to cities, spend enough money on human capital or education and start a new business (Clarke et al. 2006). Eventually, the poor are only equipped with primary education and participate in the unskilled labor market with low wages (Ahmed and Masih 2017).

The second is the inequality-narrowing hypothesis, which indicates that financial development is a mitigating effect on income inequality. This hypothesis, proposed by Galor and Zeira (1993) and Banerjee and Newman (1993), implies that the development of the financial sector will facilitate the access of the poor to the loans. Such a financial system might provide equal opportunities for talented and ambitious low-income individuals (Law and Tan 2009). Individuals are considered to inherit wealth at different levels. It is stated that those with greater wealth have invested more in education and have directed more qualified work. On the other side, individuals with less initial wealth have to invest in human capital to reach higher incomes. In an underdeveloped financial system where borrowing is difficult and costly, poor individuals will not be able to find credit for human capital investments. Moreover, this structure will continue for new generations. Poverty will be transferred to other generations as well. Therefore, as the financial system grows and develops, wider credit opportunities emerge. The poor might access opportunities to credit for human capital investments and increase their potential to start their own business and gain earnings (Abosedra et al. 2016; Ahmed and Masih 2017). Consequently, income inequality decreases with the development of the financial sector.

The third hypothesis, called the Greenwood-Jovanovic hypothesis and based on the theoretical approach of Kuznets (1955), indicates that there is a non-linear relationship between financial development and income inequality. According to this approach, financial markets are growing very slowly in the early stages of economic development. Due to the insufficient financial infrastructure at this stage, only the rich might access credit facilities. In the middle stages of the economic development process, the financial superstructure begins to emerge, economic growth and savings grow, and rich people benefit much more from this process of progress. The inequality between the poor and the rich begins to expand. In the last stage of economic development (maturity phase), financial markets have reached a certain volume, the infrastructure required for financial

services has been established, and credit facilities have become accessible to all individuals, including poor individuals. As the financial system reaches a certain level of development, the development of the financial system begins to cause a mitigating effect on income inequality (Greenwood and Jovanovic 1990). This relationship between financial development and income inequality is also called the inverted U-shaped hypothesis.

The aim of this paper is to determine the relationship between financial development and income inequality in Turkey during the period 1980-2013. Turkey has embarked on a process of structural transformation in the economy since 1980. In the last 40 years, the country has significantly liberalized, rapidly urbanized in the field of foreign trade and finance, and displayed a significant growth performance in employment and per capita income (Koçak and Şarküneşi 2018). According to the World Bank 2019 reports, Turkey has a population of 78.6 million, a GDP of 851 billion dollars, and 9,631-dollar income per capita in 2018. Another remarkable development in this development process is the observed decrease in income inequality. According to Güven et al. (2016), while the Gini coefficient was 0.49 in 1994, it decreased to 0.40 in 2000 and 0.38 in 2005 and was realized as 0.40 in 2012. Although the downward trend in the Gini coefficient is a positive development in Turkey, the value of the coefficient is still quite high compared to developed countries. This shows that income inequality is an important problem that needs to be solved. In this context, this paper tries to answer whether there is a significant effect of financial development on income inequality in Turkey. The contribution of this paper is threefold: (1) Financial development is represented by four indicators. These indicators are deposits money assets of banks, deposits of the financial system, domestic credits, and broad money supply. In addition, these indicators are aggregated and a financial development index is produced by principal component analysis (PCA). The effects of financial development on income inequality are estimated both by disaggregated and aggregated indicators. Thus, the effects of different financial development indicators on income inequality are explained in a more comprehensive way. (2) As far as we know, there is no empirical research examining the relationship between financial development and income inequality in Turkey (see table 1). This paper fills the gap in the literature. (3) The third possible contribution of this study is the empirical method. This paper uses recently developed Maki (2012) structural breaks co-integration test and dynamic least squares estimator (DOLS). These methods have the following important advantages: (a) In economic life, there are many structural elements such as economic crises, technological shocks, institutional developments, policy and regime changes that may affect the relationship between variables. Conventional co-integration tests that do not consider structural breaks into account have a lower estimate power. (b) The long-term relationship between variables is the focus of many pieces of research. However, the data used for the researchers to produce effective estimates must have asymptotic properties. On the other hand, researchers generally do not have data to justify asymptotic theories. For example, the conventional least squares (OLS) estimator produces biased estimates in small samples. In addition, regression estimates using small samples may cause an endogeneity problem. In this case it is important to use alternative estimation methods that produce unbiased results in small samples (Montalvo 1995). Therefore, this study, which estimates with 34-year data, follows the DOLS method developed by Stock and Watson (1993) for regression estimation. The DOLS estimator produces unbiased

results in small samples and is free from serial correlation and endogeneity (Masih and Masih 1996; Al-Azzam and Hawdon, 1999; Irffi et al. 2008; Ahmad et al. 2017; Koçak and Şarkgüneşi 2018). Thus, this study will provide robust results for the relationship between financial development and income inequality.

The rest of the work is organized as follows: Section 2 reveals the literature findings. Section 3 exhibits model, data and methodology. Section 4 presents the production of the financial development index for Turkey. Section 5 reports estimation results and discussion. Finally, section 6 indicates summary findings and conclusions.

1. Empirical Literature

Although the theoretical literature on the relationship between financial development and income inequality goes backward (Greenwood and Jovanovic 1990; Banerjee and Newman 1993; Galor and Zeira 1993), the empirical literature has recently improved. Empirical studies are seen to cover a period of about 15 years. The first reason for these developments is the calculation of new income inequality indicators for countries in recent years. With this data, researchers are able to conduct further studies on income inequality in underdeveloped and developing countries. For example, the Texas Inequality Project (UTIP) sets out a calculation method to measure and explain the movements of inequalities in wages and earnings in the world. The data set, called the Estimated Household Income Inequality (EHII), provides income inequality indicators covering the period 1963 to 2015 for 151 countries. In addition, the World Income Inequality Database (WIID) provides comprehensive statistics on income inequality for approximately 172 developed, developing and transition countries. Finally, Solt (2009) develops the data set called the Standardized World Income Inequality Database (SWIID). This method is developed to solve the data problem for countries. Because international research on the causes and consequences of income inequality has been inadequate due to limitations of existing data sets. SWIID produces indicators such as gross and net income inequality for 192 countries. The second reason for the recent development in the literature is the advances in econometric estimation methods.

This study examines the twenty-seven studies in the relatively new literature (see table 1) and reaches the following observations: (a) The econometric estimation models are built in three groups. The first group investigates the relationship between financial development and income inequality within a linear model (Beck et al. 2004; Law and Tan 2009; Ang 2010; Bittencourt 2010; Kappel 2010; Mookerjee and Kalipioni 2010; Jalil and Feridun 2011; Kim and Lin 2011; Ling-Zheng and Xia-Hai 2012; Fowowe and Abidoye 2013; Prete 2013; Tiwari et al. 2013; Kunieda 2014; Law et al. 2014; Sehrawat and Giri 2016; De Haan and Sturm 2017). The second group estimates the relationship between financial development and income inequality within a nonlinear model (Satti et al. 2015; Azzam and Ali Raza 2018; Younsi and Bechtini 2018). The third group examines the relationship between financial development and income inequality both within the linear and nonlinear models (Clarke et al. 2006; Liang 2008; Batuo et al.

2010; Shahbaz and Islam 2011; Shahbaz et al. 2015; Jauch and Watzka 2016; Bittencourt et al. 2018).

(b) Models are estimated by panel data methods such as co-integration, DOLS, fixed effects (FE), random effects (RE), instrumental variables (IV), two-step least squares (2SLS) and generalized method of moments (GMM). Single-country surveys often use time series analysis methods such as autoregressive distributed lag estimation (ARDL). Fewer studies use the threshold regression method (Kim and Lin 2011; Ling-Zheng and Xia-Hai 2012; Law et al. 2014).

Table 1. Literature on the relationship between financial development and income inequality

Author(s)	Country	Period	Methodology	Conclusion
Beck et al. (2004)	(a) 52 developed and developing countries (b) 58 developing countries	(a) 1960-1989 (b) 1980-2000	Panel OLS, IV	The inequality-narrowing hypothesis is supported.
Clarke et al. (2006)	83 countries	1960-1995	Panel OLS, 2SLS, RE, IV	The inequality-narrowing hypothesis is supported. The Greenwood-Jovanovic hypothesis is rejected.
Liang (2008)	China (Provincial-level)	1991-2000	GMM	The inequality-narrowing hypothesis is supported. The Greenwood-Jovanovic hypothesis is rejected.
Law and Tan (2009)	Malaysia	1980-2000	ARDL	There is no significant relationship between financial development and income inequality.
Ang (2010)	India	1951-2004	ARDL	The inequality-narrowing hypothesis is supported.
Batuo et al. (2010)	22 African countries	1990-2004	GMM	The inequality-narrowing hypothesis is supported. The Greenwood-Jovanovic hypothesis is rejected.

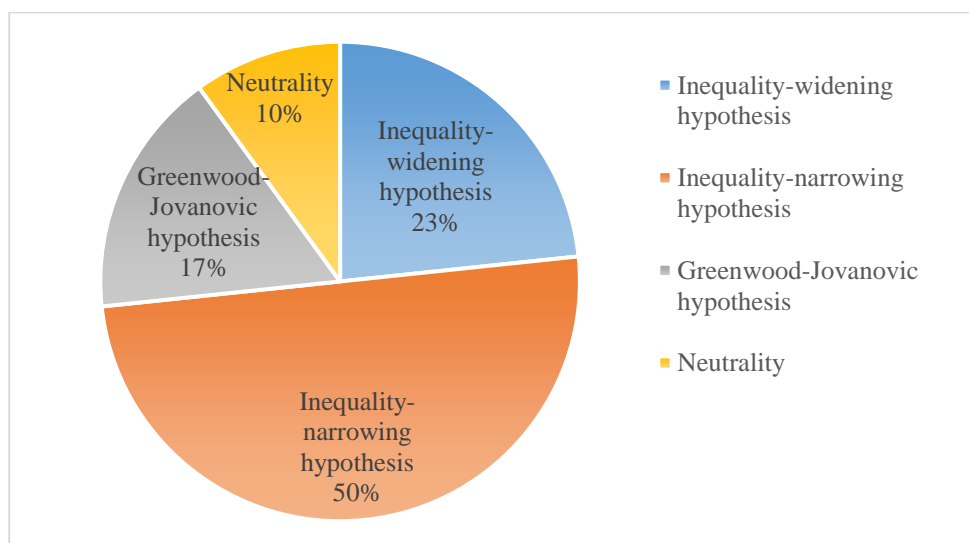
Bittencourt (2010)	Brazil (6 Major regions)	1985-1994	Panel OLS	The inequality-narrowing hypothesis is supported.
Kappel (2010)	78 developed and developing countries	1960-2006	Panel OLS, 2SLS	The inequality-narrowing hypothesis is supported.
Mookerjee and Kalipioni (2010)	115 developed and developing countries	2000-2005	Panel OLS, IV	The inequality-narrowing hypothesis is supported.
Jalil and Feridun (2011)	China	1978-2006	ARDL	The inequality-narrowing hypothesis is supported.
Kim and Lin (2011)	72 countries	1960-2005	Threshold regressions	The inequality-narrowing hypothesis is supported.
Shahbaz and Islam (2011)	Pakistan	1971-2005	ARDL	The inequality-narrowing hypothesis is supported. The Greenwood-Jovanovic hypothesis is rejected
Ling-Zheng and Xia-Hai (2012)	China (Provincial-level)	1996-2009	Threshold regressions	The inequality-widening hypothesis is supported.
Fowowe and Abidoye (2013)	27 African countries	1981-2005	Panel OLS, GMM	There is no significant relationship between financial development and income inequality.
Prete (2013)	30 countries	1980-2005	Panel OLS	The inequality-narrowing hypothesis is supported.
Tiwari et al. (2013)	India	1965-2008	ARDL	The inequality-widening hypothesis is supported.
Kunieda et al. (2014)	119 countries	1985-2009	Panel OLS, IV, GMM	(1) The inequality-widening hypothesis is supported (if financial markets are open to world markets at a high level). (2) The inequality-narrowing hypothesis is supported (if financial markets are closed to world

				markets at a high level).
Law et al. (2014)	81 countries	1985-2010	Threshold regressions	The inequality-narrowing hypothesis is supported (After reaching a certain level of institutional development)
Shahbaz et al. (2015)	Iran	1965-2011	ARDL	The inequality-narrowing hypothesis is supported. The Greenwood-Jovanovic hypothesis is supported.
Satti et al. (2015)	Kazakhstan	1991-2011		The Greenwood-Jovanovic hypothesis is rejected.
Sehrawat and Giri (2016)	11 south Asian countries	1990-2013	Panel co-integration, Panel DOLS	The inequality-widening hypothesis is supported
Jauch and Watzka (2016)	138 developed and developing countries	1960-2008		The inequality-widening hypothesis is supported. The Greenwood-Jovanovic hypothesis is partially supported.
De Haan and Sturm (2017)	121 countries	1975-2005	Panel RE	The inequality-widening hypothesis is supported.
Ahmed and Masih (2017)	Malaysia	1970-2007	ARDL	There is no significant relationship between financial development and income inequality.
Azam and Ali Raza (2018)	ASEAN-5 Countries	1989-2013	Panel co-integration, FE	The Greenwood-Jovanovic hypothesis is supported.
Younsi and Bechtini (2018)	BRICS countries	1995-2015	Panel co-integration, POLS, FE, GMM	The Greenwood-Jovanovic hypothesis is supported.
Bittencourt et al. (2018)	USA (State level)	1976-2011	FE	The inequality-widening hypothesis is supported (High-income inequality

states).
The Greenwood-Jovanovic hypothesis is supported (Low-income inequality states).

(c) When the literature results are evaluated, it is seen that there is no consensus in the researches. The results of the researches differ according to the countries, the periods and the estimation methods. The results of the studies show that 50% supported the inequality-narrowing hypothesis, 23% the inequality-widening hypothesis, 17% the Greenwood-Jovanovic hypothesis, and 10% neutrality hypothesis (see figure 1).

Figure 1. Distribution of literature results (%)



Source: Own processing

(d) Among the non-methodological reasons for the lack of a common consensus in the literature findings, differences in economic structure, institutional quality, and development levels among countries can be shown. Kunieda et al. (2014) show that the effect of financial development on income inequality varies according to the openness structure of the financial markets in the country. Law et al. (2014) demonstrate that the mitigating effect of financial development on income inequality is driven by a certain improvement in institutional quality. Beck et al. (2004), Kappel (2010), Mookerjee and Kalipioni (2010) and Jauch and Watzka (2016) provide evidence that the impact of financial development on income inequality may vary according to the level of development of their countries.

(e) As mentioned earlier, there are no studies in the literature investigating the financial development and income inequality relations in Turkey. However, in some multi-country panel data research, Turkey is examined in the developing countries group (Kim and Lin 2011; Law et al. 2014; De Haan and Sturm 2017). There is also no consensus in these researches on the relationship between financial development and income inequality in developing countries (including Turkey).

2. Model, Data and Methodology

In this study, the following model is estimated for the determination of the relationship between financial development and income inequality:

$$INQ_t = \beta_0 + \beta_1 Y_t + \beta_2 Trade_t + \beta_3 Modern_t + \beta_4 INF_t + \beta_5 FDI_t + \varepsilon_t \quad (1)$$

Here, INQ, FDI, t and ε denote dependent variable (income inequality), explanatory variable (financial development), time period ($t = 1980, \dots, 2013$) and error term, respectively. β_0 is a constant term and $\beta_1, \beta_2, \dots, \beta_5$ denote the coefficient parameters of the variables. The reason for selecting the data in a limited time period (1980-2013) is related to the accessibility of data for income inequality. Y , Trade, Modern and INF, which are added as model control variables, show economic growth, trade, industrialization (representing modernization) and inflation. Table 2 summarizes the definitions of variables and data sources. Prior to the analysis, the logarithm transformation of all data is performed to achieve more consistent and unbiased results. This reduces the skew in the data and softens the change in variance (Changyong et al. 2014). In addition, nonlinear relationships can be captured in regression by expressing dependent and / or independent variables in terms of natural logarithms.

Table 2. Definitions of variables and data sources

Dependent Variable	Proxy	Unit	Source	Definition
Income inequality	INQ	Theil Index (0 - ∞)	University of Texas Inequality Project	Theil index is calculated by comparing the income of the people with the average income of the population. The increase in Theil index value implies an increase in income inequality.
Explanatory variables	Proxy (FD)	Unit	Source	Definition
Deposit assets of the banks	Bank-assets	% of GDP	Beck et al., (2000, 2009); Čihák et al., (2012)	Deposit money bank assets to GDP

Total deposits of the financial system	Fin-depositts	% of GDP	Beck et al., (2000, 2009); Čihák et al., (2012)	Financial system deposits to GDP
Broad money supply	Money	% of GDP	World Bank	Broad money is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper.
Domestic credit to the private sector	Credit	% of GDP	World Bank	Domestic credit to the private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment.
Financial Development Index	FDI	Index (0 - ∞)	Produced by authors	Financial development index is calculated by the authors using the PCA method.
Control variables	Proxy	Unit	Source	Definition
Economic growth (GDP per capita)	Y	(constant 2010 and US\$)	World Bank	GDP per capita is gross domestic product divided by population.
Trade openness	Trade	% of GDP	World Bank	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.

Industrialization (representing modernization)	Modern	% of GDP	World Bank	Industrialization includes mining, manufacturing, construction, electricity, water and natural gas production and value-added activities.
Inflation	INF	annual %	World Bank	Inflation is measured by the change in the annual consumer price index.

Equation (1) is a linear model, and the model's possible estimation results are as follows: (a) If $\beta_5 = 0$ or statistically insignificant, there is no relationship between financial development and income inequality (neutrality). (b) If $\beta_5 < 0$ and statistically significant, financial development has a negative/decreasing effect on income inequality (The inequality-narrowing hypothesis is supported). (c) If $\beta_5 > 0$ and statistically significant, financial development has a positive/increasing effect on income inequality (The inequality-widening hypothesis is supported).

To test the Greenwood-Jovanovic hypothesis, the following nonlinear model is followed:

$$INQ_t = \beta_0 + \beta_1 Y_t + \beta_2 Trade_t + \beta_3 Modern_t + \beta_4 INF_t + \beta_5 FD_t + \beta_6 FD^2_t + \varepsilon_t \quad (2)$$

(d) If $\beta_5 > 0$ (and statistically significant) and $\beta_6 < 0$ (and statistically significant), there is an inverse U-shaped relationship between financial development and income inequality. This result supports the Greenwood-Jovanovic hypothesis.

Econometric models are often estimated by ordinary least square method in the literature. The validity of the OLS estimator is only possible if the series used in the analysis are stationary. In the opposite case, the traditional t, Wald F, R^2 statistics reveal deviated results. Estimation results, applied with non-stationary series, are expressed as spurious regression. For this reason, the stationarity of the series should first be investigated by unit root tests. Traditional unit root tests developed by Dickey and Fuller (ADF, 1981) and Phillips and Perron (PP, 1988) are widely used in econometric literature. According to the unit root test results, if the series are not stationary in the level values [I(0)], the first differences of the series are taken, and unit root tests are applied again. If the series are stationary at first difference [I(1)], the cointegration relation must be investigated before estimating their coefficients. Engle and Granger (1987), Johansen (1988, 1990) and Pesaran et al. (2001) co-integration tests are frequently used in the literature. However, these methods do not consider structural changes or structural breaks that occur in a certain period of time. Gregory and Hansen (1996), Hatemi-J (2008) and Maki (2012) have developed co-integration tests that

consider structural breaks as an alternative to traditional co-integration tests. This study focuses on the relatively new method of Maki (2012) co-integration test.

Maki (2012) calculates a possible breakpoint and t-statistics for each period in the time interval of the sample. To test co-integration under the assumption of multiple breakpoints, use the following models:

$$y_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \beta' X_t + \mu_t \quad (3)$$

$$y_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \gamma t + \beta' X_t + \mu_t \quad (4)$$

$$y_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \beta' x_t + \sum_{i=1}^k \beta'_i x_t D_{i,t} + \mu_t \quad (5)$$

$$y_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \gamma t + \sum_{i=1}^k \gamma_i t D_{i,t} + \beta'_i x_t + \sum_{i=1}^k \beta'_i x_t D_{i,t} + u_t \quad (6)$$

$t = 1, 2, \dots, T$, y_t and $x_t = (x_t, \dots, x_{mt})'$ are observable variables and u_t indicates the error term. Equations (3) - (6) show level break (C), trend break (C/T), regime change (C/S) and regime change and trend break (C/T/S), respectively. The null hypothesis for "no co-integration" is tested separately for the four models with the Maki (2012) co-integration test statistic. If the test statistic is greater than the critical value, the null hypothesis is rejected. In this case, it is decided that a long-run equilibrium relation between the variables is valid. Critical values are produced by Monte Carlo simulation.

The next step after the validation of the co-integration relation is to estimate the long-run coefficients that reveal the relationship between the variables. The DOLS developed by Stock and Watson (1993) is an appropriate and frequently used method for estimating co-integration coefficients. The DOLS method is a dynamic estimator that contains the lagged values of the differences of the independent variables. The DOLS estimator is defined in the following equation:

$$y_t = \alpha_0 + \alpha_1 t + \alpha_2 x_t + \sum_{i=-q}^q \delta_i \Delta x_{t-i} + \varepsilon_t \quad (7)$$

Y , t , x , q , Δ , and ε in Eq.(6) indicate the dependent variable, time period, independent variable, optimal lag, difference operator and the error term, respectively.

3. Production of Financial Development Index for Turkey

This study considers four key indicators to produce the FDI. The first is the deposit assets of the banks (Bank-assets). The second indicator is the total deposits of the financial system (Fin-deposits). The third is the broad money supply (Money) that represents the amount of money in circulation. The fourth indicator is the domestic

credits provided in the private sector (Credit). FDI covers 1980-2013 period. Table 3 provides information for the indicators.

Table 3. Results of the PCA

Eigenvalues					
Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	3.692	3.446	0.923	3.692	0.923
2	0.245	0.188	0.061	3.938	0.984
3	0.057	0.053	0.014	3.995	0.998
4	0.004	-	0.001	4.000	1.000
Eigenvectors					
Variable	PC1	PC2	PC3	PC4	
Bank-assets	0.511	-0.338	-0.225	0.756	
Fin-deposits	0.513	0.044	-0.675	-0.527	
Money	0.499	-0.470	0.630	-0.361	
Credit	0.474	0.813	0.308	0.134	
Correlation matrix					
	Bank-assets	Fin-deposits	Money	Credit	
Bank-assets	1.000				
Fin-deposits	0.782	1.000			
Money	0.900	0.711	1.000		
Credit	0.418	0.443	0.411	1.000	
FDI = 0.511*Bank-assets + 0.513*Fin-deposits + 0.499*Money + 0.474*Credit					

The PCA is followed in the production of the FDI. The purpose of this analysis is to transform a structure made up of several related variables into a single variable. During this transform, there is no significant loss of information about the structure (Abdi and Williams 2010). In the first step for the PCA, variables must have combinable properties. In other words, the units of the variables must be the same. Otherwise, variables are subject to transformation by standardization and rescaling methods. Thus, the differences between the units are eliminated. The unit of all variables used for the production of the FDI is the same (see Table 3). For this reason, PCA analysis is performed without any transformation. In the second step, the suitability of the data for the variables to PCA is investigated by Kaiser-Meyer-Olkin (KMO) and Bartlett (1950) tests. If the KMO test statistic is greater than 0.60, it indicates that the data set is suitable for analysis. The result of the KMO test statistic is calculated as 0.632. The sample adequacy measure statistics of Bank-assets, Fin-deposits, Credit and Money and

variables are 0.627, 0.589, 0.725 and 0.628, respectively. The Bartlett test reveals whether there is a relationship between variables. Thus, it is decided whether the index production is suitable for the variables. The final decision is based on Bartlett test results and probability values (The test result should be statistically significant for PCA). The Bartlett test statistic and probability value results are estimated to be 21.008 and 0.000, respectively.

In the third and final step of the PCA, the factors (eigenvalues) that explain the maximum variance between the variables are calculated. According to this calculation, the component whose eigenvalue is greater than 1 and the highest variance ratio (explanation proportion) is preferred. Once the most suitable component has been identified, the relevant index is produced using the weights of the variables. Table 3 depicts the PCA results. The first principal component (PC1) has an eigenvalue of 3.69 and a total variance ratio of 92%. The PC1 component is more successful than the others. The first principal component (PC1) is selected and the weights of PC1 are used to produce the FDI for Turkey.

4. Results and Discussion

Table 4 provides preliminary information on descriptive statistics prior to econometric analysis. Descriptive statistics are not used to directly estimate model parameters but provide summary information about the data, showing the value trends and spreads of the data. For example, the mean, median, minimum, and maximum values of Y are greater than the values of other indicators. It is observed that the data used in the analysis have values close to each other. Finally, the standard errors of the data belonging to variables take values close to zero. These values indicate that the model estimation made with the indicators used in the analysis are effective.

Table 4. Descriptive statistics (1980 - 2013)

Variables	Descriptive statistics					Observations
	Mean	Median	Maximum	Minimum	Std. Dev.	
INQ	-2.512	-2.366	-1.986	-3.171	0.363	34
Y	8.947	8.946	9.462	8.515	0.263	34
Trade	3.654	3.737	4.006	2.838	0.271	34
Modern	3.402	3.407	3.526	3.170	0.185	34
INF	3.481	3.805	4.702	1.832	0.740	34
Bank-assets	3.232	3.134	3.919	2.467	0.397	34
Fin-deposits	3.389	3.182	4.313	2.884	0.442	34
Money	3.501	3.491	3.974	2.892	0.282	34
Credit	3.062	2.892	4.106	2.609	0.399	34
FDI	4.003	3.906	4.771	3.429	0.360	34

Table 5 shows the ADF and PP unit root test results. The level values of the variables used in the analysis are not stationary. At least one of the test statistics reveals that the series contain unit roots. The first difference of the series is taken, and the unit root test is followed again. In this case, it is observed that all of the series are stationary in their first differences. All of the data used in the analysis is [I(1)]. For this reason, it is not possible to directly estimate the coefficients that reveal the relationship between variables. For the coefficient estimation, firstly the co-integration relation is investigated.

Table 5. Unit root tests

Variables	ADF test statistic		PP test statistic	
	Intercept	Intercept and trend	Intercept	Intercept and trend
INQ	-1.340	0.090	-1.452	0.020
Y	0.161	-2.443	0.461	-2.444
Trade	-2.371	-4.169 ^b	-3.140 ^b	-3.922 ^b
Modern	-2.330	-2.316	-3.142 ^b	-3.051
INF	-0.268	-1.606	-0.974	-1.151
Bank-assets	-0.999	-2.705	-0.959	-2.825
Fin-deposits	0.825	-1.141	1.200	-0.961
Money	-0.983	-3.320 ^c	-1.661	-4.633 ^a
Credit	0.459	-0.458	0.282	-0.615
FDI	-0.063	-1.631	0.257	-1.152
Δ INQ	-5.038 ^a	-6.006 ^a	-5.146 ^a	-5.986 ^a
Δ Y	-5.928 ^a	-5.890 ^a	-5.954 ^a	-5.918 ^a
Δ Trade	-4.870 ^a	-5.024 ^a	-4.872 ^a	-4.991 ^a
Δ Modern	-4.809 ^a	-4.718 ^a	-5.376 ^a	-5.190 ^a
Δ INF	-4.068 ^a	-4.416 ^a	-6.260 ^a	-6.608 ^a
Δ Bank-assets	-5.488 ^a	-5.420 ^a	-5.657 ^a	-5.532 ^a
Δ Fin-deposits	-4.599 ^a	-5.541 ^a	-5.453 ^a	-5.842 ^a
Δ Money	-5.241 ^a	-5.139 ^a	-9.319 ^a	-9.098 ^a
Δ Credit	-3.962 ^a	-4.530 ^a	-4.316 ^a	-4.656 ^a
Δ FDI	-4.904 ^a	-5.312 ^a	-6.275 ^a	-6.650 ^a
Critical values	1%	-3,646	-4.262	-4.262
	5%	-2,954	-3.552	-3.552
	10%	-2,615	-3.209	-3.209

Notes: (1) ^a, ^b, ^c indicate the rejection of the null hypothesis at 1, 5, and 10 % levels of significance, respectively.

Table 6 exhibits the result of the structural breaks co-integration test. Maki (2012) level break (equation 3) co-integration test results are reported. Models from 1 to 5 reveal the co-integration relationship between income inequality, economic growth, trade, modernization, inflation and financial development (linear models). Model 6 refers to the co-integration relationship between income inequality, economic growth, trade, modernization, inflation, financial development and the square of financial development (nonlinear model). The co-integration test results for all models support the long-term equilibrium relationship between variables. All models are co-integrated. The breaking dates indicated by the co-integration test results are 1982, 1985, 1988, 1989, 1991, 1994, 2007, and 2011. Turkey has experienced a military coup in the early 1980s. Democracy was over, and there was political instability. On the other hand, it began a liberalization process in Turkey over the same period. In particular, Turkey has made significant progress in liberalization at the end of the 1980s. Similarly, periods 1991 and 1994 correspond to periods before and after the economic crisis in 1993. Finally, periods 2007 and 2011 indicate the periods of the global financial crisis. These structural changes or breaks experienced during this period have an increasing or decreasing effect on many economic variables. For this reason, the break dates obtained from the co-integration test results are included as an additional explanatory variable to the regression model. Thus, the effect of the structural changes in the relevant dates on the dependent variable is explained.

Table 6. Co-integration results

Co-integration Models	Test statistic	Break dates	Decision
Model (1) INQ = f (Y, Trade, Modern, INF, Bank-assets)	-6.111 ^b	1982; 1989	Co-integrated
Model (2) INQ = f (Y, Trade, Modern, INF, Fin-deposits)	-5.871 ^b	1985; 1988	Co-integrated
Model (3) INQ = f (Y, Trade, Modern, INF, Money)	-5.942 ^b	1989; 1994	Co-integrated
Model (4) INQ = f (Y, Trade, Modern, INF, Credit)	-6.046 ^b	1989; 2011	Co-integrated
Model (5) INQ = f (Y, Trade, Modern, INF, FDI)	-5,863 ^b	1994; 2007	Co-integrated
Model (6) INQ = f (Y, Trade, Modern, INF, FDI, FDI ²)	-7,215 ^a	1988; 1991	Co-integrated

Notes: (1) Critical values are obtained from Table 1 in Maki (2012).

(2) ^a, ^b indicate the rejection of the null hypothesis at 1 and 5 % levels of significance, respectively.

The next step in determining the co-integration relationship is to estimate the long-run co-integration coefficients that explain the relationship between variables. Table 7 shows the results of long-run parameters estimates. These results are obtained by Stock and Watson (1993) DOLS estimators.

Table 7. Estimation of the long-term coefficients (Baseline results)

Independent variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Y	-2.361 ^a (0.005)	-2.224 ^a (0.000)	-2.005 ^b (0.013)	-2.169 ^a (0.007)	-1.839 ^b (0.020)	2.083 ^c (0.068)
Trade	0.356 (0.120)	0.003 (0.988)	0.340 (0.160)	-0.479 (0.187)	0.282 (0.256)	0.048 (0.906)
Modern	-0.164 (0.757)	-4.080 ^a (0.001)	0.209 (0.683)	-0.915 (0.198)	0.214 (0.658)	-0.801 (0.274)
INF	0.005 ^c (0.089)	0.097 ^c (0.069)	-0.044 (0.946)	0.275 ^b (0.013)	0.031 (0.636)	0.204 ^b (0.037)
Bank-assets	-1.006 ^b (0.016)					
Fin-deposits		-1.175 ^a (0.000)				
Money			-0.722 ^b (0.037)			
Credit				-0.556 ^a (0.005)		
FDI					-1.493 ^a (0.000)	10.649 ^c (0.059)
FDI ²						-1.444 ^b (0.038)
Dummy 1	0.158 (0.418)	0.531 ^a (0.000)	0.539 ^a (0.001)	0.242 (0.101)	0.004 (0.977)	0.257 (0.220)
Dummy 2	0.364 ^b (0.026)	0.321 ^c (0.061)	0.181 (0.202)	-0.152 (0.334)	0.034 (0.838)	0.388 (0.190)
Constant	19.004 ^a (0.005)	-5.583 (0.197)	14.943 ^b (0.023)	-16.498 ^a (0.003)	15.930 ^b (0.012)	-38.803 ^a (0.002)
Adj. R ²	0.872	0.928	0.873	0.915	0.874	0.746

Notes: (1) ^a, ^b, ^c indicate significance at the 1%, 5%, and 10%, respectively.

(2) Dependent variable: INQ.

(3) The optimal lag length for all models is 1.

Estimation results are as follows:

(1) The parameter of deposit assets (Bank-assets) of the banks is negative and 5% statistically significant (see model 1). An increase in banks' deposit assets has a mitigating or improving effect on income inequality. (2) The parameter of total deposits of the financial system (Fin- deposits) is negative and 1% statistically significant (see model 2). An increase in the total deposits of the financial system has a mitigating effect on income inequality. (3) The parameter of broad money supply (Money) is negative and 5% statistically significant (see model 3). An increase in the money supply reduces income inequality. (4) The parameter of the domestic credits provided in the private sector (Credit) is negative and 1% statistically significant (see model 4). This finding suggests that the increase in domestic credits is a mitigating effect on income inequality. (5) The parameter of the financial development index (FDI) obtained from the aggregation of the financial development indicators is negative and 1% statistically significant (see model 5). When all linear models are evaluated, strong findings are observed that financial development is a mitigating effect on income inequality. The estimation results of the linear models support the inequality-narrowing hypothesis. Model 6 estimates the non-linear relationship between financial development and income inequality. The parameters for financial development and the square of financial development are respectively positive and negative. Both coefficients are statistically significant at 5%. This finding suggests that financial development has an increasing impact on income inequality. However, once the financial structure reaches a certain level of development, this effect reverses and financial development has a decreasing impact on income inequality. In other words, the estimation results of model 6 support the Greenwood-Jovanovic hypothesis.

Economic growth (Y) has a significant and strong negative impact on income inequality. Economic growth has a strong mitigating effect on income inequality (The parameter of economic growth is negative for all other models except Model 6). The parameter of trade openness (Trade) is statistically insignificant in all models. The effect of modernization on income inequality is weak. According to the estimation results of the second model only, the parameter of modernization (Modern) is negative and significant. The neutrality hypothesis is supported by other models. According to economic expectations, inflation is a factor that increases income inequality. When the estimation results are evaluated, the parameters of the inflation (INF) are positive and significant (for four models). Findings related to inflation support economic expectations. The estimation results of the parameters of the dummy variables are mixed. The parameters of dummy variables representing 1985, 1988 and 1989 are positive and significant. This implies that the liberalization process at the end of the 1980s and military coup is an increasing effect on income inequality.

Finally, analysis is repeated with an alternative estimator to robustness check. The fully modified least squares (FM-OLS) regression analysis method developed by Philips and Hansen (1990) is used for robustness check. The method modifies the OLS method by considering serial correlation effects and endogeneity in the regressors. Thus, the FM-

OLS estimator produces more reliable results in co-integration parameters. Table 8 reports FM-OLS estimation results. The FM-OLS results for all of the linear models strongly suggest that financial development is a mitigating effect of income inequality. The FMOLS estimation results of the linear models support the validity of the inequality-narrowing hypothesis. Alternative estimation results of Model 6, which reveal non-linear relationship between financial development and income inequality, are similar to baseline results. When the parameter estimation results of model 6 are evaluated, it is seen that the Greenwood-Jovanovic hypothesis is supported.

Table 8. Robustness check (Alternative estimator)

Independent variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Y	-3.177 ^a (0.000)	-1.888 ^a (0.000)	-2.586 ^a (0.003)	-0.361 ^b (0.030)	-1.791 ^a (0.006)	2.114 (0.100)
Trade	0.648 ^c (0.094)	0.107 (0.340)	0.555 ^c (0.065)	0.580 (0.911)	0.240 (0.275)	0.068 (0.845)
Modern	0.220 (0.717)	-0.802 ^b (0.018)	0.469 (0.340)	-0.270 (0.450)	0.177 (0.687)	-0.531 (0.386)
INF	0.087 (0.286)	0.084 ^b (0.013)	-0.006 (0.402)	0.057 (0.147)	0.033 ^c (0.059)	0.216 ^a (0.000)
Bank-assets	-1.271 ^a (0.002)					
Fin-deposits		-1.269 ^a (0.000)				
Money			-0.889 ^a (0.009)			
Credit				-0.272 ^a (0.007)		
FDI					-1.604 ^a (0.000)	11.036 ^a (0.009)
FDI ²						-1.499 ^a (0.004)
Dummy 1	0.238 (0.220)	0.136 ^b (0.036)	0.551 ^a (0.002)	0.765 ^a (0.000)	0.001 (0.990)	0.282 ^c (0.060)
Dummy 2	0.392 ^b (0.025)	0.201 ^a (0.009)	0.173 (0.207)	-0.175 ^c (0.065)	0.090 (0.402)	0.423 ^c (0.055)
Constant	14.701 ^a (0.005)	19.292 ^a (0.000)	18.672 ^a (0.004)	-14.378 ^a (0.000)	16.410 ^a (0.001)	-40.771 ^a (0.000)
Adj. R ²	0.856	0.931	0.857	0.888	0.859	0.718

Notes: (1) ^a, ^b, ^c indicate significance at the 1%, 5%, and 10%, respectively.

(2) Dependent variable: INQ. (3) The optimal lag length for all models is 1.

The empirical findings of this paper are discussed from three perspectives for potential readers and policy authorities. First, the linear model estimation results for Turkey support the inequality-narrowing hypothesis. These findings are similar to the results of Beck et al. (2004), Ang (2010), Bittencourt (2010), Kappel (2010), Mookerjee and Kalipioni (2010), Jalil and Feridun (2011), Kim and Lin (2011), Prete (2013) and Tiwari et al. (2013). These findings indicate that the increase in assets in the banking system, the growth of domestic credit, and the expansion of money supply have a decreasing effect on income inequality in Turkey. Therefore, incentives and policies towards financial developments in Turkey are expected to contribute to the fight against income inequality. Second, the estimation findings for the nonlinear model confirm the Greenwood-Jovanovic hypothesis. These results are similar to previous findings obtained by Shahbaz et al. (2015), Azam and Ali Raza (2018), Younsi and Bechtini (2018) and Bittencourt et al. (2018). These results indicate that financial development increases income inequality in the short term or up to certain point but decreases in the long term or after a certain point.

After all, this paper reveals an inverse U-shaped relationship between financial development and income inequality in Turkey. It also shows that the final impact of financial development on income inequality is mitigating. Third, we discuss the possible reasons for the results obtained for Turkey. A possible reason behind this conclusion is the fact that low-income groups in society can access credit facilities as a result of the developments in the financial system. Thus, the poor can obtain the necessary funds for human and physical capital investment. Supports the outputs of this paper, credits have been an important policy variable since the second half of 2010 in Turkey. Authorities have followed policies that support credit growth by taking into account global liquidity conditions (Aydın and Yılmaz, 2019). As a result of these policies, while the credit / GDP ratio was 18% in 1998, the credit / GDP ratio reached 40% in 2010 and 65% in 2017 (Central Bank of the Republic of Turkey, 2019). During the same periods, similar growth tendencies are observed in monetary expansion and banks' assets. Thus, in recent years in Turkey have experienced liquidity and credit expansion and interest rates have remained at relatively low levels. These developments may have enabled low-income groups in the country to access loans and move to a better income level.

Conclusion

This paper examines the linear and nonlinear effects of financial development on income inequality in Turkey over the period of 1980-2013. Indicators of financial development are deposits, money assets of banks, deposits of the financial system, domestic credits, and broad money supply. In addition, these four indicators are aggregated, and a financial development index is produced by the PCA method. Economic growth, trade, inflation, and modernization are added to the regression model as control variables. Structural breaks co-integration test and DOLS estimator are used for empirical investigation. Robustness check is performed with the FM-OLS estimator. According to the estimation results of linear relationship, financial development has a mitigating effect on income inequality. These results are consistent with the literature supporting the inequality-narrowing hypothesis. The estimation results of the nonlinear relationship show that financial development first increases income inequality, but after

financial development reaches a certain level, this effect is reversed, and financial development reduces income inequality. These results are in line with the literature supporting the Greenwood-Jovanovic hypothesis. Empirical results for all models strongly suggest that financial development is a mitigating or improving effect on income inequality over the long-run. Finally, empirical analysis reveals that economic growth and inflation are also significant influences on income inequality. Another remarkable result is that economic growth and inflation are also significant influences on income inequality.

Within the framework of empirical findings in Turkey, it is recommended that the following direct policies be followed (Law and Tan 2009; Suter 2010; Shahbaz and Islam 2011; Law et al. 2014; Ahmed and Masih 2017; Kaidi et al. 2018): (a) Policymakers should take measures to reduce constraints and disruptions in the financial markets when designing policies to combat poverty and economic growth. (b) A financial environment should be created to enable the poor to reach a better life opportunity. For this, regulations that make financial resources difficult to access should be audited and access to capital should be facilitated. Thus, entrepreneurial activities may develop and productivity increases throughout the economy. Moreover, low-income individuals make the necessary investments in their education. Among low-income people, skilled labor is emerging in engineering, medicine, and other fields. (c) Policies and incentives to support the development of private credit channels can help reduce income inequality. Indirect policies to be followed are: (d) Factors such as bureaucracy, disruptions in the legal system, high transaction costs and an insecure business environment make access to finance difficult. Governments must first provide the necessary institutional environment to improve income distribution and combat poverty. (e) Finally, policies that encourage economic growth also cause a reduction in income inequality. Macroeconomic stability is also critical to combat income inequality. In particular, the fight against inflation provides a significant improvement in income inequality.

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