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Review

The nonlinear dynamic effect of government expenditure on income inequality: The case of macroprudential policy switching

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Abstract: A panel data analysis of nonlinear government expenditure and income inequality dynamics in a macroprudential policy regime was conducted on a panel of 15 emerging countries from 1985–2019, where there had been a non-prudential regime from 1985–1999 and a prudential regime from 2000–2019. The paper explored the validity of the nonlinearity between government expenditure and income inequality in the macroprudential policy regime as well as the threshold level at which excessive spending reduces income inequality using the Bayesian spatial lag panel smooth transition regression (BSPSTR) and fix effect models. The BSPSTR model was adopted due to its ability to address the problems of heterogeneity, endogeneity, and cross-section correlation in a nonlinear framework. Moreover, as the transition variable often varies across time and space, the effect of the independent variables can also be time- and space-varying. The results reveal evidence of a nonlinear effect between government spending and income inequality, where the minimum level of government spending is found to be 29.89 percent of GDP, above which expenditure reduces inequality in emerging countries. The findings confirmed an inverted U-shaped relationship. The focal policy recommendation is that fiscal policy decisions that will reinforce the need for more emphasis on education and public expenditure on education and health, as important tools for improving income inequality, are crucial for these economies. Caution is needed when introducing macroprudential policies, especially at a low level of government expenditure.

Keywords: BSLPSTR; government expenditure; income inequality; macroprudential policy; nonlinearity

1. Introduction

Inequality has been a long-standing problem in the world for more than a century. Both economists and politicians have debated this issue in light of its impact on society, connecting it to various macroeconomic indicators. In the literature, income inequality has been linked to a number of macroeconomic variables, such as lack of economic growth (Zungu et al., 2022), lack of financial development (Zungu et al., 2022), murder, and crime (Zungu and Mtshengu, 2023). However, no studies in the literature have investigated the impact of government expenditure on income inequality, apart from the study documented by Sidek (2021) in a panel of 122 countries, with 91 and 31 countries categorized as emerging and advanced countries, respectively. Their findings suggest that, in general, government expenditure does reduce income inequality, which is a goal to be pursued since such inequality raises concern in everyone that it might lead to various negative factors in society and even in the economy. Factors such as high violent crime rates, socio-political instability, social unrest, financial exclusion, and institutional distrust can deter growth (Stiglitz, 2013; Breunig and Majeed, 2020). The current study embraces the definition of fiscal policy, which involves government spending, taxation, and deficits and aims to reduce income

inequality. The current study adopts government spending as a fiscal stance to respond to economic downturns. The mechanism underpinning expansionary fiscal policy is that it raises output, creates jobs, promotes economic and social development, and contributes to income distribution (Blanchard et al., 2010).

The current study aim to investigate the interaction of macroprudential policy switching on government expenditure and income inequality in emerging markets. Government expenditure has a significant impact on income inequality. It can provide social safety nets like welfare programs and healthcare, benefiting lower-income individuals. Additionally, spending on education and infrastructure can promote equal opportunities and human capital development, narrowing income gaps. However, high levels of government expenditure can strain public finances, leading to increased taxation or borrowing, which can disproportionately burden certain income groups and exacerbate inequality. The interaction between macroprudential policies and government expenditure on income inequality is shaped by various channels. First, macroprudential policies can influence the effectiveness of government expenditure by affecting the distributional consequences of fiscal policies. For example, restricting credit availability for low-income individuals may hinder the full achievement of its intended goals. Second, macroprudential policies can influence the macroeconomic environment in which government expenditure occurs, contributing to financial stability and reducing the likelihood of economic downturns. Third, macroprudential policies can influence the funding sources of government expenditure, promoting financial stability and reducing financial institution vulnerability, allowing governments to access more stable and lower-cost financing (Zinman, 2010; Acharya et al., 2020; Konstantinou et al., 2021) Macroprudential policy regimes and government expenditure are intertwined factors that impact income inequality. Understanding these interactions can help policymakers design more effective and targeted policies that promote financial stability and equal income distribution.

Even the existing studies on the relationship between fiscal policy (government expenditure) and income inequality have shown contradictory findings, with some studies suggesting an unfavorable relationship (Muinelo-Gallo and Roca-Sagalés, 2013) and others finding it to be income distribution (Lee et al., 2007). Whereas some find the nonlinearity (Sidek, 2021), others, such as the study by Boro (2000), learn from the inconclusiveness, while others document the mixed finding on the subject matter (Shahbaz, 2010). When examining the relationship between government expenditure and income inequality, the disagreement may result from different model specifications, data sets, estimating methods, or the level of economic development of the countries under investigation.

Figure 1 shows that most countries, except Chile, India, and Indonesia, experienced high inequality when considering the 35 Gini index as an arbitrarily threshold. All of these countries incurred government spending of over 10%, except for the Philippines and Argentina.

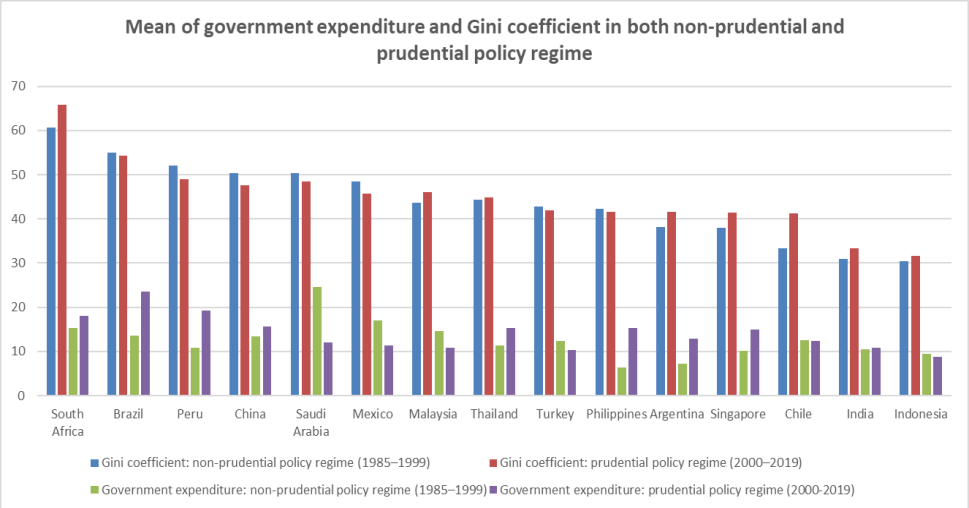


Figure 1. Graphic analysis of the trend of economic growth and fiscal variables, 1985–2019 (source: Author's calculations based on SWIID data (Solt, 2020)).

This data is based on both non-macroprudential and macroprudential policy regimes from 1985–2019. The data reveals that income inequality has worsened in some countries during the prudential policy regime, while some countries have seen slight improvement. For example, Chile's income inequality was above the 40 Gini index during the prudential policy regime, indicating an increasing trend in income inequality and government expenditure compared to the non-prudential policy regime. This perception suggests that these policies have contributed to the current high levels of inequality and government expenditure.

This study builds on Sidek's (2021) study, which adopted the dynamic panel threshold model. The study uses Gini coefficients to capture income inequality and categorizes government expenditure into health, development, education, and military. However, the impact of government expenditures on addressing inequality is underexplored. The study aims to expand the existing debate on the impact of government spending on income inequality in 15 emerging markets (see Appendix for the list of countries) in four ways. Firstly, it adds a twist by introducing a distinction between a non-prudential and prudential policy regime, referring to the periods 1985–1999 and 2000–2019, respectively, and further comparing this to the period of non-macroprudential policy to find out how these policies triggered the impact of government spending on inequality. We all know that countries execute fiscal and monetary policy simultaneously for different purposes, which then trigger the potential impact of government expenditure on income inequality. Secondly, given objective one, the study seeks to expand definition by exploring the impact of macroprudential monetary policy instruments, such as capital-related and borrower-related instruments, on distributional policy conditions during the 2007 financial crisis. To be concise, the intention is to look at how macroprudential policies implemented during the financial crisis triggered the distributional policy conditions in these countries. The literature on macroprudential inequality suggests that these policies indirectly or directly influence inequality, a finding not captured in previous studies. The study also suggests that as countries transition from a non-prudential to a prudential policy regime, the relationship between these two variables may change. The research aims to expand the

definition of monetary policy during the crisis. Thirdly, to find the possibility of non-linearity between government expenditure and income inequality and further the threshold as which excessive government expenditure reduces income inequality. Fourthly, to the best of our knowledge, no studies have attempted to use the Bayesian spatial lag panel smooth transition regression (BSLPSTR) model to estimate the threshold effect of the government expenditure-income inequality nexus. Therefore, the author believes this analysis will enhance Sidek's (2021) argument and provide further insight after controlling for spatial correlation and heterogeneity problems in the data. The Bayesian method will play a crucial role in obtaining accuracy. The chosen model is suitable for this study and the adopted countries due to its smooth transition and spatial econometric benefits and its ability to handle panel data with various problems like heterogeneity, endogeneity, and cross-section correlation. The Bayesian approach has the benefit of incorporating both priori and posteriori information, which leads to improvements in estimation reliability and precision. The researchers believe that the model, the countries being investigated, and the factors included in the model will add to the growing body of knowledge.

The rest of the paper is organized as follows: Section 2 provides a brief assessment of the linked literature, while section 3 summarizes the study model. Section 4 discusses the results of the BSLPSTR and FE models. Section 5 contains the conclusion, as well as notes and policy implications.

2. Review of literature

2.1. Theoretical framework

A brief summary of the pertinent theoretical literature on this topic is provided in this section. The Kuznets's curve hypothesis will be applied as a theoretical foundation for the nonlinearity, as the current study intends to investigate the possible nonlinearity between government spending and income inequality and further connect it to the distributional relationship. The research will then examine the idea of power resources and conduct an additional evaluation of the channels for monetary policy.

Kuznet's curve theory suggests that income inequality rises and falls as a country develops, resulting in an inverted U-shaped curve. As a country industrializes, people migrate from rural to urban areas for better jobs, widening the rural-urban income gap. The income gap is predicted to reduce progressively after a certain level of average income is achieved through industrialization processes and trickle-down effects, possibly due to delayed government expenditure redistribution. However, redistribution is harmful to economic progress in industrialized countries. According to the power resource hypothesis, the redistribution process has two sources or channels: the influence of left-leaning political parties and trade unions. The political-institutional setup is another name for the left-leaning political parties. Utilizing the political-institutional framework is part of this strategy. Nepotism, crony capitalism, and social and political instability may all be products of inequality.

In economies with high rates of proliferating inequality, the upper class may engage in rent-seeking activities or have a say in redistribution decisions, which would stifle long-term prosperity (Alesina and Perotti, 1996; Glaeser et al., 2003; Iversen and Soskice, 2001; Herwartz and Theilen, 2017). As a result, redistribution tends to be

fairer in electoral outcomes where MPs from both the left and right cast proportional votes (Iversen and Soskice, 2001; Persson, 2007; Beramendi and Cusack, 2009). If these left-wing parties succeed and implement their redistributive program, more spending on redistribution may reduce socioeconomic disparity. This reinforces the notion that the election procedures have an influence on the policies chosen by the ruling party (Persson and Tabellini, 2004). Election processes influence incumbent party policy decisions, but these are long-term initiatives that require fiscal reforms and reconsolidation in the short term (Persson and Tabellini, 2004). Trade unions motivate the working class to seek more redistribution to eliminate income and socioeconomic inequalities. Fiscal policy instruments, such as government spending on education at all levels, support the accumulation of physical and human capital, allowing those with proper education and training to obtain suitable capital and accumulate greater prosperity. Both approaches are essential for achieving a more equitable society.

Finally, macroprudential measures were put into effect to address financial stability difficulties by minimizing credit risk and credit cycles. When the macroprudential policy restricts credit availability, resulting in more expensive loans, the distribution of income and wealth is most affected. Asset-based (loan-to-value) ratios, capital-based measures (bank capital requirements), and collateral restrictions are often suggested policy options. As a result of the various metrics, a variety of effects on inequality may be discovered. Most studies investigating the influence of macroprudential policies on income and wealth inequality, utilize LTV ratios as an essential tool of macroprudential policy. The fundamental rationale behind choosing LTV is that it affects loan access, which directly affects income and wealth. There has been insufficient theoretical research in this field, and the influence of macroprudential tools is frequently modeled through the housing market.

2.2. Empirical literature

2.2.1. Government expenditure and income inequality

Following an evaluation of the literature, it became obvious that the correlation between government spending and income inequality has received sparse attention to date, and several economic concerns remain unresolved to this day. Given the scarcity of empirical research on non-linearity and the inconsistency of the available results in the existing literature, a fresh investigation using modern data and economic models is required.

Going back as far as the study by Lee et al. (2007), they argue, inter alia, that government expenditure has no direct effect on income inequality and that it depends on globalization-related variables such as trade and investment. Two years after Lee et al. (2007), a contradiction emerged from the study by Subarna et al. (2009), who investigated the effectiveness of fiscal policies in influencing the nature of the income distribution of the economy in transition economies. Their findings revealed that there is a significant relationship between income distribution and fiscal policy. Niehues (2020) furthered the argument by investigating social spending generosity and income inequality using the System GMM estimator. The findings suggest that more social spending effectively reduces inequality levels. The result is robust with respect to the

instrument count and different data restrictions. Looking at the structure of benefits, unemployment benefits and public pensions, in particular, are responsible for the inequality-reducing impact. The results thus reported by Niehues (2020) supported the argument made by Subarna et al. (2009), but contradicted the results documented by Lee et al. (2007). The results reported by Doerrenberg and Peichl (2014) were in line with those studies that found government spending to be a useful tool in combating income inequality. Doerrenberg and Peichl (2014) found that government social expenditure reduced income inequality in OECD countries from 1981–2005 but did not find significant results with other data sources. Sancez and Perez-Corral (2018) found a negative correlation between public social expenditure and income inequality in 28 European Union member states from 2005–2014. Martin and Martin (2018) identified a causal relationship between income inequality and government size in 30 European countries from 2004–2015 using instrumental variable estimation techniques. They found that accounting for the possible endogeneity of government size increased the magnitude of the estimated negative effects. Ulu (2018) found that education expenditures were positively related to income inequality in 21 OECD economies, but this happened when social spending was funded to reduce income inequality. These studies highlight the limitations of the data on income inequality provided by different databases.

When looking at the recent literature, Doumbia and Kinda (2019) argue that reallocating government expenditure to defence expenditure for the sake of social protection and infrastructure reduces income inequality. This further supports those studies that documented government expenditure as a useful tool in reducing income inequality. Biyase et al. (2022) examined the relationship between military spending and income inequality using the ARDL bounds testing approach to cointegration. Their findings uncovered a long-term association between military expenditure and income inequality in South Africa. The results showed that an increase in military expenditure resulted in a high rate of inequality in the country. Dustmann et al. (2022) focused empirically on housing expenditure in establishing the impact of government expenditure on income inequality in Germany. The income share of housing expenditure rose disproportionally for the bottom income quintile and fell for the top quintile. Factors contributing to these trends include declining relative costs of homeownership versus renting, changes in household structure, declining real incomes for low-income households, and residential mobility towards larger cities. Younger cohorts spend more on housing and save less than older cohorts did at the same age, which will affect future wealth accumulation, particularly at the bottom of the income distribution. Eita et al. (2022) in South Africa followed a different approach to non-linearity using the non-linear autoregressive distributed lag model in South Africa over the period 1980–2017 to investigate the short-run and long-run asymmetric effects of military spending on South Africa's income inequality. We find evidence to suggest an asymmetric association between military spending and income inequality. Income inequality responds differently to the positive and negative shocks of military spending in the long and short run.

2.2.2. The impact of macroprudential policies on income inequality

This study explores the relationship between macroprudential policies and

income inequality, a topic that has not yet been explored in the literature. The research found that increased adoption of these policies can enhance income inequality. The study identified five relevant empirical studies that evaluated the effectiveness of macroprudential policies on inequality based on a review of existing literature (Zinman, 2010; Tzur-Ilan, 2016; Frost and van Stralen, 2018; etc.). The findings suggest that macroprudential policies can have a significant impact on income inequality.

Zinman (2010) investigated wealth and income inequality, as well as the consumption consequences of macroprudential policies in the state of Oregon in the United States. The empirical data suggest that macroprudential policies redistribute wealth and reduce income inequality. Following borrower-related logic, Tzur-Ilan (2016) used a macro-analytical approach to examine how the loan-to-value (LTV) cap affected Israel's The scientific data indicates that consumer credit is a kind of higher-rate, unsecured debt. The economy's general susceptibility to recession and unemployment is increased by borrowers. The results lend credence to the idea that LTV macroprudential instruments will increase the vulnerability of less wealthy borrowers.

Moreover, Frost and van Stralen (2018) and Acharya et al. (2020) conducted a study on the impact of macroprudential policy using borrower-related measures on net and market Gini coefficients. Frost and van Stralen (2018) adopted 69 countries from 2000–2013. They found that stricter regulations, such as increased reserve requirements and LTV limitations, increase income inequality. Acharya et al. (2020) also found that borrower-related macroprudential tools increase wealth disparity by making the wealthy group wealthier, supporting the hypothesis of redistributive impacts of macroprudential policies.

Carpantier et al. (2018) used the data from 12 European Union countries to model the impact of macroprudential policy on income inequality. They found that limitations on LVT ratios can lower wealth inequality by making mortgages harder for households to obtain, leading to lower indebtedness. Konstantinou et al. (2021) found that macroprudential policies can exacerbate income disparity, depending on financial growth and globalization. Low levels of openness and financial development can aggravate inequality. However, some macroprudential policies can decrease income inequality if adopting countries have a sufficiently open and developed financial sector.

3. Methodology

3.1. Data used

The study investigates the non-linear dynamics of government expenditure on income inequality in a macroprudential-policy regime (2000–2019) and a non-macroprudential-policy regime (1985–1999). The period for the investigation is split, using Cerutti data (Cerutti et al., 2017) variables of the dummy type for the use of multiple macroprudential instruments and data availability from 2000 to the present. Variables recognized in the literature as explaining the relationship between government spending and income inequality were taken into account. The study employed the Gini coefficient sourced from SWIID (Solt, 2020) and WIIDv2c as proxies for income inequality (INE), and three types of government expenditure were

utilized to capture government expenditure. The study controls for macroprudential policy instruments such as capital instruments and borrower-related instruments, where the borrower-related instrument (BRI) is calculated by summing the loan-to-value ratio with the debt-to-income ratio. The capital-related instrument (CRI) will be adopted as a proxy for the general counter-cyclical capital buffer requirement. A simulation of the counter-cyclical capital buffer designed in the Basel III package could influence bank lending, as the buffer could help reduce credit growth during booms and attenuate the credit contraction once it is released (Acharya et al., 2020). This could have a direct or indirect impact on income inequality. The study supports the production argument by including the investment-captured gross fixed capital formation (% of GDP) (INV), as increased capital investment requires some goods to be produced that are not immediately consumed but instead are used to produce other goods, such as capital goods that lead to an increase in economic growth, which will then decrease inequality. Given the Wagner's Law Hypothesis's emphasis on the argument, it follows that increased redistribution is a byproduct of economic growth (Choi, 2019). The log of GDP per capita at constant prices (GDPCP) was utilized to control for heterogeneity between countries, level of development, and the size of an economy. House prices (HP) were adopted for two reasons: (1) existing literature, such as Filandri and Olagnero (2014), among others, has studied the impact of house prices on income inequality, documenting that increasing house prices resulted in a housing affordability crisis in various countries; and (2) at the same time, house prices increased homeowners' wealth. The study used population growth as a stand-in for human capital, taking into account the important research outlined in the study by Barro and Lee (2013), as the human capital and dependence ratio would represent the level of social benefits and pensions required in a country. To capture global market integration, the study used openness (OPEN), which was computed as the sum of imports and exports divided by GDP. In order to fully understand the influence, the analysis additionally takes institutional variables (IV) into account, as suggested by Sidek (2021), such as the balance between the right and left parties as determined by Armingeon et al. (2018) using the Comparative Political Dataset 1960–2016. Ultimately, the research takes into account government spending that is conditional on external debt (Gov_Exp_ext. debt), which captures debt-financed government expenditure (DFGE). The data for all variables—all save the Gini coefficient—came from the World Bank (WDI, 2023).

3.2. Spatial lag panel smooth transition regression (SLPSTR) model

The spatial lag panel smooth transition regression (SLPSTR) model was applied in order to investigate the possibility of non-linearity between government spending and income inequality. The present system is predicated on the notion that government policy acts as the principal policy for income distribution, eliminating income inequality and poverty. Existing research, such as the study by Zungu and Greyling (2022), focuses on the relationship between government spending and economic growth using the panel smooth transition regression (PSTR) model. However, in accordance with the recommendation given by Sidek (2021), the purpose of this study is to investigate the potential of non-linearity between the two variables using the

BSLPSTR model developed in this work, where y_{it} is income inequality which is a dependent variable which is a vector, *k*-dimensional and q_{it} is government spending which has been constructed as follows:

$$y_{it} = \rho(WK)_{it} + \beta_0 X'_{it} + \beta_1 X'_{it} g(q_{it},; \gamma, c) + \beta_2 z_{it} + \mu_i + \varepsilon_{it} \quad i = 1, \dots, N, \text{and } t = 1, \dots, T \tag{1}$$

where in Equation (1), $i = 1, \dots, N,$ while $t = 1, \dots, T$ in this case *N* and *T* simply indicate cross section and the time dimensions of the panel, correspondingly. *W* is the *NT* × *NT* spatial weight matrix. The vector of time varying exogenous variables government expenditure on health (GEH), economic development (GDPCP), house prices (HP), investment (INV), openness (OPEN), population growth (PG), and debt-financed government expenditure (DFGE) are denoted by x_{it}. Henceforth the x_{it} regressors are presumed to be exogenous-variable. While z_{it} control for macroprudential policy instrument which are capital-related instrument (CRI) and borrower-related instrument (BRI) for this study. Whereas μ_i and ε_{it} signifies the fixed individual effect and denotes the errors term correspondingly. The threshold variable q_{it} determines the continuous transition function $g(q_{it}; \gamma, c)$, which is normalized to have a range of zero to one. Regression coefficients β_0 and $\beta_0 + \beta_1$ are related to these two extreme values. The effective regression coefficients $g(q_{it}; \gamma, c)$ for individual i at time t are, more generally, determined by the value of the transition variable q_{it}. By employing the logistic specification, the study follows Teräsvirta (1994, 1998), Jansen and Teräsvirta (1996), and Teräsvirta et al. (2010):

$$\varepsilon_{\text{it}} \sim N(O, \sigma^2), g(q_{it}; \gamma, c) = \left(1 + \exp\left(-\gamma \prod_{j=1}^{m} (q_{it} - cj)\right)\right)^{-1} \tag{2}$$

The dimensional vector of parameters location is m which is denoted by $c = (c_1, \dots, c_m)$' in equation, while the smoothness of the transitions is controlled by the slope parameter denoted by γ. The imposed restriction for the identification practice is given by $\gamma > 0$ and $c_1 < \cdots < c_m$. In reality, $m = 1$ or $m = 2$ are often regarded as levels that permit the most frequent sorts of parameter modification. According to the model, the high and low q_{it} values for $m = 1$ are associated to both extreme regimes $\beta_0 + \beta_0 + \beta_1$, and the monotonic transition of the coefficients from as q_{it} increases is fixed around c_1. As soon as the pointer function $(q_{it}; \gamma, c)$ is created, $I[q_{it} > c_1]$, as shown by $I[A] = 1$ when *A* occurs and zero otherwise, is created.

3.3. Building a Bayesian estimation for the PSTR model

Before providing a specific estimation procedure, the author first constructs the Bayesian analytical framework for model Equation (2). The prior distribution of parameter ρ is usually assumed to be a uniform distribution with probability density function $\pi(\rho) = \frac{1}{\lambda_{\max}^{-1} - \lambda_{\min}^{-1}}$, where $\lambda_{\max}$, $\lambda_{\min}$ are the maximum and minimum eigenvalues of a spatial weight matrix W, respectively, indicating the $\rho \sim (\lambda_{\min}^{-1}, \lambda_{\max}^{-1})$. The prior distribution of parameter Θ is set to be multiple normal distribution $N(\mu_0, \Sigma_0)$, where μ_0 and Σ_0 are the prior expectation and covariance.

4. Empirical analysis, data analysis and interpretation of results

4.1. Data analysis

For this study, before executing the BSLPSTR model, the researcher did a great deal of different data inspections as background to understanding the study's data well. Therefore, for data inspections, the author employed the data descriptive, correlation matrix result, cointegration, and cross-sectional independence tests. The author then used machine learning to further find the most appropriate measure of government expenditure among the three variables adopted in this study.

The descriptive statistics for the different variables are shown in **Table 1**. The study did not test for the panel unit root, given the nature of the study. According to descriptive statistics, the average total government expenditure, government expenditure on education and government expenditure on health in these countries are around 13.35, 4.19 and 3.19 percent, respectively, while income inequality is around 43.88 percent. All of the variables are found to be negatively skewed, as reported.

Table 1. Descriptive statistics and the panel stationery test (source: Author's illustration based on data SWIID (Solt, 2020; WDI, 2023)).

Variables	Mean	Std.d	Min	Max	SKW	KUR	JB-ST	JB-P
INE	43.88	7.51	30.50	63.50	−0.68	3.68	26.64	0.00
TGE	13.35	4.15	6.53	30.00	−1.18	2.31	82.86	0.00
GED	4.91	3.29	1.07	19.51	−2.76	2.43	94.68	0.00
GEH	3.91	6.02	0.54	26.76	−3.29	2.32	11.18	0.00
BRI	0.67	0.78	0.00	2.44	−0.65	3.96	31.57	0.00
CRI	0.05	0.15	0.00	1.00	−5.96	3.59	14.23	0.00
GDPCP	8.83	0.89	6.63	10.91	−0.09	3.01	0.43	0.80
HP	85.48	25.56	0.10	162.6	−0.39	3.21	7.61	0.02
OPEN	13.78	4.14	6.53	30.00	−1.12	3.99	67.95	0.00
DFGE	26.33	1.25	24.32	29.17	−0.45	2.19	16.58	0.00

Kurtosis values for all variables, on the other hand, were within the required range of 2 to 3 percent. Except for GDPCP, all of these variables reject the alternative normality hypothesis by demonstrating that they are not normally distributed. Because the probability values of the Jarque-Bera tests for these variables, with the exception of GDPCP, are less than 10 percent, the implications may be due to country-specific factors supporting rejection of the alternative hypothesis of normal distribution

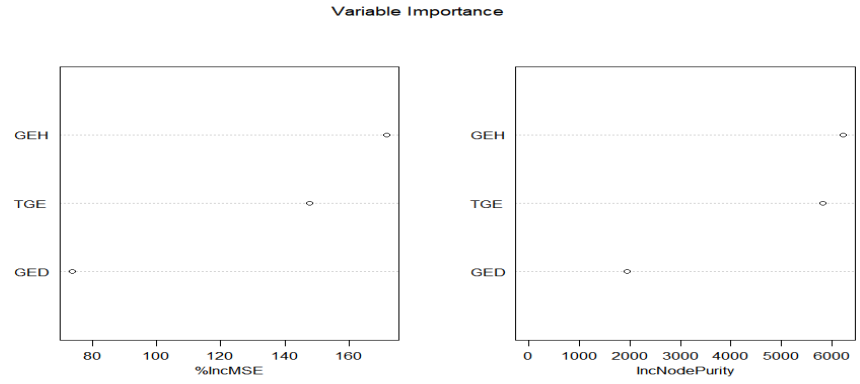
The researcher found it significant to test for cointegration and cross-sectional independence to validate the variables utilized in this study. Therefore, **Table 2** presents the pedroni cointegration (Pesaran, 2004) and cross-sectional dependency (CD) test statistics (Friedman, 1937), as well as data from Frees (1995).

Table 2. Cointegration and cross-sectional independence tests (source: Author's illustration based on data SWIID (Solt, 2020; WDI, 2023)).

Pedroni tests for cointegration			**Tests for cross-sectional independence**		
Augmented dickey—fuller *t*	8.17	Pr = 0.05	Friedman's test	161.02	Pr = 0.00
Modified Phillips—perron *t*	2.11	Pr = 0.00	Frees' test	0.82	Pr = 0.01
Phillips perron *t*	6.20	Pr = 0.001	Pesaran's test	13.22	Pr = 0.02

All three cross-sectional reliance tests, as well as the Pedroni cointegration test, significantly reject the null hypothesis of no cointegration and cross-sectional reliance on variables. It is quite challenging to investigate the interplay of fiscal policy, particularly government spending, with macroeconomic variables. This is due to the fact that government expenditures may be recorded using multiple metrics, such as total government spending, education expenditure, health expenditure, and military expenditure. As a result, the current study's issue is to select the proper measure of government spending.

To address this issue, the study used machine learning developed by Breiman (2001), utilizing the random forest (RF) to identify the variable that contributes the most to income inequality among all metrics of government expenditure mentioned above. The author believes that this will help both researchers and policymakers to comprehend the most important contributor of income inequality between these metrics of government spending in these countries. The number of trees beneath the RF in the machine learning program was set to 5000 in order to more precisely anticipate the RF. According to the RF, all the government expenditure factors altogether explain 70.88 percent of the variation in income inequality. **Figure 2** depicts the results of the RF. The first chart on the left, **Figure 2a**, shows mean decrease accuracy ("percentincMSE" test), which measures how well the model performs without each variable. The second graph, identified by **Figure 2b** on the right, exhibits the nodes (IncNodePurity), which seek to quantify how pure the nodes are at the conclusion of the tree without each variable.



(a) **(b)**

Figure 2. Results of the variable Importance. **(a)** shows permutation-based variable importance; **(b)** displays inequality importance-for an RF binary classification model (source: Author's illustration based on data SWIID (Solt, 2020; WDI, 2022)).

Note: Variable importance is reported in **Figure 2**. For an RF binary classification model created for the BCW dataset, **Figure 2a** displays permutation-based variable significance, while the **Figure 2b** presents inequality importance.

Under-the-mean government expenditure on health (GEH) reduces accuracy; looking at its value, percentIncMSE, which is 171.75 percent, GEH is the largest contribution leading towards accurately predicting income inequality, followed by total government expenditures (TGE) with 147.85 percent. Finally, the government's education expenditure (GED) is shown to be the third contributor, with a mean reduction accuracy of 73.60 percent. It appears that these results will aid researchers in understanding which variables must be utilized when working on similar topics. This will further assist policymakers in comprehending the appropriate variable among all the government spending metrics that contribute to either positive or negative income in these countries. Consequently, while dealing with redistribution strategies, it is critical to first identify the relevant pathways that cause inequality. As a result, as advised by machine learning, the current study will employ government spending on health (GEH) as the primary variable to capture government expenditure and total government expenditure (TGE) as the robustness variable. The logical explanation behind government spending on health is important for addressing income inequality because it helps address unequal access to healthcare services. By investing in healthcare, governments can ensure that affordable and quality medical care reaches all citizens, regardless of their income levels. This reduces the gaps in health outcomes between the rich and the poor, contributing to a more equitable society. Adequate healthcare also allows people to remain productive, reducing the negative impact of illness on their income and overall well-being. Additionally, government spending on health can alleviate financial burdens on low-income households by providing public health insurance programs or subsidizing healthcare costs. Ultimately, investing in health promotes fairer opportunities and reduces income disparities. The proposed wild-cluster bootstrap (WCB) and wild-bootstrap (WB), which are robustness checks, were used to determine the order m of the transition function after inspecting the data. The BSLPSTR was then run as described in the methodological section, going through the three stages of the model, which involve choosing the appropriate transition variable among all the candidate variables, testing the linearity, and determining the order in which to choose the transition function using the LM-type test. In the sections that follow, each step's results are presented separately.

4.2. The results of the transition variable, homogeneity test and selection of the order *m* of the BSLPSTR

González et al. (2017) considered all variables to be candidates when selecting the suitable transition variable. The current study follows exactly what has been done in their study. The pre-estimation of the BSLPSTR was tested and the results are reported in **Table 3**. As is known, the model contained three pre-estimated tests; the first one being the appropriate transition in the panel regression of government expenditure and income inequality. The results of the appropriate transition, as reported in the first column of **Table 3**, show government expenditure on health is the best suitable choice of transition variable for the study, as both the p values of the LM_X test (6.983×10^{-50}) and LM_F test (4.887×10^{-20}) are smaller compared to other included variables as candidates. The second pre-test is the homogeneity test. The homogeneity results are reported in the second column of **Table 3**, which signifies that

there indeed is a non-linearity between government expenditure and income inequality in emerging countries, as both the p-values of the LM_F (2.331×10^{-15}) and LM_X (0.00) reject the null hypothesis of linearity. The WCB (0.00) and WB (0.00), as their *p*-value signifying that non-linearity remains between the two variables, further supports this.

Table 3. Results of selecting the transition variable, linearity and selection order m (source: Author's illustration based on data SWIID (Solt, 2020; WDI, 2023)).

	Transition Variable GEH				**Results of the H_0**	**Selecting order m**		
		$m = 1$	$m = 2$	$m = 3$	$m = 1$	$m = 1; H_{01}^*$	$m = 1; H_{02}^*$	$m = 1; H_{03}^*$
LM_F	F-statistic	4.99	4.20	2.17	30.12	2.91	16.34	7.23
	p-values	4.887×10^{-20}	0.0002	0.00020	4.112×10^{-25}	0.9019	3.002×10^{-2}	2.912×10^{-2}
LM_χ	F-statistic	20.87	13.77	12.04	12.5	10.30	82.63	35.99
	p-values	6.983×10^{-50}	3.129×10^{-25}	2.062×10^{-6}	0.00023	0.7879	2.488×10^{-4}	6.102×10^{-4}
WB	*p*-values	-	-	-	0.00	-	-	-
WCB	*p*-values	-	-	-	0.00	-	-	-

Note: Dependent variable is the INE. All variables GEH, CRI, BIR, GDPCP, HP, INV, OPEN, PG and DFGE were included as candidates for identifying the appropriate transition variable using the LM-type test.

The third pre-test is that of selecting the sequence for choosing order *m* in the model. The results reject H_0 in both the LM_χ and LM_F when $m = 1$ signifying that, when GEH was selected as best transition variable, the model had one regime, which separated the low level from the high level of government spending. Following Teräsvirta (1994), the researcher evaluated the results of the LM_χ and LM_F using the WCB and WB.

4.3. Model evaluation and the estimated threshold of the BSLPSTR model

The findings of the model evaluation and the projected BSLPSTR threshold are presented in this section. Using two sets of misspecification tests—parameter consistency (PC) and no remaining non-linearity (NRN)—the author first assessed the validity of selecting order $m = 1$ as the optimum transition variable for the current model, following Eitrheim and Teräsvirta (1996) (González et al., 2017). The PC, NRN, and estimated threshold results are shown in **Table 4**. The first portion of **Table 4** presents the PC findings. The parameters are constant, according to the *p*-values of the LM_F and LM_χ. The second section of **Table 4** shows the results of the WB and WCB tests, which take into account heteroskedasticity and potential within-cluster reliance, showing that the model estimate with a single transition is satisfactory. The estimated threshold findings for the baseline model and robustness model are finally shown in **Table 4** last section.

Table 4. Results of the evaluation test and the estimated threshold (source: Author's illustration based on data SWIID (Solt, 2020; WDI, 2023)).

	Government expenditure on health (GEH)		**Government expenditure on education (GED)**		**Total government expenditure (TGE)**	
	Macroprudential policy regime	**Non-macroprudential policy regime**	**Macroprudential policy regime**	**Non-macroprudential policy regime**	**Macroprudential policy regime**	**Non-macroprudential policy regime**
	Baseline model I and II		**Robustness model III and IV**		**Robustness model V and VI**	
	Parameter constancy test					
LM_F	4.123 (5.989 × 10^{-4})	4.123 (5.989 × 10^{-4})	9.197 (2.800 × 10^{-4})	6.987 (0.0000)	5.765 (3.545 × 10^{-8})	6.094 (0.0000)
LM_χ	90.898 (7.231 × 10^{-10})	90.898 (7.231 × 10^{-10})	100.765 (18.982 × 10^{-15})	70.273 (0.000)	130.545 (20.234 × 10^{-10})	80.323 (0.000)
	No Remaining non-linearity					
WB	1 (p-value)	1 (p-value)	1 (p-value)	1 (p-value)	1 (p-value)	1 (p-value)
WCB	1 (p-value)	1 (p-value)	1 (p-value)	1 (p-value)	1 (p-value)	1 (p-value)
	Results of the estimated threshold for all models					
c	29.89*** (4.29)	20.01*** (6.01)	27.54*** (6.01)	19.48*** (6.01)	27.88*** (4.00)	21.98*** (6.01)
γ	15.12*** (3.30)	17.01*** (5.92)	11.21*** (5.92)	13.09*** (5.92)	17.90*** (2.30)	15.30*** (3.60)

The Gini coefficient is the dependent variable, whereas government spending is the independent variable. (***) signify the level of significance of 1%, respectively.

The results show that the estimated fiscal policy threshold for government expenditure is 29.89 percent of GDP. As a result, under the first regime, when the level of government spending is below the threshold of 29.89 percent of GDP, fiscal policy involvement through the government tends to favor some people in the economy, increasing income inequality. This illustrates that, under a low regime of spending and high inequality, growing inequality may reduce the professional opportunities available to society's most disadvantaged groups, diminishing social mobility and the economy's development potential. More fiscal intervention through government spending above the threshold, however, translates to more income distribution, contributing to investment in physical capital (machinery, factories, and roadways), and further enabling human skills, education, and training, which then reduces income inequality. **Figure 3** illustrates countries that are below and above the anticipated threshold in terms of government spending. **Figure 3** shows that all of the selected emerging markets appear to be below the estimated threshold (29.89 percent of GDP) in this study.

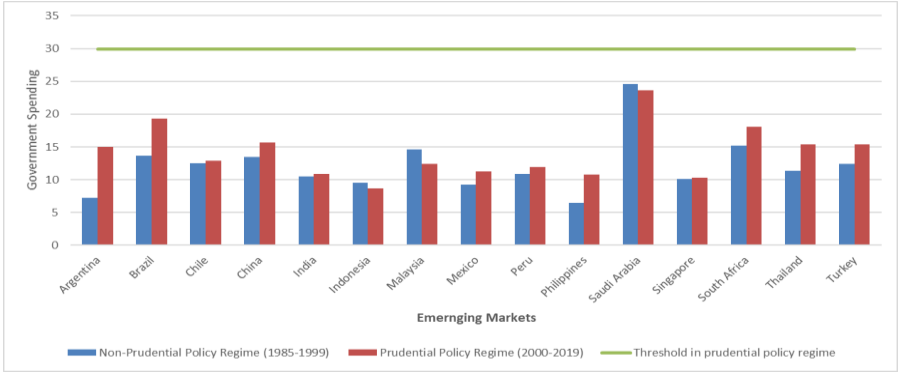


Figure 3. The mean of government expenditure and the estimated thresholds (source: Author's calculation based on SWIID data (Solt, 2020; WDI, 2023)).

The findings challenge fiscal policy decisions and reinforce the need for more emphasis on education and public expenditures on education and health as important tools for improving income equity by reducing income equality. However, a warning is paused for policymakers as high public debt has several implications, including increased interest payments, lower economic growth, fiscal instability, and intergenerational inequalities. This may result in a crowding-out effect and increase government debt in emerging countries; therefore, governments need to carefully manage their borrowing and spending policies to ensure sustainable debt levels and mitigate the negative consequences on the economy and society.

4.4. Empirical results of the BSLPSTR, and FE models

Table 5 presents the findings of the BSLPSTR model, a lag of a two-regime model, and the FE model, supporting the BSLPSTR. The results show that government spending directly affects income inequality in macroprudential policy regimes, with a positive and substantial effect. The results also validate the homogeneity test, showing nonlinear effects of government expenditure on income inequality, as shown in **Table 3**. The coefficient of the nonlinear component, $\beta_{0j} + \beta_{1j}$, is negative and significant. While in non-macroprudential policy regimes, the direct effect of government spending on income inequality seems to differ as it is positive and significant.

Table 5. Government expenditure and income inequality; BSLPSTR and FE model, emerging markets (source: Author's illustration based on SWIID data (Solt, 2020; WDI, 2023)).

Variables	**Model I: Government expenditure Inequality: Prudential policy regime (2000–2019)**			**Model II: Government expenditure Inequality: Non-prudential policy regime (1985–1999)**		
	BSLPSTR		**FE**	**BSLPSTR**		**FE**
	LR $\beta_{0j} \times 100$	**HR $(\beta_{0j} + \beta_{1j}) \times 100$**		**LR $\beta_{0j} \times 100$**	**HR $(\beta_{0j} + \beta_{1j}) \times 100$**	
Government expenditure on health (GEH)	5.87** (2.00)	−3.89*** (0.22)	2.90** (1.01)	−2.32** (0.99)	0.89** (0.21)	−1.14** (0.45)
Government expenditure on health GEH^2			−1.13** (0.22)			1.30** (0.20)
Capital-related instrument (CRI)	1.20** (0.39)	−2.20 (3.90)	2.22** (0.56)			
Borrower-related instrument (BRI)	2.00*** (0.38)	2.20** (0.99)	2.89** (0.99)			
Economic development (GDPCP)	−3.43** (1.11)	2.55*** (0.20)	2.00** (0.44)	−1.20** (0.30)	2.38** (0.89)	−1.30 (0.89)
House prices (HP)	1.89*** (0.20)	2.62** (0.87)	2.45** (0.77)	1.88** (0.55)	2.05** (0.67)	2.88** (0.99)
Investment (INV)	−3.47** (1.68)	−2.56** (0.90)	−2.00*** (1.00)	1.23** (0.40)	2.70 (2.43)	1.22** (0.23)
Openness (OPEN)	−2.07** (0.39)	−1.11** (0.38)	−0.39 (0.29)	1.70** (0.70)	−1.70** (0.38)	−0.91** (0.23)
population growth (PG)	−2.55** (0.49)	1.89** (0.89)	2.22** (0.99)	−0.95*** (0.09)	1.98** (0.60)	2.90** (0.56)
Debt-financed government expenditure (DFGE)	3.00** (0.89)	1.15** (0.28)	2.22*** (0.89)	1.43** (0.27)	0.89** (0.39)	1.91** (0.87)
Dum	Yes	No	No	Yes	No	No

Note: The INE is a dependent variable. The figures in brackets indicate the standard errors, which take into account error dependence within individual nations and are calculated using the cluster-robust and heteroskedasticity-consistent covariance estimators. The levels of significance (***), (**), and (*) correspond to 1%, 5%, and 10%, respectively. LR and HR stand for lower regime and high regime, respectively, and the *p*-values are the *p*-values.

This finding suggests that while the government expenditure variable ranges from low to high, changes in income inequality with respect to it vary from $\beta_{0j} + \beta_{1j}$. The corresponding endogenous location parameter c is where these severe regimes change. In contrast to the other policy regimes, the macroprudential policy regime results in an inverted U-shape, indicating that the implementation of macroprudential regulations has an impact on the link between government expenditure and income inequality.

Even when the magnitude impact of prudential and non-macroprudential policy regimes are compared, it is clear that government spending has a massive positive impact on income inequality in a macroprudential policy regime compared to its impact in a lower regime, under a non-macroprudential policy regime. The results reveal that even in the high regime of government spending, the magnitude impact of government expenditure still dominates as it has a massive impact on the common man in the macroprudential policy regime compared to the non-macroprudential policy regime. In our model of interest, the magnitudes below the threshold are 5.85 and 2.32, respectively, whereas they are 3.89 and 0.89 above the threshold. The results reveal that accounting for policies implemented by the monetary authority during financial crises is important to understand the relationship between government spending and income inequality, especially in countries that adopt macroprudential policies. This is because the results confirm that adopting these policies triggered the relationship by exacerbating income inequality. This result is consistent with prior empirical research that found a significant, both beneficial and detrimental, impact of government expenditure on income inequality, such as that conducted by Sidek (2021) and Eita et al. (2022). The findings by Sidek (2021) were reached in a panel of 122 countries, both advanced and emerging economies, over the period 1980–2018, while the study by Eita et al. (2022) was conducted in South Africa over the period 1980–2017, using the ARDL model. When the positive and negative findings in these studies are combined, they indicate evidence of an inverted U-shape relationship between government spending and income inequality, which confirms the findings of Sidek (2021). The logic behind the inverted U-shape in these countries could be that a low level of government expenditure generates inequality in a regime of low expenditure, whereas an increase in government spending above a certain level is beneficial in reducing inequality among the people in a regime of high expenditure. This might be because policy execution in the two regimes (high and low) favors various demographics. For instance, during a period of recession, intensive government involvement through spending might encourage consumption by consumers in high regime, but in the low regime, it may benefit investors or certain groups of people, which will exacerbate income inequality.

The current research then assesses the impact of joint macroprudential policy measures on the current issue, including capital-related and borrower-related instruments. Countercyclical or time-varying capital needs, time-varying or dynamic provisioning, and profit distribution constraints are all examples of capital-related tools. The results show that the capital-related instrument (CRI) has a statistically negative effect in the regime of low government spending but a statistically negligible negative effect in the domain of high government expenditure on income inequality.

A borrower-related instrument (BRI) has a statistically favorable effect on income inequality in both the low and high regimes of governmental spending. The study reveals that increasing loan-to-debt and debt-to-income ratios leads to an increase in income inequality. This is due to the introduction of borrower-related macroprudential instruments, which can directly redistribute wealth by excluding low-income households from the mortgage market. This may lead to increased inequality under adverse macroeconomic conditions. The findings reported by Frost and van Stralen (2018) and Carpantier et al. (2018) are supported by the findings of this study. In the low regime of government expenditure, the economic development log of GDP per capita at constant prices (GDPCP) statistically has a negative impact on income inequality; in the high regime, it statistically has a positive impact on this expenditure. Similar conclusions have been reported by a large number of researchers in the literature, including the studies by Ivaschenko (2002) on the transitional economies of 24 Eastern European (EE) nations and the former Soviet Union (FSU) and Zungu et al. (2021) on the 13 SADC countries, among others. The research cited by Zungu et al. (2022) provides an explanation of the reasoning behind these conclusions.

In both regimes, house prices (HP) have a positive and statistically significant influence on income inequality. These findings show that rising house prices laid the path for a housing affordability issue, while also increasing homeowners' wealth. This supports the findings reported by Filandri and Olagnero (2014). In both non-prudential and macroprudential policy regimes, investment (INV) has a negative and statistically significant influence on income inequality in both the low and high regimes of government expenditure. The findings are in line with the results documented by Figini and Görg (2011) for 100 developing and developed countries. Theoretically, the rationale for the detrimental effect of investment on income inequality is that increased capital investment causes some goods to be produced that are not immediately consumed, but are instead utilized to produce other goods as capital goods, leading to an increase in economic growth and, consequently, a decrease in inequality.

Trade openness (OPEN) has a statistically detrimental impact on income inequality in both the non-prudential and macroprudential policy regimes, whereas it promotes income inequality in the high regime. The notion is that trade in emerging economies benefits the relative income shares of the extremely poor, but not necessarily all of the poor. In most industrialized economies, trade increased income inequality, with outliers driving the effect. The findings are in line with the results documented by Dorn et al. (2023) for a panel of 139 countries and Al-Jaidi and Warrad (2022) for a panel of 10 developing countries. In their study Dorn et al. (2023) allude that trade openness tends to disproportionately benefit the relative income shares of the very poor, but not necessarily all the poor, in emerging and developing economies. In both policy regimes, population growth (PG) has a negative influence on income inequality in the lower regime and the high regime. Even the fixed effect supports the two variables' negative association. The results confirmed the finding documented by Ayodele et al. (2017) for South Africa. The findings simply demonstrate that when population growth is modest it is related to lower inequality. The rationale was that populous nations are less unequal because their populace benefits from opportunities when there is a newly elected government, where there is a foundation for revolution or insurgency against the governing class. Finally, debt-financed government

expenditure (DFGE) has a positive impact on income inequality in both regimes and in both prudential and non-macroprudential policy regimes across all estimation tools. The findings support the empirical studies documented by Wilkista and Seher (2022).

Table 6. Government expenditure and income inequality: Robustness checks model (source: Author's calculation results based on SWIID data (Solt, 2020; WDI, 2023)).

Government expenditure on education as proxy of government expenditure (GED)		
Pre-tax income held by the top 10% (GiniW10), as dependent variable		
	Model III: Government-Inequality (2000–2019)	**Model IV: Government-Inequality (1985–1999)**
BSLPSTR	6.10GED*** + 2.11CRI** + 1.33BIR* − 2.34GDPCP** + 0.90HP** − 1.18INV*** − 2.90OPEN** − 1.20PG** + 0.80DFGE** − 1.10IV** [17.01.50γ **, 27.54C***] − 4.00GED*** − 1.02CRI** + 3.33BIR* + 3.04GDPCP** + 2.20HP** − 2.19INV*** − 0.90OPEN** + 2.32PG** + 1.140DFGE** − 1.20IV**	−2.20GED** + 1.43GDPCP** + 2.00HP** − 1.11INV** − 1.32OPEN** + 1.88PG** + 2.11DFGE** − 1.18IV** [13.09γ**, 19.48C***] 1.78GED*** + 0.89GDPCP** + 0.90HP** − 2.32INV** − 0.89OPEN** + 2.29PG** + 1.00DFGE** − 2.01IV**
	Model V: Government-inequality (2000–2019)	**Model VI: Government-inequality (1985–1999)**
FE	= 1.76GED** − 0.99GED^2** + 2.00BOR** − 2.11CC** + 1.94GE** + 2.29HP*** − 1.70INV*** + 0.29INFL**	−5.87GED*** + 4.99GED^2* − 1.08GE* + 0.90HP** − 1.20INV** + 1.10INFL**
	Hansen: p-value 0.598 R^2: 0.68	Hansen: p-value 0.709 R^2: 0.61

The ***/**/* denotes the level of significance at 1%, 5% and 10%, respectively.

4.5. Sensitivity analysis and robustness checks

The findings show that the influence of government spending on income inequality is non-linear in emerging economies, regardless of the variable used to measure income inequality and government spending. Following the results of the ML using the RF to determine the variable that contributes the most to income inequality across all measures of government spending (as shown in **Figure 2**), the study used government expenditure on education (GED) and total government expenditure as a proxy for government expenditure for robustness motives. The researcher further estimated another model where a different measure of income inequality was adopted to capture income inequality. To measure income inequality, the researcher used the Gini coefficient (GiniW10) and Gini coefficient (GiniW1) from WIIDv2c. The data from WIIDv2c, on the other hand, had a frequent problem in that it had missing values. As a result, data manipulation utilizing the data interpolation technique was used to fill in the gaps in Eviews 9. For the sensitivity analysis, the researcher added institutional variables (IV) to the model as additional control variables. This was done to see if the results given in the baseline approach were sensitive to the variables used as control variables. **Table 6** summarizes the robustness and sensitivity analysis results for the BSLPSTR and FE model in both prudential and non-prudential policy regimes. The results for robustness and sensitivity analysis using Total Government expenditure on education as proxy for government expenditure (GED) and Gini coefficient (GiniW1) are reported in the Appendix **Tables A2** and **A3** respectively. The variables are defined in the same way as in the baseline methodology. Again, all of the models' testing methods were followed.

The estimated results revealed that the proxy utilized for inequality and government expenditures, as well as the control variables added to the model did not affect the non-linear effects of government spending on income inequality. Indeed, the

results were remarkably comparable to those obtained initially in the baseline model.

5. Conclusion and policy recommendations

The impact of government spending on income inequality has received little research, as scholarly research tends to focus on the impact of economic growth on income inequality (Zungu et al., 2022); economic development and income inequality (Zungu et al., 2022); financial development and income inequality (Zungu et al., 2022); and other macroeconomic variables. Moreover, there are studies that suggest the non-linearity between government expenditure and income inequality (Zahirah and Sidek, 2021). The foremost question on both economists' and politicians' minds is whether fiscal policy through government expenditure is structured well enough to reduce income inequality. This paper aims to contribute in four ways to the existing debate on this subject matter. Firstly, the study adopted machine learning to identify the variable that contributes most to income inequality among all metrics of government expenditure (total government spending, education expenditure, health expenditure, and military expenditure). According to the machine learning results, government spending on health is the most variable contributor to inequality, followed by government expenditure on education, and lastly, total government expenditure, and all government expenditure components explain 70.88% of the variation in income inequality. The results support the idea that the government should look closer at the issues around health and education when trying to combat income inequality, as spending on health and education is found to contribute more to income inequality. These would be further guided by the results drawn from **Tables A2** and **A3** in the Appendix.

This study explores the relationship between macroprudential policies and income inequality, a topic previously explored in the literature. The research found that increased adoption of these policies can enhance income inequality. The study identified five relevant empirical publications that evaluated the effectiveness of macroprudential policies on inequality based on a review of existing literature. The findings suggest that macroprudential policies can have a significant impact on income inequality. Considering that the results varied when comparing the macroprudential policy regime with the non-macroprudential policy regime, it was further discovered that macroprudential regulations trigger the relationship between government spending and income inequality.

Thirdly, this study aims to find the possibility of non-linearity between the two variables in the case of emerging economies, as it was first discovered by Sidek (2021), and further examine above which level of government expenditure inequality is reduced in the adopted countries. The estimation results strongly confirm the existence of non-linearities in the correlation between government spending and income inequality in emerging countries, where the results of the study illustrate that at a low level of government spending, below the threshold of 29.89 percent of GDP, government spending encourages income inequality as only a minority of people in the economy benefit from these government interventions during the regime. While in the high regime, the government becomes adequate for income redistribution among the population as it reduces inequality. The study confirmed the Kuznets inverted U-

shape during the macroprudential policy regime, while in the non-macroprudential policy regime it confirmed the U-shape relationship. Fourthly, model-wise, the study aims to use a model that will be able to account for several problems, such as data issues, controlling for spatial issues in the data using the Bayesian spatial lag panel smooth transition regression BSLPSTR, and further adopting the fixed effect for model robustness. These findings were discovered to be insensitive to the technique and control variables utilized since the study verified the same results using fixed-effect methods even when institutional variables in the system were included.

From a policy perspective, our findings may have various policy implications. Firstly, the presence of a government expenditure threshold challenges the effectiveness of distribution policies in titling down inequality. Secondly, as advised by machine learning on the variable that contributes the most to income inequality among all metrics of government expenditure, policymakers, especially on the fiscal policy instance, need to increase government spending on health and education as these two metrics seem to have a strong impact on income redistribution, especially above the threshold. Thirdly, the findings may assist policymakers in emerging economies in developing policies that may encourage accommodating house prices, which would be crucial for these countries. Furthermore, measures aimed at encouraging trade in these economies are critical, as the study found trade to reduce income inequality under both regimes of government spending.

Conflict of interest: The authors declare no conflict of interest.

References

Acharya, V., Bergant, K., Crosignani, M., et al. (2020). The Anatomy of the Transmission of Macroprudential Policies. IMF Working Papers, 20(58). https://doi.org/10.5089/9781513545158.001

Alam, Z., Alter, A., Eiseman, J., et al. (2019). Digging Deeper—Evidence on the Effects of Macroprudential Policies from a New Database. IMF Working Papers, 19(66), 1. https://doi.org/10.5089/9781498302708.001

Alesina, A., & Perotti, R. (1996). Income distribution, political instability, and investment, European Economic Review. 40, 1203-1228.

Al-Jaidi, N. F., Warrad., T. M. A. (2022). Trade openness and income inequality: Empirical evidence from selected developing countries. Jerash for Research and Studies, 22, 1777-1994.

Armingeon, K., Wenger, V., Wiedemeier, F., et al. (2018). Codebook: Comparative political dataset 1960–2016.

Ayodele, O., Frederick, M., Yemesrach, W, Wilmot, R. (2017). Income inequality and population growth in Africa. Income Inequality Trends in Sub-Saharan Africa: Divergence, Determinants and Consequences. Available online: https://ssrn.com/abstract=3101800 (accessed on 17 June 2022).

Barro, R. J. (2000). Inequality and Growth in a Panel of Countries. Journal of Economic Growth. 5, 5-32.

Barro, R. J., & Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. Journal of Development Economics, 104, 184–198. https://doi.org/10.1016/j.jdeveco.2012.10.001

Beramendi, P., & Cusack, T. R. (2009). Diverse Disparities. Political Research Quarterly, 62(2), 257–275. https://doi.org/10.1177/1065912908319220

Berg, A., Ostry, J. D., Tsangarides, C. G., et al. (2018). Redistribution, inequality, and growth: new evidence. Journal of Economic Growth, 23(3), 259–305. https://doi.org/10.1007/s10887-017-9150-2

Biyase, M., Eita, H., Udimal, T., & Zwane, T. (2022). Military spending and inequality in South Africa: An ARDL bounds testing approach to Cointegration. EDWRG Working Paper Number 05-2022.

Blanchard, O., Dell'Ariccia, G., & Mauro, P. (2010). Rethinking Macroeconomic Policy. Rethinking Macroeconomic Policy, 10(03), 2–19. https://doi.org/10.5089/9781455224982.004.a001

Breiman, L. (2001). Random forests. Machine Learning. 45, 5-32. https://doi.org/10.1023/A:1010933404324

Breunig, R., & Majeed, O. (2020). Inequality, poverty and economic growth. International Economics, 161, 83–99. https://doi.org/10.1016/j.inteco.2019.11.005

Carpantier, J. F., Olivera, J., & Van Kerm, P. (2018). Macroprudential policy and household wealth inequality. Journal of International Money and Finance, 85, 262–277. https://doi.org/10.1016/j.jimonfin.2017.11.009

Cerutti, E., Claessens, S., & Laeven, L. (2017). The use and effectiveness of macroprudential policies: New evidence. Journal of Financial Stability, 28, 203–224. https://doi.org/10.1016/j.jfs.2015.10.004

Checchi, D., Ichino, A., & Rustichini, A. (1999). More equal but less mobile? Education financing and intergenerational mobility in Italy and in the US. Journal of Public Economics. 74, 351-393.

Choi, G. (2019). Revisiting the redistribution hypothesis with perceived inequality and redistributive preferences. European Journal of Political Economy, 58, 220–244. https://doi.org/10.1016/j.ejpoleco.2018.12.004

Cingano, F. (2014). Trends in Income Inequality and its Impact on Economic Growth. (2014). OECD Social, Employment and Migration Working Papers. https://doi.org/10.1787/5jxrjncwxv6j-en

Doerrenberg, P., & Peichl, A. (2014). The impact of redistributive policies on inequality in OECD countries. Applied Economics, 46(17), 2066–2086. https://doi.org/10.1080/00036846.2014.892202

Dorn, F., Fuest, C., & Potrafke, N. (2021). Trade openness and income inequality: New empirical evidence. Economic Inquiry, 60(1), 202–223. Portico. https://doi.org/10.1111/ecin.13018

Doumbia, D., & Kinda, T. (2019). Reallocating public spending to reduce income inequality: Can it work? International Monetary Fund.

Dustmann, C., Fitzenberger, B., & Zimmermann, M. (2021). Housing Expenditure and Income Inequality. The Economic Journal, 132(645), 1709–1736. https://doi.org/10.1093/ej/ueab097

Eita, H., Biyase, M., Udimal, T., & Zwane, T. (2022). Does military spending affect inequality in South Africa? A revisit. EDWRG Working Paper Number 03-2022E.

Eitrheim, Ø., Teräsvirta, T. (1996). Testing the adequacy of smooth transition autoregressive models. Journal of Economics. 74, 59-75. https://doi.org/10.1016/0304-4076 (95) 01751-8

Figini, P., & Go¨rg, H. (2011). Does Foreign Direct Investment Affect Wage Inequality? An Empirical Investigation. The World Economy, 34(9), 1455–1475. https://doi.org/10.1111/j.1467-9701.2011.01397.x

Filandri, M., & Olagnero, M. (2014). Housing Inequality and Social Class in Europe. Housing Studies, 29(7), 977–993. https://doi.org/10.1080/02673037.2014.925096

Frees, E. (1995). Assessing cross-sectional correlation in panel data. Journal of Econometrics. 69, 393-414. https://doi.org/10.1016/0304-4076(94)01658-M

Friedman, M. (1937). The Use of Ranks to Avoid the Assumption of Normality Implicit in the Analysis of Variance. Journal of the American Statistical Association, 32(200), 675–701. https://doi.org/10.1080/01621459.1937.10503522

Frost, J., & van Stralen, R. (2018). Macroprudential policy and income inequality. Journal of International Money and Finance, 85, 278–290. https://doi.org/10.1016/j.jimonfin.2017.11.010

Glaeser, E., Scheinkman, J., & Shleifer, A. (2003). The injustice of inequality. Journal of Monetary Economics. 50, 199-222.

González, A., Teräsvirta, T., Dijk, D., & Yang, Y. (2017). Panel smooth transition regression models. Available online: https://EconPapers.repec.org/RePEc:hhs:hastef:0604 (accessed on 23 March 2022).

Granger, C. W. J., & Terasvirta, T. (1993). Modelling non-linear economic relationships. Available online: https://ideas.repec.org/b/oxp/obooks/9780198773207.html (accessed on 20 May 2022).

Herwartz, H., & Theilen, B. (2017). Ideology and redistribution through public spending. European Journal of Political Economy, 46, 74–90. https://doi.org/10.1016/j.ejpoleco.2016.11.002

Ivaschenko, O. (2002). Growth and Inequality: Evidence from Transitional Economies. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.322740

Iversen, T., & Soskice, D. (2001). An Asset Theory of Social Policy Preferences. American Political Science Review, 95(4), 875–893. https://doi.org/10.1017/s0003055400400079

Konstantinou, P., Rizos, A., & Stratopoulou, A. (2021). Macroprudential policies and income inequality in former transition economies. Economic Change and Restructuring, 55(2), 1005–1062. https://doi.org/10.1007/s10644-021-09333-9

Lee, C. S., Nielsen, F., & Alderson, A. S. (2007). Income Inequality, Global Economy and the State. Social Forces, 86(1), 77–111. https://doi.org/10.1353/sof.2007.0102

Martin, G., & Martin, K. (2018). Income inequality and the size of government: a causal analysis. IZA institute of Labor

Economics discussion paper series. IZA DP No. 12015

Muinelo-Gallo, L., & Roca-Sagalés, O. (2013). Joint determinants of fiscal policy, income inequality and economic growth. Economic Modelling, 30, 814–824. https://doi.org/10.1016/j.econmod.2012.11.009

Niehues, J. (2010). Social Spending Generosity and Income Inequality: A Dynamic Panel Approach. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1675689

Okun, A. M. (2015). Equality and efficiency: The big trade off Brookings Institution Press.

Persson, T. (2007). Electoral Rules and Government Spending in Parliamentary Democracies. Quarterly Journal of Political Science, 2(2), 155–188. https://doi.org/10.1561/100.00006019

Persson, T., & Tabellini, G. (2004). Constitutions and Economic Policy. Journal of Economic Perspectives, 18(1), 75–98. https://doi.org/10.1257/089533004773563449

Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.572504

Sancez, A., & Perez-Corral, A. L. (2018). Government Social Expenditure and Income Inequalities in The European Union. Review of Public Economics. 227, 33-156. https://doi.org/10.7866/HPE-RPE.18.4.5

Shahbaz, M. (2010). Income inequality-economic growth and non-linearity: a case of Pakistan. International Journal of Social Economics, 37(8), 613–636. https://doi.org/10.1108/03068291011060652

Sidek, N. Z. M. (2021). Do government expenditure reduce income inequality: evidence from developing and developed countries. Studies in Economics and Finance, 38(2), 447–503. https://doi.org/10.1108/sef-09-2020-0393

Solt, F. (2020). Measuring Income Inequality Across Countries and Over Time: The Standardized World Income Inequality Database. https://doi.org/10.31235/osf.io/mwnje

Stiglitz, J. (2013). Inequality is a choice. The New York Times, 13.

Subarna, K., Samanta, J., & Cerf, G. (2009). Income distribution and the effectiveness of fiscal policy: Evidence from some transitional economies. Journal of Economics and Business. XII: 1.

Teräsvirta, T., (1994). Specification, Estimation, and Evaluation of Smooth Transition Autoregressive Models. Journal of the American Statistical Association, 89(425), 208–218. https://doi.org/10.1080/01621459.1994.10476462

Tzur-Ilan, N. (2016). The effect of credit constraints on housing choices: The case of LTV limits. Available online: https://www.boi.org.il/he/NewsAndPublications/PressReleases/Documents/%D7%A0%D7%99%D7%A6%D7%9F%20%D7%A6%D7%95%D7%A8%20%D7%90%D7%99%D7%9C%D7%9F.pdf (accessed on 24 May 2021).

Ulu, M. I. (2018). The effect of government social spending on income inequality in OECD: A panel data analysis. International Journal of Economics Politics Humanities and Social Sciences, 1, 3.

Wilkista, L. O., Seher, G. T. (2022). Do public and internal debt cause income inequality? Evidence from Kenya. Journal of Economics, Finance and Administrative Science, 27(53), 124–138. https://doi.org/10.1108/jefas-05-2021-0049

World Development Indicators. (2023). World Bank, Washington, D.C. Available online: http://data.worldbank.org/data-catalog/world-development-indicators (accessed on 1 January 2023).

Zinman, J. (2010). Restricting consumer credit access: Household survey evidence on effects around the Oregon rate cap. Journal of Banking & Finance, 34(3), 546–556. https://doi.org/10.1016/j.jbankfin.2009.08.024

Zungu, L. T., Greyling, L., & Mbatha, N. (2022). Nonlinear Dynamics of the Development-Inequality Nexus in Emerging Countries: The Case of a Prudential Policy Regime. Economies, 10(5), 120. https://doi.org/10.3390/economies10050120

Zungu, L. T., & Greyling, L. (2022). Government size and economic growth in African emerging economies: does the BARS curve exist? International Journal of Social Economics, 49(3), 356–371. https://doi.org/10.1108/ijse-01-2021-0016

Zungu, L. T., Greyling, L., & Mbatha, N. (2021). Economic growth and income inequality: a non-linear econometrics analysis of the SADC region, 1990–2015. African Journal of Economic and Management Studies, 12(2), 285–301. https://doi.org/10.1108/ajems-09-2020-0465

Zungu, L. T., & Mtshengu, T. R. (2023). The Twin Impacts of Income Inequality and Unemployment on Murder Crime in African Emerging Economies: A Mixed Models Approach. Economies, 11(2), 58. https://doi.org/10.3390/economies11020058

Appendix

Table A1. List of 15 emerging countries adopted.

Argentina
Brazil
China
Chile
India
Indonesia
Malaysia
Mexico
Peru
Philippines
South Arabia
Singapore
South Africa
Thailand
Turkey

Table A2. Government total expenditure and income inequality: BSLPSTR and EF model (source: Author's calculation results based on SWIID data (Solt, 2020; WDI, 2023).

Total government expenditure on education as proxy for government expenditure (GED)		
Pre-tax income held by the top 10% (SWIID), as dependent variable		
	Model VII: Government-inequality (2000–2019)	**Model VIII: Government-inequality (1985–1999)**
BSLPSTR	−3.98GED*** + 2.00CRI** − 1.99BIR* + 3.21GDPCP** + 2.03HP**1.92INV** + 2.98OPEN** + 2.81PG** + 0.90DFGE** − 1.20IV** [17.90γ**, 27.88C**] 1.92GED*** + 1.99CRI** − 2.99BIR* + 2.00GDPCP** + 1.30HP** − 2.34INV** + 3.12OPEN** + 3.54PG** + 1.02DFGE** − 0.90IV**	4.20GED***2.00GDPCP** + 2.91HP** − 1.30INV** + 3.02OPEN** + 0.90PG** + 1.02DFGE** − 2.10IV** [17.90γ**, 21,88C***] 0.99GED*** + 1.45GDPCP** + 2.00HP** − 2.33INV** + 3.00OPEN** + 1.44PG** + 1.0DFGE** − 2.10IV**
	Model IX: Government-inequality (2000–2019)	**Model X: Government-inequality (1985–1999)**
FE	= 1.76ED** − 0.99ED^2** + 2.00BOR** − 2.11CC** + 1.94GE** + 2.29HP*** − 1.70INV*** + 0.29INFL** Hansen: p-value 0.598 R^2: 0.68	= 5.87ED*** + 4.99ED^2* − 1.08GE* + 0.90HP** − 1.20INV** + 1.10INFL** Hansen: p-value 0.709 R^2: 0.61

The ***/**/* denote the level of significance at 1%, 5% and 10%, respectively.

Table A3. Government expenditure on education and income inequality: BSLPSTR and EF model (source: Author's calculation results based on SWIID data (Solt, 2020; WDI, 2023)).

Government expenditure on health as proxy of government expenditure (GEH)		
Pre-tax income held by the top 1% (SWIID), as dependent variable		
	Model XI: Government-inequality (2000–2019)	**Model XII: Government-inequality (1985–1999)**
BSLPSTR	−3.98GEH*** + 2.00CRI** − 1.99BIR* + 3.21GDPCP** + 2.03HP** − 1.92INV** + 2.98OPEN** + 2.81PG** + 0.90DFGE** − 1.20IV**[16.20γ**, 25,10C***] 1.92GEH*** + 1.99CRI** − 2.99BIR* + 2.00GDPCP** + 1.30HP** − 2.34INV** + 3.12OPEN** + 3.54PG** + 1.02DFGE** − 0.90IV**	4.20GEH***2.00GDPCP** + 2.91HP** − 1.30INV** + 3.02OPEN** + 0.90PG** + 1.02DFGE** − 2.10IV** [19.00γ**, 23,09C***] 0.99GEH*** + 1.45GDPCP** + 2.00HP** − 2.33INV** + 3.00OPEN** + 1.44PG** + 1.0DFGE** − 2.10IV**
	Model XIII: Development inequality (2000–2019)	**Model XIV: Development inequality (1985–1999)**
FE	= 1.76GEH** − 0.99GEH^2** + 2.00BOR** − 2.11CC** + 1.94GE** + 2.29HP*** − 1.70INV*** + 0.29INFL** Hansen: p-value 0.598 R^2: 0.68	= 5.87GEH*** + 4.99GEH^2* − 1.08GE* + 0.90HP** − 1.20INV** + 1.10INFL** Hansen: p-value 0.709 R^2: 0.61

The ***/**/* denote the level of significance at 1%, 5% and 10%, respectively.