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Threshold impact of corruption on income inequality-social transfers nexus in Central and Eastern Europe

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Abstract

Corruption, which adversely affects macroeconomic aspects such as growth, investment, and income distribution, causes the anticipated accomplishment from social transfers not to be realized. In this study, the income inequality effects of social transfers under the corruption threshold are investigated with the annual data of 19 Central and Eastern Europe (CEE) countries for the period 1999-2019. Following Hansen's (1999) and Wang's (2015) modeling, it has been detected that corruption has a significant threshold effect on this relationship. Two thresholds have been specified. Below the first threshold of 3.520, the relationship between social transfers and income inequality is inverse. Above this threshold level and the second threshold value of 3.577, the relationship is in the same direction. In 19 CEE countries, it can be concluded that an augmentation in the corruption and the abuse of social transfers by public officials may amplify income inequality.

Keywords: corruption, social transfer, income inequality, threshold

Introduction

After the disintegration of the socialist system, former union countries faced crises and depressions. In the first stage, the deterioration of the commercial system caused the loss of markets, resulting in the closure of production-oriented enterprises and a decrease in the welfare level. Subsequently, poverty and unemployment rates were enhanced, education and health services were disrupted, and the social security system collapsed. The second stage was the period when the reform programs started in the second half of the 1990s. Ensuring financial and monetary stability, the start of privatization, the creation of a competition system, the beginning of land reform in agriculture, and the beginning of the efforts to put raw material resources on the market are among the important features of the second stage. Aggrandizing oil and natural gas revenues, attributing importance to regional development policies,

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developing infrastructure, fighting corruption, struggling with the informal economy, policies to fight poverty, and integration policies towards the west were among the important features of the last stage. The integration process in question included the membership of the former union countries in the North Atlantic Treaty Organization (NATO) and the European Union (EU) in waves. Although the economies, most of which are Eastern Block (Warsaw Pact) countries, have achieved rapid economic, social, human, and institutional development until today, the internal dynamics of the countries require a gingerly screening of some neglected aspects of the development. One of them is corruption, which has several socio-economic impacts on the transformation process of countries. According to the definition made by Klitgaard (1998, p. 4), the dynamics that lead to corruption are:

Discretion (D) + Monopoly Power (M) - Accountability = Corruption (C)

The United Nations Development Program has also expanded this definition as follows (UNDP, 2004, p. 2):

Discretion (D) + Monopoly Power (M) - Accountability (A) - Integrity (I) - Transparency (T) = Corruption (C)

Corruption may eventuate due to many social, administrative, economic, and political reasons. It has become an issue that every country faces. Past practices of some Central and Eastern Europe (CEE) countries confirm that the power of the ruling class (public power) is abused for private interests. In countries where various fiscal policy tools, especially public expenditures, are misused by public officials for their private interests, corruption may deepen domestic inequalities by disrupting the efficient distribution of resources. Populism, nepotism, and unjust profit are activities aimed at obtaining private benefits through behaviors that cause corruption. Corruption is based on the unjust transfer of public resources (Faure, 2011, p. 5). Corruption paves the way for the rent economy to become more functional by causing public expenditures to be higher than they should be (Del Monte and Papagni, 2001, pp. 3-4). Corruption disrupts the expenditure size and structure, causes an enhancement in public spending, especially in low-income economies due to low wages, and begets rent-seeking activities (Dzhumashev, 2014, pp. 403-416). There are many reasons for corruption such as the role of the state in the economy, public policies, unfair income distribution, multiple exchange rate mechanisms, poverty, trade restrictions, low wages, scarce resources, subsidies, pricing restrictions, poor control, and mismanagement. Corruption gains an international dimension through these areas in which it interacts and is perceived as an additional income source (Jancsis, 2019, p. 528). The distorting effect of these issues, caused by corruption, on public finance has been discussed by Tanzi (1998) in two dimensions. It is stated that the decrease in public revenues as a result of corruption in customs and tax administrations causes a decrease in the financing opportunities to be allocated for public expenditures (Tanzi, 1998, p. 2). It is emphasized that this change in public revenues occurs in public expenditures and that the composition of expenditures changes in the presence of corruption. According to Tanzi (1998), this bilateral interaction leads to a budget deficit and in the presence of corruption, the state does not have the opportunity to implement a strong fiscal policy. Corruption causes an increase in public expenditures; there will inevitably be an augmentation in the tax burden.

Social transfers, one of the public expenditure items, are affected by the negative effects of corruption. Social transfer expenditures come to the forefront with their unique characteristics in each country and have an impact on income redistribution with different items. Unfair income distribution, which is not limited to economic life negatively affects the social, societal, and cultural structures of countries. The social transfer expenditures policy realized through the public budget for the consumer segment with no or low income is one of the most important phenomena implemented in many countries. In this context, many public policies are improved and implemented to gain and sustain fair income distribution. It is conferred that income inequality, which has become one of the issues that whole countries are concerned with, has expanded in almost every region of the world in recent years. CEE countries, which have made significant changes and developments in the political, social, and economic fields since the 1990s, are one of the regions where income inequality is experienced. These issues reveal how significant the effects of national policies and institutions on income inequality are (Alvaredo *et al*., 2018, p. 46).

The effect of social transfers on income distribution varies according to the type of transfer expenditure. Accordingly, transfer expenditures categorized as subsidies, grants and social aid in Public Financial Statistics can be divided into four main groups: i) direct payments to low-income groups, ii) payments for social purposes, iii) payments to support certain economic activities, iv) interest payments. While the effect of interest payments on income distribution is negative, the effect of other payments is positive. The impact of corruption on the relationship between income inequality-social transfers is more complex. To compensate for the injustices caused by corruption, decision-makers aim to reduce income inequality by applying a progressive taxation system, and by supporting low-income people through social transfers and redistribution policies. At this point, the density of corruption in economic life and among politicians is essential. The rent-seeking activities of high-income groups and the effort to pressure politicians to cut down tax rates may bring about political corruption. Low-income earners are more affected by corruption as higher-income earners have more motivation, penetration, and resources with special advantages. These circumstances negatively affect the quality, results, and quantity of social transfers aimed at reducing inequalities by causing more inequality, and corruption, especially in countries where corruption is greater. The losses caused by corruption may even be larger than the success of social transfers. As an example of this, Olken (2006) states that in Indonesia, 18% of the rice distribution program to low incomes is lost from the moment it is subtracted from state-owned warehouses until it reaches households. Thus, a situation arises where the cost of corruption exceeds the expected benefit from transfers. Based on the explanations made so far, corruption is likely to affect the composition, efficiency, quantity, quality, and fair income distribution of public expenditures and social transfers. The corruption levels of 19 CEE countries are higher than that of developed countries. It is aimed to examine the effects of corruption on social transfers and income inequality in these countries.

This study centers upon the relationship between income inequality and the subsidies and other transfers variable, which includes all four groups and is included in the World Bank database. The basic hypothesis is corruption may have a significant effect on this relationship. A linear panel fixed-effect model has been established. A preliminary estimate has been carried out for the 1999-2019 period and 19 CEE countries. Next, Hansen's (1999) panel threshold regression model and nonlinear effects of corruption have been analyzed in the relationship. The contribution and innovation of the study to the literature are as follows: i) Previous literature mostly explores the link between corruption-public expenditures, corruption-income inequality, and social transfers-income distribution. In this study, the corruption threshold has been put for 19 CEE countries in terms of providing methodological superiority to the relationship between income inequality and social transfers. ii) Policy recommendations are made for CEE countries that are undergoing a major social, economic, geographical, and cultural transformation. iii) The analysis has worthy of note consequences for policymakers in terms of procuring fair income distribution by utilizing social transfers in CEE countries that have a political, social, and economic multifaceted and corrupt nature. iv) Other control variables are put into the model to reveal exactly how the variables interact with each other or whether the findings alternate.

1. Literature review

In this section, the theoretical and empirical scope of the relationship between income inequality and social transfers is reviewed. The literature on the effect of corruption on the relationship between income inequality and social transfers is limited. The relevant literature indicates that there is political corruption in countries with high levels of corruption. It is stated that this disrupts income distribution, the costs of corruption are reflected in low incomes, the tax system is corrupted, and corruption reduces the chances of success in social transfers (Gupta *et al*., 2002; Persson and Tabellini, 2008; Goni *et al*., 2011; Dincer and Gunalp, 2012). On the other hand, Bergh and Bjørnskov (2011), Bjørnskov and Svendsen (2013), Daniele and Geys (2015), Algan *et al*. (2016), Wulfgramm and Starke (2017) explain that the demand for redistribution is lower in countries with high corruption due to the decrease in confidence in government interventions. The use of state-financed programs to spread transfers to high incomes, or the withdrawal of funds from poverty reduction programs by individuals who are on good terms with politicians due to their rent-seeking activities, may reduce the impact of social transfers on income distribution and poverty.

Income distribution effects are mostly researched through public expenditures. While some of these studies deal with public expenditures, others focus on the effects of income inequality by making use of public expenditure classification. The theoretical framework for transfer expenditures has been first introduced by Pigou (1947). Pigou (1947) has remarked on a distinction between transfer expenditures and non-transfer expenditures and alleged that transfer expenditures are defined as an income transfer mechanism. All types of public expenditures directly or indirectly affect the social welfare of households. Tax and transfer policies within the redistribution mechanism of governments influence not only the income of households but also business and investment decisions. Atkinson (1996) has discussed the social and political sources as well as the economic sources of income inequality. Public transfer expenditures are the source of the second-largest share of household incomes. Atkinson (1996) draws attention to the effects of economic growth on income sharing, as well as the effects of political preferences. Gottschalk and Smeeding (1997) have concluded that there is a strong inverse relationship between public cash transfer expenditures and disposable income inequality in OECD countries. Gustafsson and Johansson (1999) have stated that social transfers do not have any effect on income distribution by using the panel data analysis, and the data of 16 OECD countries for the period 1966-1994. Heady *et al*. (2001) have analyzed the distributional effects of social transfers for European Union countries and stated that social transfers have a reducing effect on income inequality.

Keane and Prasad (2002) have determined that social transfer expenditures play a crucial role in reducing the increases in inequality and poverty, using the simple correlation calculation method for the 1988-1997 period in Poland. Schwabish *et al*. (2004) have analyzed the series of 17 countries with the panel data method and stated that the relationship between social transfers and income inequality varies according to income groups. It is remarked that social transfers affect positively low and middle-income groups. Huber *et al*. (2004) have concluded that social security and welfare expenditures (especially pensions) reduce income inequality for 18 countries in Latin America and the Caribbean, and the period 1970-1995. Niehues (2010) has investigated the effect of social expenditures on income distribution in 15 EU countries, using the panel data analysis for the period 1993-2006. It has been specified that the increase in social expenditures, especially in unemployment benefits and pensions, deadens income inequality. Immervoll and Richardson (2011) have analyzed the impact of tax-transfer policies on OECD countries for 25 years. The effect of transfer expenditures on reducing income inequality is higher than taxes. Joumard *et al*. (2012) have compared the relative effects of taxes and transfer expenditures on reducing income inequality for OECD countries. Transfer expenditures are more effective in decreasing income inequality.

Heisz and Murphy (2016) examine the effect of direct transfer expenditures on income inequality for Canada and the period 1976-2011. The findings provide evidence that transfer expenditures reduce income inequality. Transfer expenditures have a decisive effect on income inequality not only in quantity but also in the method of implementation. Caminada *et al*. (2017) have discussed the effects of taxes and transfers in 47 countries from 1967 to 2014. It has been revealed that the effect of transfer expenditures on income distribution is higher. Eroglu *et al*. (2017) examine the effect of social assistance expenditures on income distribution by using the data of the 21 OECD countries for the period 2004-2011 and the panel data analysis. Income inequality decreases when social assistance expenditures enhance. Sánchez and Pérez-Corral (2018) have questioned the relationship between social transfer expenditures and income inequality in terms of expenditure types for 28 European Union countries using dynamic panel models. Countries are grouped according to their income levels. While an inverse relationship has been found between health and social protection expenditures and income inequality in developing member countries, the redistributive effect of transfer expenditures emerges with social protection expenditures in other member countries. Urper (2018) has examined the effect of public expenditures on income inequality by using the regression analysis method for the 1987-2016 period in Turkey. It is quoted that social transfers downsize income inequality. d'Agostino *et al*. (2020) have evinced the corruption effects in the nexus. It has been calculated the simultaneity bias exploiting an instrumental variable that identifies the main driver of social transfers from the interaction between partisanship of coalitions winning elections and electoral systems. The study indicates that a 1% increase in social transfers decreases inequality by a 0.5% point. The research exposes heterogeneous findings conditional on the level of corruption and expenditure components. Topuz and Dogan (2020) state that the relationship between transfer expenditures and income inequality differs according to the income inequality levels of 39 countries. One-way causality has been found from transfer expenditures to income inequality in countries with high-income inequality, while in countries with low-income inequality, the causality has been detected to be reversed.

2. Empirical data

Annual data from 19 Central and Eastern European (CEE) countries between 1999 and 2019 have been utilized for the empirical analysis. The most substantial challenge in determining countries is the constraint on the data. Besides, there is no consensus in the literature regarding the determination of CEE countries. The CEE countries identified by the OECD in 2001 are Albania, Bulgaria, Croatia, the Czech

Republic (Czechia), Hungary, Poland, Romania, the Slovak Republic (Slovakia), Slovenia, Estonia, Latvia, and Lithuania. However, there have been many economic, political, and cultural turns and alterations in the European region since this date. For instance, there have been many CEE countries that have joined the European Union and North Atlantic Treaty Organization. The incidents such as the unification of East and West Germany in 1991, the collapse of the Union of Soviet Socialist Republics (USSR), and the declaration of independence of the former Eastern Bloc countries one by one, the Bosnian War, the Yugoslav War(s), etc. have played a fundamental role in the reshaping of today's Europe. As a result of these evolvements, the integration of the countries into the global hegemon system has sparked the development and/or change of the socio-economic circumstances of the region. The result of these incidents continues. For this reason, the sample of the analysis is based on 19 European countries[1] of which data can be accessed dissipationless. Certainly, the issues or conflicts between the years 1990-2000 significantly affect the time dimension of the analysis. In this respect, the period of 1999-2019, in which the data have been obtained uninterruptedly, represents the time interval of the sample. The salient feature of the data is as follows.

The hassle associated with income inequality coefficients arises from the inability to reach up-to-date, trustworthy, and loss-free indicators. The most well-recognized inequality coefficient in the literature is the Gini coefficient. The income inequality coefficient obtained from the Standardized World Income Inequality Database (SWIID-Version 9.1) ranges from 0 (the lowest inequality coefficient) to 100 (the highest inequality coefficient) (Solt, 2020, pp. 1184-1186). The income inequality coefficient, which is the indicator of household disposable income after taxes and transfers, indicates the dependent variable used in the model. The income inequality coefficient, which is an indicator of household disposable income before taxes and transfers, is also included in the analysis for robustness check. The corruption indicator has been defined as the threshold variable and the variable has been acquired from PRS Group International Country Risk Guide Table 3B. The explanatory (regime-dependent) variable is the social transfer indicator. The control variables and social transfer indicators have been compiled from the World Bank database. Table 1 is a summary of knowledge about the data. These variables have been selected among the indicators that are presumed to have significant effects on the relationship between income inequality-social transfers-corruption, in line with the previous literature.

[1] Estonia, Latvia, Lithuania, Czechia, Slovakia, Poland, Hungary, Slovenia, Romania, Bulgaria, Croatia, Russia, Belarus, Ukraine, Moldova, Austria, Germany, North Macedonia, Serbia.

Table 1. Salient features of the data

Variable	Indicator	Source
Dependent Variable: *GINI_NET* and *GINI_MKT*	Gini coefficient: Income inequality indicator equalized with household income before (for robustness check) and after taxes and transfers.	Standardized World Income Inequality Database (SWIID, 2022)
Threshold Variable: *COR*	Corruption index: The corruption indicator is interpreted over 6 points within the political risk component. 0 indicates the lowest level of corruption, 0 shows the highest level of corruption.	PRS Group International Country (Political) Risk Guide Table (3B)[2]
Explanatory Variable (Regime-Dependent Regressor): *TRA*	Subsidies and other transfers (current LCU): Social and employer benefits in cash and kind. Non-refundable and unrequited transfers to public and private entities; grants to other governments, other government agencies, and international organizations.	World Bank Database (WB Database)
	Control Variables	
GDP	Gross domestic product per capita (current LCU)	WB Database[3]
TAX	Tax revenue (current LCU)	WB Database[4]
INV	Gross fixed capital formation (current LCU)	WB Database[5]
EXP	General government final consumption expenditure (current LCU)	WB Database[6]
UNE	Unemployment, total (% of the total labor force) (modeled ILO estimate)	WB Database[7]

Source: Author's representation

[2] ICRG (2022), International Country Risk Guide Political Risk Index Corruption Indicator. (https://doi.org/10.7910/DVN/4YHTPU).
[3] World Bank, (2022), Gross Domestic Product Indicator (retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CN).
[4] World Bank, (2022), Tax Revenue Indicator (retrieved from https://data.worldbank.org/indicator/GC.TAX.TOTL.CN).
[5] World Bank, (2022), Gross Fixed Capital Formation Indicator (retrieved from https://data.worldbank.org/indicator/NE.GDI.FTOT.CN).
[6] World Bank, (2022), General Government Final Consumption Indicator (retrieved from https://data.worldbank.org/indicator/NE.CON.GOVT.CN).
[7] World Bank, (2022), Unemployment Indicator (retrieved from https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS).

As it can be realized from Table 2, the explanatory variable social transfers and threshold variable corruption measures do not vary a lot between countries. Measures of dependent variable Gini coefficient and control variables are also close to each other. The standard deviations and means of the series differ negligibly. Please note that the series is included in the regression(s) in their natural logarithmic form.

Table 2. Descriptive statistics

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
TRA	399	6.56e+11	1.85e+12	1.10e+09	8.40e+12
COR	399	2.837	0.617	2	5
GINI_NET	399	29.878	4.020	23	38
GINI_MKT	399	45.691	3.448	38	52
GDP	399	301070	834645.3	2453.111	4863707
TAX	399	6.40e+11	1.85e+12	1.13e+09	1.07e+13
INV	399	7.09e+11	1.91e+12	1.40e+09	1.29e+13
EXP	399	6.22e+11	1.69e+12	1.19e+09	9.41e+12
UNE	399	2.172	0.448	0.698	2.991

Source: Author's calculations with Stata. 14.2

3. Research methodology

In the analysis, first, linear estimations have been realized with the fixed-effect panel data model. Then nonlinear estimations have been performed with the threshold model. This section describes the research methods in detail.

3.1. Linear fixed-effect model

Fixed-effect panel data models are conducted when the differences between units are constant. This effect is expressed with a constant parameter in the estimation results. The slope parameters are the same for all units in fixed-effect panel data models. They vary according to the fixed panel units. Although the regression constant in which the unit effects are analyzed is not deterministic, it is observed that the sample units are intensified. In cases where the sample units do not come from a large population, these models are defined as covariance models. A certain number of *N* panels are subject to unit estimates (Un, 2018, p. 60).

$$Y_{it} = \alpha_{it} + \beta_{2it}X_{2it} + \beta_{kit}X_{kit} + U_{it} \tag{1}$$

$$\alpha_{it} = \alpha_i \text{ for all } t$$

$$\beta_{kit} = \beta_k \text{ for all } i \text{ and } t \; (k=2,3,\ldots, K)$$

Fixed coefficient models are used for cases where the differences according to the units affect the slope coefficients (Un, 2018, p. 60).

$$\alpha_{kit} = \alpha_{ki} \text{ for all } i\ J=1, ,...N;\ t=1,....T;\ k=1,...., k$$

In fixed-effect models, there is no assumption that independent variables are unrelated to error term components. In random effect models, the error term components and the independent variables are uncorrelated. If there is prior knowledge about the use of the fixed-effects model and the random-effects model, estimations can be effectuated based on this. The fixed-effect models propose that various estimators can be used depending on whether there is endogeneity, heteroscedasticity, autocorrelation, and cross-section dependence in the series. In the study, Hansen's (1999) approach has been preferred. This is an analysis that eliminates the issues and procures methodological superiority. The nonlinearity of the relationship has been tested. It is aimed to reach predictive findings with the linear model before Hansen's (1999) threshold analysis.

3.2. Single threshold model

Hansen (1999) presents an asymptotic distribution theory that enables the estimation of threshold regression models. It differs from traditional analyses by using the bootstrap method and allows the estimation of threshold regression models. The method has evolved to designate whether the regression functions are the same or discrete in all observations in a sample. Threshold regression models specify whether individual observations can be evaluated in separate regimes according to the value of an observed variable. Hansen (1999) argues that econometric techniques do not yield effective results for threshold regression. The bootstrap method is operated to express the statistical value of the threshold effect. A two-stage ordinary least squares approach is used to test the threshold effect. While realizing this, a method is used in which the sum of squares of error is calculated independently for each possible threshold value, and then these values are minimized. Finally, coefficient parameters are estimated in separate regimes determined by the threshold parameter (Hansen, 1999, pp. 345-346). Hansen (1999) has recently been widely used in threshold analysis as a method that provides methodological superiority in solving problems such as multicollinearity and endogeneity. Moreover, dynamic panel threshold models may also be used in this framework. This study focuses on fixed effects panel threshold analysis. Hansen (1999) states the single-threshold model as follows (Hansen, 1999, p. 347; Wang, 2015, p. 122):

$$y_{it} = \mu + X_{it}\,(q_{it} < \gamma)\beta_1 + X_{it}\,(q_{it} \geq \gamma)\beta_2 + u_i + e_{it} \qquad (2)$$

Here q_{it} is the threshold variable. γ is the threshold parameter that divides the equation into two regimes, β_1 and β_2. u_i and e_{it} represent individual effects and error terms, respectively. It is also possible to show equation (2) as below. *I* represents the indicator function (Hansen, 1999, p. 347; Wang, 2015, p. 122):

$$y_{it} = \mu + X_{it}\,(q_{it}, \gamma)\beta + u_i + e_{it}$$
$$X_{it}\,(q_{it}, \gamma) = \begin{Bmatrix} X_{it}\, I\,(q_{it} < \gamma) \\ X_{it}\, I\,(q_{it} \geq \gamma) \end{Bmatrix} \tag{3}$$

Given the threshold parameter γ, the least ordinary squares estimator of β is as in equation (4) (Hansen, 1999, p. 349; Wang, 2015, p. 122):

$$\hat{\beta} = \{X^*(\gamma)' X^*(\gamma)\}^{-1}\,\{X^*(\gamma)'\,y^*\} \tag{4}$$

y^* and $X^*$are within-group deviations. Now the sum of squares is $\hat{e}^{*\prime}$ and $\hat{e}^*$. To estimate the threshold parameter γ, a subset of the threshold variable q_{it} needs to be calculated. Instead of testing the entire sample, the series is limited to the range $(\underline{\gamma}, \bar{\gamma})$. These ranges are the distribution of the threshold variable q_{it}. The estimator of γ is now the value that minimizes the sum of squares and is as in equation (5) (Hansen, 1999, p. 349; Wang, 2015, p. 122):

$$\hat{\gamma} = \underset{\gamma}{\arg min}\, S_1\gamma \tag{5}$$

If γ is calculated, the model does not differ from the ordinary linear model. However, there is a nuisance parameter problem that makes the distribution of the γ estimator non-standard if it cannot be calculated. Hansen (1999) has proved that $\hat{\gamma}$ is a consistent estimator for γ. Hansen (1999) argues that the best way to test $\gamma = \gamma_0$ is to create a confidence interval using the maximum likelihood ratio (*LR*) and the "non-rejection region" method, and this statistic is as follows (Hansen, 1999, p. 351; Wang, 2015, p. 122):

$$LR_1(\gamma) = \frac{\{LR_1(\gamma) - LR_1(\hat{\gamma})\}}{\hat{\sigma}^2} \xrightarrow{Pr} \xi$$
$$Pr(\mathfrak{x} < \xi) = (1 - e^{\frac{-\mathfrak{x}}{2}})^2 \tag{6}$$

Given the confidence interval α, the lower bound corresponds to the maximum value in the *LR* series and this value is smaller than the α distribution. The upper bound corresponds to the minimum value that is smaller than the α distribution in the *LR* series. The α distribution is calculated from the following inverse function of equation (7) (Hansen, 1999, p. 352; Wang, 2015, p. 123):

$$c = -2\log(1 - \sqrt{1-\alpha}) \tag{7}$$

Namely, three critical values are calculated for 0.1, 0.05, and 0.01 confidence intervals. If the maximum likelihood ratio $LR_1(\gamma_0)$ is greater than the critical values of the distribution *c*(α), the null hypothesis is rejected. Testing for a threshold effect is the same as testing whether the coefficients are the same in each regime. The null hypothesis and alternative hypothesis (proving the linear and single-threshold model) are as in Equation (8) (Hansen, 1999, p. 351; Wang, 2015, p. 123):

$$H_0: \beta_1 = \beta_2 \qquad\qquad H_\alpha: \beta_1 \neq \beta_2 \tag{8}$$

The *F* statistic is as in the equation (9) (Hansen, 1999, p. 350; Wang, 2015, p. 123):

$$F_1 = \frac{S_0 - S_1}{\hat{\sigma}^2} \tag{9}$$

In case the null hypothesis (H_0) is valid, the threshold parameter γ cannot be determined and the *F* statistic indicates a non-standard asymptotic distribution. For this reason, the bootstrap method is used for critical values of the *F* statistic to test the significance of the threshold effect. The p-value significance level of the *F* statistic test demonstrates whether the threshold effect is significant or not. If a significant threshold is detected, it is observed that the statistical value *F* is greater than the coefficients estimated for the confidence intervals of the critical values α of the distribution.

3.3. Multi threshold model

Hansen (1999) also authorizes estimations for multi-threshold models. An example model with double thresholds is as follows (Hansen, 1999, p. 353; Wang, 2015, p. 123):

$$y_{it} = \mu + X_{it}\,(q_{it} < \gamma_1)\beta_1 + X_{it}\,(\gamma_1 \le q_{it} < \gamma_2)\beta_2 + X_{it}\,(q_{it} \ge \gamma_2)\beta_3 + u_i + e_{it} \tag{10}$$

γ_1 and γ_2 are threshold parameters and split the equation into three different regimes as β_1, β_2, and β_3. The equation requires to be calculated $(N \times T)^2$ times using the grid interval method, which is not used much. According to Bai (1997) and Bai and Perron (1998), the sequential estimator is consistent; therefore, the thresholds are estimated as follows (Hansen, 1999, p. 353; Wang, 2015, p. 123):

$$\hat{\gamma}_2^r = \arg min\, S_2^r(\gamma_2)$$
$$S_2^r = S\,\{\min(\hat{\gamma}_1, \gamma_2\,) max(\hat{\gamma}_1, \gamma_2\,)\}$$
$$LR_2^r(\gamma_2) = \frac{\{S_2^r(\gamma_2) - S_2^r(\hat{\gamma}_2^r)\}}{\hat{\sigma}_{22}^2} \quad (11)$$

$$\hat{\gamma}_1^r = \arg \min\{S_1^r(\gamma_1)\}$$
$$S_1^r = S\,\{\min(\hat{\gamma}_1, \gamma_2\,) max(\hat{\gamma}_1, \gamma_2\,)\}$$
$$LR_1^r(\gamma_1) = \frac{\{S_1^r(\gamma_1) - S_1^r(\hat{\gamma}_1^r)\}}{\hat{\sigma}_{21}^2} \quad (12)$$

Threshold effect testing is also sequential. If the null hypothesis is rejected in a single-threshold model, the double-threshold model should also be tested. The null hypothesis is a single-threshold model and the alternative hypothesis is a double-threshold model. The F statistic is formed as follows (Hansen, 1999, p. 354; Wang, 2015, p. 124):

$$F_2 = \frac{\{S_1^r(\gamma_1) - S_1^r(\hat{\gamma}_1^r)\,\}}{\hat{\sigma}_{22}^2} \quad (13)$$

As in the single-threshold model, the bootstrap method is used. Given the null hypothesis, a new series is created in the form of $H_0\ DGP, X_{it}^*\beta_S + v_{it}^*$. β_S is an estimator of the single-threshold model with $H_a\ DGP$ data. The process is similar for models with more than two threshold parameters. Chan (1993) and Hansen (1999) state that the dependence of the β (slope parameter) result and the reliability of the estimation on the threshold estimation does not have a first-order asymptotic significance. The estimation of β (slope parameter) can be continued since there is γ data (Hansen, 1999, pp. 354-355; Wang, 2015, p. 124).

It is possible to evaluate the data and purpose of this study within the framework of Hansen (1999). The model helps confirm the threshold values of the sample by subdividing the corruption indicator internally in the relationship between income inequality and social transfers. Depending on the threshold value, the relationship in different aspects can be explained. The model obtained from equations (2) and (10) has been set up with a balanced panel data set. t represents time effects and i indicates individual effects. $lnGINI_{it}$ shows the income inequality indicator which is the dependent variable of the model. The threshold variable is defined as the $lnCOR_{it}$ corruption indicator. lnX_{it} specifies the vector of control variables. The nonlinear model examining the effect of income inequality on social transfers under the threshold corruption level is as in equation (14):

$$lnGINI_{it} = \begin{cases} \delta_i + \alpha_1 lnX_{it} + \beta_1 lnTRA_{it} + e_{it}, lnCOR_{it} \le \lambda \\ \delta_i + \alpha_2 lnX_{it} + \beta_2 lnTRA_{it} + e_{it}, lnCOR_{it} > \lambda \end{cases} \quad (14)$$

e_{it} represents the error term assumed to be identical and independently distributed with infinite variance and zero mean. $lnTRA_{it}$ is the regime-dependent regressor (explanatory variable) which is defined as the social transfer indicator δ_i includes fixed effects showing the heterogeneity of panel countries with different corruption indexes. λ represents the best value estimation. β_1, β_2 reveal the effects of social transfers on income inequality in different regimes of corruption, in other words, below and above the estimated threshold corruption value.

The null hypothesis of the research is that the relationship between income inequality and social transfers is linear. It is possible to express the alternative hypothesis as the income inequality social transfers relationship is not linear, and a significant (single) corruption threshold effect is detected. The estimated threshold value depends on the significance of the probability value of the threshold effect test and whether the critical values estimated for the confidence intervals of the F statistical coefficient are greater than the coefficient. The threshold appoints the linearity of the relationship in question first, then designates the aspect of the nexus below and above the threshold. Following the single-threshold estimation, the multi-threshold estimation has also been conducted. Hansen's (1999) panel fixed effect threshold analysis can uncloak effective and authentic findings on the relationship under the corruption threshold.

4. Results and discussion

First, fixed-effect panel data analysis has been performed with linear models. Findings regarding the estimations are shared in Table 3. The relationship of both income inequality indicators with other variables is statistically significant. Besides, the effects of significant variables (positive and negative) are in line with expectations and the previous literature. Schwabish *et al*. (2004), Niehues (2010), Eroglu *et al*. (2017), Sánchez and Pérez-Corral (2018), Topuz, and Dogan (2020) have found a negative or inverse relationship between social transfers and income inequality by using linear panel data analysis. Growth (*GDP*), total tax revenues (*TAX*), unemployment (*UNE*), and corruption (*COR*) variables have a positive relationship with income inequality. The relationship between general government final consumption expenditures (*EXP*) and gross fixed capital formation (*INV*) variables with income inequality is negative. The robustness check with the (*GINI_MKT*) variable determines similar coefficients, significance levels, and aspects of the relationship for all variables.

Table 3. Linear fixed-effect panel regression results

Dependent variable: ***GINI_NET***		
Variable	**Coef. (std. dev.)**	**Prob.**
TRA	-0.076 (0.037)	√ (0.045)
COR	0.118 (0.039)	√ (0.003)
GDP	0.010 (0.014)	√ (0.090)
TAX	0.210 (0.045)	√ (0.000)
INV	-0.153 (0.036)	√ (0.000)
EXP	-0.500 (0.097)	√ (0.000)
UNE	0.033 (0.022)	√ (0.000)
Dependent Variable: ***GINI_MKT***		
TRA	-0.063 (0.020)	√ (0.001)
COR	0.015 (0.013)	√ (0.044)
GDP	0.018 (0.035)	√ (0.000)
TAX	0.111 (0.028)	√ (0.000)
INV	-0.029 (0.017)	√ (0.090)
EXP	-0.063 (0.037)	√ (0.089)
UNE	0.047 (0.007)	√ (0.000)

Note*:* X indicates that the relationship is not significant. √ shows that the relationship is significant.
Source: Author's calculations using panel fixed-effect regression results

Contrary to previous literature, this study aims to reveal how a change in the level of corruption affects the aspect of the relationship, beyond evaluating the relationship with linear analysis. It is substantial to determine aspects of the relationship in different regimes with a threshold defined over the level of corruption. Table 4 shows the single and double threshold effect test results of the relationship between social transfers and income inequality in 19 CEE countries estimated by the panel threshold least squares method.

Table 4. Threshold effects test results for first and double thresholds

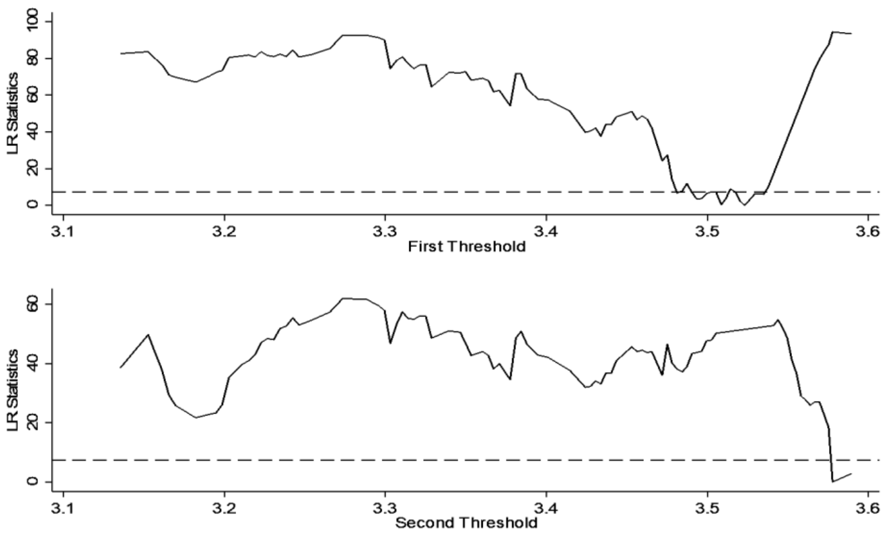
Threshold value	***F* statistics**	***p*-value**	**Critical values**		
			10%	**5%**	**1%**
3.520	121.582	√ 0.000*	42.225	51.706	67.006
3.577	67.510	√ 0.000*	34.256	38.672	50.814

Note*:* * shows the bootstrap (300) iterative probability distribution. √ indicates that the relationship is significant.
Source: Author's calculations using panel fixed-effect threshold regression results

The threshold value for the corruption (COR) variable is 3.520 and the p-value is (0.000). As can be seen from the F statistic coefficient (121.58), all critical values of 10%, 5%, and 1% are less than this value. As such, the null hypothesis is rejected at the 1% level. In other words, there is no linear relationship between social transfers and income inequality. This relationship has a strong and significant corruption threshold effect. Multiple threshold analysis, as suggested by Hansen (1999), has applied to the corruption variable. The threshold parameter for this analysis, the probability value for this parameter, the F statistic, and the critical values are also shared in Table 4. The F statistical coefficient of the second threshold parameter (67.510) is greater than the critical value coefficients determined by the confidence intervals of the distribution. The probability value is also significant (0.000). These findings figure that there is a double-threshold effect in the model. According to the estimation findings of the threshold rates (3.520) and (3.577), it is behooved to remark that corruption affects the income inequality-social transfers relationship under and above these two levels in different regimes. The results of single and multi-threshold effect tests performed with the (GINI_MKT) indicator are also shown in Appendix (Table 6). These findings are in parallel, and the F statistical coefficient of 82.092 recorded for a single threshold is greater than the critical values of the distribution. The value of (85.520) determined for the double threshold is greater than all the critical values of the distribution. That is, the null hypothesis is rejected at the 1% significance level for a single threshold. The variable for robustness check (GINI_MKT) is in a nonlinear relationship with social transfers through the corruption threshold.

LR maximum likelihood statistics are used to determine the confidence intervals of the distribution in the threshold test. The red dashed horizontal line in Figure 1 represents the critical value of 95% significance level. This value is shown as (7.35). The 95% confidence interval is determined as lower and upper levels for a single threshold. These levels are as follows [3.516 and 3.523]. The threshold value, which minimizes the maximum likelihood function and is estimated by the least-squares sum is (3.520). The lower and upper levels for the double threshold are determined as [3.575 and 3,589]. The double threshold value, which minimizes the maximum likelihood function and is estimated by the least-squares sum, is (3,577). These thresholds provide evidence for the existence of two different regimes for both thresholds. Figure 1 shows these graphs representing first and double threshold parameter values. Appendix (Figure 2) also includes the LR maximum likelihood statistics graph, which illustrates the upper and lower levels tested for the robustness check by using the variable (GINI_MKT). These levels are determined as [3.688 and 3.701] for a single threshold and as [3.879 and 3.887] for a double threshold. The threshold values that minimize the maximum likelihood statistics and are estimated by the sum of the least-squares are (3.698) for the first threshold and (3.883) for the double threshold.

Figure 1. LR maximum likelihood statistics for first and double thresholds



Source: Author's representation using Stata 14.2

Table 5 shows the estimation findings performed following Equations 10 and 14. The parameters β_1, β_2, and β_3 indicate the impact of corruption variables of different regimes on the relationship between social transfers and income inequality. These parameters are the coefficients representing the effect of social transfers on income inequality due to the corruption regime. (β_1) represents the first threshold regime. Social transfers income inequality relation is the inverse (negatively) below the threshold corruption (3.520). In the case of a corruption rate above this value, social transfers are in the same direction as income inequality. In other words, income inequality deepens if the social transfers increase. Both parameters are statistically strongly significant (0.018 and 0.000). On the other hand, the double-threshold parameter (β_3) is also statistically significant (0.000). Parameter (β_3) has been detected significantly in the model. This openly demonstrates that there are two thresholds and that there are three regimes in terms of the corruption variable.

β_1 shows the direction of the effect of the social transfers on income inequality below the threshold corruption level of 3.520. β_2 indicates the direction of the impact of the social transfers on income inequality in the case of corruption levels between 3.520 and 3.577 and equal to 3.520. β_3 demonstrates the effect of social transfers on income inequality above the threshold corruption level of 3.577. As can be seen from the sign of the coefficient corresponding to the B1 parameter, below the 3.520 threshold corruption level, the relationship is negative. That is, social transfers affect income inequality in the opposite direction, and an increase in transfers reduces inequality. The sign of the coefficients corresponding to the parameters B2 and B3 is positive. At these levels of corruption, the relationship is the same, and social transfers increase income inequality. In summary, the inequality-reducing effect of transfers disappears as the threshold goes away from the first threshold level of corruption (3.520) or as corruption increases.

Table 5. Estimation results of corruption threshold on income inequality of social transfer's nexus

Threshold Value Estimation		
First Threshold Parameter	3.520	√ 0.000
95% Confidence Interval	[3.516 and 3.523]	
Double Threshold Parameter	3.577	√ 0.000
95% Confidence Interval	[3.575 and 3.589]	
Regime Coefficients for Single and Double Corruption Thresholds *(the impact of social transfers on income inequality)*		
β_1 ($\lambda \leq 3.520$)	-0.007** (0.003)	√ 0.018
β_2 ($3.520 \leq \lambda > 3.577$)	0.012*** (0.003)	√ 0.000
β_3 ($3.577 >$)	0.046*** (0.004)	√ 0.000
Control Variables		
GDP	0.203*** (0.033)	√ 0.000
TAX	-0.121*** (0.023)	√ 0.000
INV	0.055*** (0.012)	√ 0.000
EXP	0.090*** (0.027)	√ 0.001
UNE	0.050*** (0.005)	√ 0.000
Number of observations	399	
R-squared	0.003 [0.000 and 0.711]	

Note*:* ***, **, * denotes significance level of 1, 5, 10%, respectively. √ indicates that the relationship is significant. Values in brackets represent standard deviations, and values before brackets represent coefficients.

Source: Author's calculations using panel fixed-effect threshold regression results

The findings are similar to the study conducted by d'Agostino *et al*. (2020) which denominated heterogeneous effects of corruption in the social transfers-income inequality. This study, on the other hand, contributes to the literature by defining the corruption threshold for the relationship and proving that the relationship differs above and below this threshold and is not linear. In the Appendix (Table 6) (*GINI_MKT*) the results of the robustness check are also included, and the results show parallelism. It will be insufficient to interpret the findings only as to the nonlinearity of the relationship or the differentiation of its direction. This result indicates that social transfers below the threshold corruption value for the 19 CEE countries provide a (relatively) fair distribution among income earners and/or income groups. The purchasing power of households or individuals can be positively affected by transfers in case of low or no corruption. The (fair) distribution of income between individuals/income groups or the transfer of income to each other through consumption or social transfers by individuals with increased purchasing power may play a role in reducing income inequality. Before the Eastern Bloc collapsed, the political, economic, and social power that lasted for a long time and gathered in the hands of a certain ruling class, may affect the fight against corruption in the transition process of these countries differently. The ruling class in these countries has dominated all social and economic mechanisms for a long time. It should not be expected in terms of these 19 CEE countries that the reactions to corruption are in a homogeneous structure with countries with low corruption rates. In other words, the fact that the ruling class has the power to affect all economic decision-making preferences may cause fiscal policy tools such as spending and taxes to be used in arbitrary and corrupt activities and even wasted.

Considering that the CEE countries do not have homogeneous corruption indexes, it is deliberated that the corruption levels of the countries are also noteworthy. The negative relationship between social transfers and income inequality below the threshold corruption level, and the positive relationship above this value confirm the requirement for policymakers to attach different importance to low and high corruption values for the countries. For instance, Persson and Tabellini (2008) state that politicians may aggrandize redistribution expenditure in case of a high rate of corruption. This brings about in a country political corruption. Similarly, corruption can undermine the income distribution recovery effect of social transfers. Dincer and Gunalp (2012) argue that the burden of corruption is mostly reflected in low incomes, and social expenditures are less effective in reducing income inequality when the level of corruption is high. Corruption causes weak tax administration, tax evasion, and tax exemptions in favor of high-income groups (Gupta *et al*., 2002). This reduces the progressiveness of the tax system, negatively affecting the spread of the tax base, and leads to increased income inequality. In addition, corruption can hinder the success of social transfer programs for the truly needy (Goni *et al*., 2011). The positive relationship between unemployment and income inequality can be explained by the fact that individuals who become impoverished as a result of income inequality are more willing to participate in the labor force. The positive relationship of economic growth, investment, expenditure, and unemployment variables with income inequality and the negative relationship of tax revenues with income inequality are findings that need to be evaluated concerning many channels such as technology transfer, the level of wages, the taxation system, export-import balance, the quality and quantity of production factors, whether the workforce is qualified or not, the productivity of labor, the labor or capital-intensive production structure of the economy, and the concentration in the agriculture or industry sector. Considering the old Eastern Bloc and the transition economy structure of the countries subject to the analysis, it is obvious that these channels will affect the relationship in different aspects. Although the findings are compatible with the previous literature, it may also be notable to investigate these issues in terms of future studies.

Conclusions and recommendation

Corruption is a very comprehensive phenomenon and it is not just an economic factor that affects macroeconomic indicators such as economic growth. A threshold on corruption for the period 1999-2019 and 19 CEE countries and the impact of social transfers on income inequality confirm this allegation. The analysis findings display that there are two significant thresholds for the selected period. Below the first threshold (at a lower corruption rate), social transfers improve income inequality while above the first and second thresholds, the relationship is in the same direction, that is, a high corruption eliminates the ameliorating effect of social transfers on inequality.

Corruption, which can be considered a public bad in public finance terms, negatively affects public expenditures and public revenues, including the financing of social expenditures that target low incomes and downsize the available resources for them. Corruption, which disrupts the functioning of the tax administration, harms the efficiency of the tax base and the progressive tax system by prioritizing tax evasion, exemptions, and exceptions in favor of high-income earners. As a result, it reduces the capacity of decision-makers to provide a fair distribution of wealth and income from the high-income to the low-income. It may also adversely affect the redistribution potential of social programs by reducing the expected goal of success from social transfers. Corruption and rent-seeking activities negatively impress the motivation of policymakers. It can also endamage the allocation of public resources by directing public spending towards more profitable projects and activities. Corruption can also reduce the potential impact of social welfare programs on inequality and poverty reduction.

Besides, this paper contributes to the literature as follows: i) It estimated the effect of social transfers on income inequality in 19 CEE countries. ii) The threshold level of corruption has been accounted for the nexus. iii) The equalizing effect of social transfers is determined below the first threshold. iv) It is concluded that significant nonlinear results are diversified, conditional on the threshold levels (below and above two thresholds) of corruption. Further studies may re-examine the relationship based on governance and consider other socioeconomic channels regarding corruption. Moreover, estimations realized with dynamic panel threshold regression specific to other country samples may improve the contribution to the research field.

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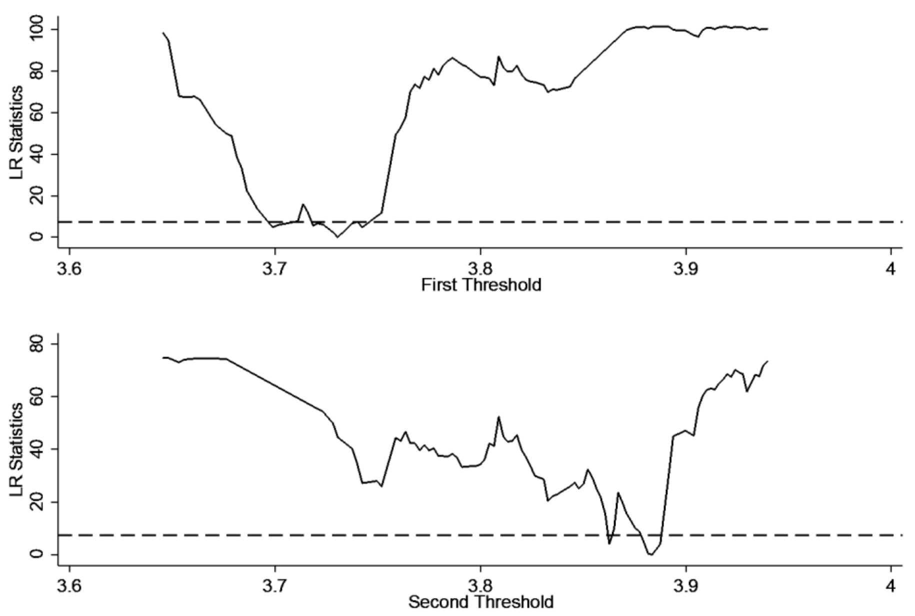
Appendix

Table 6. Threshold effects test results for first and double thresholds (robustness check with *GINI_MKT*)

Threshold value	*F* statistics	*p* value	Critical values		
			10%	5%	1%
3.698	82.092	√ 0.002*	48.862	54.847	71.215
3.883	85.520	√ 0.003*	48.707	58.709	77.765

Note: * shows the bootstrap (300) iterative probability distribution. √ indicates that the relationship is significant.
Source: Author's calculations using panel fixed-effect threshold regression results

Figure 2. LR maximum likelihood statistics for first and double thresholds (robustness check with *GINI_MKT*)



Source: Author's representation using Stata 14.2

Table 6. Estimation results of corruption threshold on income inequality of social transfers nexus (robustness check with *GINI_MKT*)

Threshold Value Estimation		
First Threshold Parameter	3.698	√ 0.002
%95 Confidence Interval	[3.688 and 3.701]	
Double Threshold Parameter	3.883	√ 0.003
%95 Confidence Interval	[3.879 and 3.887]	
***Regime Coefficients for Single and Double Corruption Thresholds** (the impact of social transfers on income inequality)*		
β_1 ($\lambda \leq 3.698$)	-0.025*** (0.003)	√ 0.000
β_2 ($3.698 \leq \lambda > 3.883$)	0.006** (0.002)	√ 0.012
β_3 ($3.883 > \lambda$)	0.008*** (0.002)	√ 0.002
Control Variables		
GDP	0.135*** (0.028)	√ 0.000
TAX	-0.037** (0.018)	√ 0.042
INV	0.004*** (0.010)	√ 0.000
EXP	0.041** (0.017)	√ 0.018
UNE	0.030*** (0.004)	√ 0.000
Number of observations	399	
R-squared	0.097 [0.062 and 0.731]	

Note: ***, **, * denotes significance level of 1, 5, 10%, respectively. √ indicates that the relationship is significant. Values in brackets represent standard deviations, values before brackets represent coefficients.
Source: Author's calculations using panel fixed-effect threshold regression results