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Taxing Divides: Exploring the Nexus between Income Inequality, Economic Growth and Taxation

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ABSTRACT

This paper investigates the impact of income inequality and economic growth on tax revenues within the context of six saarc countries, using panel data from 1990 to 2021. By applying various econometric models, including pooled ordinary least squares (pols), fixed effects (fe), random effects (re), and pooled mean group (pmg), the study evaluates the relationship between tax-to-gdp ratios and key variables like gdp, income inequality (gini), economic freedom, and employment. Results from the random effects model indicate that income inequality negatively affects tax revenues, while gdp growth, economic freedom, and employment have positive and significant impacts. The pmg model further supports these findings, revealing long-term equilibrium relationships. This research contributes to understanding the economic determinants of tax buoyancy in developing countries, highlighting policy implications for balancing income redistribution and economic efficiency.

Introduction

In recent years, poverty, growth, and redistribution have received a lot of attention (Yellen 2014; Draghi 2016). One of the key components of economic progress is equality. People recognize inequality as negative regardless of their philosophy, culture, or religion (Dabla-Norris et al. 2015). Although research indicates that inequality can impede economic progress, it is also a factor in unstable countries. On the other hand, Okun (1975) presented the concept of a trade-off between social justice and economic efficiency in "Equity and Efficiency: The Big Tradeoff." Many social scientists contend that while taxes serve as a deterrent to society, income inequality may actually shoot economic growth. Money loses value as it moves from the rich to the poor, as Okun notes. One significant mechanism for social redistribution in a society is taxation.

Karagöz, K. (2013) Using time series data, one can identify the contributing factors to tax buoyancy in Turkey from 1970 to 2010. The study's findings indicate that the industrial and agricultural sectors' respective shares of Turkey's GDP have a significant impact on the country's revenues. The agricultural sector hurts GDP. According to the findings, Turkey's tax revenues are not significantly impacted by trade openness. Belinga et al. (2014), and Akram and Sahin (2015) estimated the stability of Turkey's tax system from January 2005 to June 2014. The analysis's findings indicate that while the Turkish tax system is less buoyant in the short run than it was during the study period, there is a positive correlation between these two variables over the long term. It follows that an increase in GDP will increase tax revenue.

Dudine and Jalles (2018) examine the short- and long-term tax buoyancy of 107 nations from 1980 to 2014. The results demonstrate that social security and individual income tax contribute significantly to total revenues in developing nations. The pooled Ordinary Least Squares (POLS) method is used. While the agricultural sector hurts tax collection, the service sector has a positive and significant impact. Increases in aid, grants, and foreign assistance harm the buoyancy of taxes, whereas monetary expansion positively

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impacted tax collection methods.

Income inequality is a phenomenon that can elaborated through a variety of public policies in this study Ilaboya, & Ohonba (2013) investigated the impact of direct versus indirect taxes on income inequality in Nigeria. As the tax ratio to GDP is small in Nigeria that is between 12-15 percent even then it is observed that their taxation system helps decrease income inequality. As they concluded that the tax ratio showed a declining trend in 90's thus results showed that taxes-to-GDP ratio negatively influence inequality. It is also found that the interaction term has a positive association between taxes-to-GDP ratio and GDP. Contrary to reality labor force participation was found effecting positively to income inequality which means with the participation of the labor force income inequalities are increasing.

Cooper et al. (2015) analyzed the role of tax policies and their effect on mitigating income inequalities. This paper concluded that tax reduces income inequalities substantially in all states. Whereas in the second analysis they calculated inequality estimates and tax policies. The findings quantified the positive impact of taxes on income inequality and on average, the impact of federal taxes on income inequality was large as compared to state taxes. Two-thirds of the contribution of increasing inequality was constituted by federal taxes and the remaining proportion by state taxes. Moreover, analyses also revealed that changes in the tax code were the main indicator of increasing state-level taxes. While, at the federal level, an increase in the taxation level was due to the widening of pre-tax wage distribution which was also interacting with the progressive taxation system.

Income inequality exists in a dynamic economy when heterogeneous agents face a progressive taxation system Sarte (1997). Both variables show a slow transformation as compared to other aggregate variables which show the effectiveness of tax policy as compared to altering aggregate variables. By following agents' asymmetric responses, fiscal policy effects were also examined. The effective tax system helps reduce income inequality; it is not acting as an effective agent. Empirically the relationship between progressive tax and its burden on different income groups is studied and concluded that in many countries when the tax burden is shifted over time this helps reduce inequality.

Turnovsky (2013) focused on capital accumulation measurement. He described it with the help of three structural categories. He found a positive association between capital accumulation and growth. A significant determinant of productivity growth was the degree of income inequality in society. Dipietro (2014) determined real labour productivity growth and income inequality association for 2001-10 by employing cross-country regression analysis and concluded that income inequality reduced productivity growth, while human capital and wage flexibility promoted productivity growth.

Wahiba and Weriemmi's (2014) determined that in Tunisia trade liberalization was an aggravating factor of income inequality. Human capital and FDI were the variables that contributed to the lessening of this problem. Further results indicated that inequality was inversely connected to economic growth but increases with a rise in economic growth and this effect appeared to be stronger after an increase in the process of opening exchange with other countries.

Nigar (2015) in her study tried to figure out the combined influence of institutional quality and inequality on growth in selected lower and lower-middle-income Asian countries. She concluded that institutional quality was positively correlated with economic growth, while the influence of inequality was suppressing economic growth. However, when an interactive term of income inequality and institutional quality was included then it was observed that certain minimum levels of equal opportunities are essential in a society otherwise the results are negative.

The Model and Description of Variables

Modelling is the way of finding the path of research objectives. It not only help in analysis the research objectives but also help in policy implications. In this research study, we will perform analytical as well as descriptive analysis. Applied techniques, Housman Test, FE model, RE model, and panel data analysis for the POLS. Subsequently, we will apply the Panel ARDL technique, which includes the Mean Group (MG), Pooled Mean Group (PGG), and Housman test, to determine which of those is the best MG of PMG. Essentially, we will attempt to determine the cross-sectional dependence test as well as the short- and long-term elasticities using these methods. The primary design of the thesis will be determined by applying Pesaran CSD to determine whether cross-sectional dependence exists among them. Using panel data from 1990 to 2021, analysis will be carried out by using STATA 15.

Pooled Ols Regression Analysis

Estimate the dynamic relationship among these variables. The POLS is defined as

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \cdots \ldots \ldots \ldots \ldots \ldots + U_n$$

The fitted values b_0, b_1,....., b_n estimate the parameters β_0, β_1, … … β_n of the population regression line. Finally, Ui denotes error term, while ε is the mean value of error terms.

$Yit = \beta 0 + \beta_1 xi1 + \beta 2xi2 + \cdots \ldots \ldots \ldots \ldots + \varepsilon i$

Breusch and Pagan Lm Test.

$y = \alpha + \beta_1 x_1 + \cdots \ldots \ldots \ldots + \beta_n x_n + u_t$

$var(u\not{x}) = \sigma 2$

$v\sim(u\not{x}) = \sigma 2 f(x)$

$= \sigma 2(\alpha 0 + \alpha 1x1 + \alpha 2x2 + \cdots \ldots \ldots \ldots \ldots + \alpha pxp)$

The LM test is used to decide whether RE is best or POLS is best for this estimate.

H_o: POLS Regression is best.

H_i: RE model is best.

The Fixed Effect (Fe) Model

Each unit has unique characteristics and can have an impact on the predictor variables. This in short can affaect people's feeling about a given issue or how a country's taxes or GDP may or may not be influenced. The FE model demonstrates that the time-invariant traits are particular to each person and should not be correlated with other traits of the same person. Since each entity is unique, the error term and constant for each should not be correlated with those of the other entities. The FE equation is:

$$Y_{it} = \beta 1 x_{it} + \alpha_i + U_{it} \qquad \text{----------4.1}$$

Where α_i (i=1….n) is the unknown intercept. The Y_{it} dependent variable where i = entity and t = time. xit represents the independent variables. $\beta 1$ is the coefficient uit is the error term.

Random Effect (Re) Model

It is assumed in the RE model that the variation across entities is not correlated with the independent variables: "The main difference between fixed and random effects is whether the unobserved individual effect contains elements that are correlated with the regressed in the model, not whether these effects are stochastic or not" (Greene, 2008, p.183). The specification is:

$$Y_{it} = \beta X_{it} + \alpha_i + u_{it} + \epsilon_{it}, \qquad \text{----------4.2}$$
$$t = 1, 2, 3 \ldots . , T$$

Where x_{it} contain observable variables that change across entities i but not time t & variables that change across entities i & time t. Time-invariant variables can serve as explanatory variables in the RE model because it assumes that the entity's error term is not correlated with the independent variable. In the RE model, we looked for those unique individual traits that might not have an impact on the independent variables. The issue with the RE model is that it occasionally results in bias from omitted variables in the model.

The Hausman Test Comparing the Fe and Re Models

Hausman test is used to decide among these models where the acceptance of H_o means random effects is better (Greene 2008, chapter 9). It is used to test whether the errors are correlated with the regressors. Consider a linear model:

$y = b_1 x + e$

Where y is the dependent variable and x is a vector of regressors, b is a vector of coefficients and e is the error term. The covariance between an efficient estimator and inefficient estimator is zero, according to Hausman's research. In panel data, it can also be used to distinguish between FE and RE models. Due to its higher efficiency in this situation, RE is preferred over FE, which is preferred over the alternative because it is at least consistent.

H_0: RE model is better.

H_1: FE model is best.

Panel Unit Root Tests

It is necessary to check the unit root problem among the variables before applying the econometric technique. It is required to check the order of integration, that is, whether the variables are stationary at first difference or at the level because the unobserved country-specific effect may exist among the cross-section (Rauf et al., 2018). Similarly, Khan et al. (2019) also recommend. Therefore, we have used two-second generation tests:

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1. The Fisher ADF unit root test (Maddala and Wu 1999), and
2. The Fisher PP unit root test.

The second-generation test addresses the problem of cross-sectional dependence given by Pesaran (2007).

The economic model is developed to capture the effect of income inequality and economic growth on tax in the case of six SAARC countries.

Equation No. 1

Tax = f (GINI, GDP, Economic freedom, Employment)

All of the variables are expressed in natural log form. "i" stands for cross-section, and "t" stands for time, in the following equation.

Equation No. 2

$$LNTAX_{it} = \beta_0 + \beta_1 LNCORR_{it} + \beta_2 LNGINI_{it} + \beta_3 LNEMP_{it} + \beta_4 LNGDP_{it} + U_{it}$$

Table 1: Variables and Descriptions

Variables	Definition	Sources
LNGDP	Natural Log of GDP per capita (Constant 2015 $).	WDI
LNECOF	Natural Log of economic freedom	WEF
LNTAX	Natural Log of Total Tax Revenue as % of GDP	ICTD-2021
LNGINI	Natural Log of GINI coefficient.	WIID
LNEMP	Natural Log of employment	WDI
Source: World Development indicators, World income inequality database, International Conference on Information and Communication Technologies and Development		

Statistical Summary

Table 2 shown below indicates the descriptive statistics of all variables for six countries.

Table 2: Statistical Summary

	LNGDP	LNECOF	LNEMP	LNTAX	LNGINI
Mean	7.061649	3.996874	3.943199	2.354486	0.561025
Median	6.989940	4.007333	3.992772	2.346725	0.553225
Maximum	8.348800	4.189655	4.410736	3.089319	0.633618
Minimum	6.081158	3.711130	3.218075	1.579674	0.460675
Std. Dev.	0.561592	0.085684	0.279863	0.350003	0.036208
Source: Author's estimation					

Tests For Stationarity

The stationarity is tested by using ADF and Fisher PP test at constant and linear trend. All the variables are stationary at the level, or at first difference and no variable is at the second difference. Table 3 shows that variables are integrated of mixed orders.

Table 3: Stationarity Analysis

Series	Augmented Dicky-Fuller test statistics		Augmented Dicky-Fuller test statistics	
	Constant		Constant, Linear trend	
	Level	Fist Diff	Level	Fist Diff
LNGINI	24.558**	36.664*	37.702*	23.552*
LNTAX	11.124	69.503*	9.817	51.09*
LNGDP	4.20	38.13*	8.52	25.57*
LNECOF	14.91	67.91*	16.14	48.03*
LNEMP	4.37	56.36*	21.50*	44.89*
	PP test statistic		PP test statistic	
	Constant		Constant, Linear trend	
	Level	Fist Diff	Level	Fist Diff
LNGINI	12.299	37.748*	21.244**	33.736*
LNTAX	15.260	133.26*	14.695	240.31*
LNGDP	1.45	71.52*	5.71	58.61*
LNECOF	17.06	140.70*	24.02**	670.61*
LNEMP	1.04	82.03*	8.03	75.65*
Source: Author's estimation				

Estimation of Results

The estimation was done stepwise. First of all the regression analysis was conducted by regressing (POLS), (FE) and (RE). After that Brush-Pagan LM test is used to decide between POLS and RE. Then Hausman test was used to decide whichever is the best, FE or RE. Secondly, to find the short-run and long-run elasticities the PMG and MG were applied and the Hausman test was used to decide the one for reporting of results.

The Pols Model and Re Model

These are the results of ordinary least square regression without use of dummy variables which is called POLS regression. It is assumed that slopes and intercepts are constant and there are no country-specific effects exist among the countries. We started our analysis by applying POLS. The dependent variable is Taxes-to-GDP ratio and different independent variables like GINI, GDP Employment and economic freedom, etc. were included. Similarly, we applied the Random effect model, and with the help of the Breusch Pagan LM test, we decided between the POLS and RE models. The results of Table 4 show that we should reject the H_0 that POLS is the best and select the Random effect model.

Bp-Lm Test for Random Effects

The BP LM test for the RE model helps us decide between the POLS and Random effect and tells us which one is the best suitable model for estimation and future prediction. The acceptance of H_0 advocates RE as the best model while the alternative hypothesis recommended POLS as the best model. The results for the model having Taxes-to-GDP ratio as the dependent variable are given in Table 7.4. The chi-square value is 1090 and its p-value is 0.0001 which clearly states that we should reject the H_0, accept the alternative hypothesis and select Random effect as the best model for estimation.

Table 4: Results BP LM test for RE

Variable	Statistics	Sd=Sqrt(var)
LNGINI	0.0013111	0.0362079
E	0.0006163	0.0248245
U	0	0
Chi-bar2 = 0.0001		
Source: Author's estimation		

Hausman Test for Selecting Between Re and Fe Model

After calculating the fixed effect and random effect models we used the Hausman test to decide between the fixed effect model and the Random effect models for the purpose to choose the best one. Table 5 shows that the p-value is 0.978 which means that this p-value is greater than the 10% level of significance and we can accept the H_0.

H_0: Null Hypothesis: Random effect model is the best.

H_1: Alternative Hypothesis: The fixe effect model is the best.

Table 5: Results of Hausman Test for Selecting between RE and FE models

Entity	Coefficient
Chi-square test value	0.4567
p-value	0.978
Source: Author's estimation	

Random Effect Model

The RE model is calculated for six SAARC countries. The dependent variable is the Taxes-to-GDP ratio and it is estimated by different independent variables like GINI, GDP, Corruption, and Employment. The data set was taken from 1990 to 2021. In this model, β_0 is the intercept and β_1, β_2, β_3, β_4, and β_5 are the slope coefficients and U_t is the error term of the model. All the dependent and independent variables are taken in Log form (Natural log) and results are reported in Table 6. Total number of observations is 192. The value of the Wald chi-square test is 205 and the p-value is 0.0000. The intercept is -7.37 and the slope coefficient for GINI, GDP, economic freedom, and employment are -2.806, .693, .869, .801 respectively. In this model all the variables including the independent variables are significant. The values of R-Squared within, between, and overall are 0.52, 0.06, and 0.22 respectively.

The Wald chi-square test also guides us whether the Random effect is appropriate or not? In this case, the chi-square value is 205 and its p-value is 0.000 which shows that we cannot accept the H_0 and conclude that the Random effects model is the best. The impact of income inequality on taxes-to-GDP ratio is negative and significant, its value is -2.806 which shows that if inequality is increased by 1% the taxes-to-GDP ratio will decrease by 2.8%. The Impact of GDP is positive and significant on taxes-to-GDP ratio which means that with the increase in growth of the country the taxes-to-GDP ratio will increase. Its value is .693 which means that if GDP rises by 1%, all other things being constant, the taxes-to-GDP ratio will increase by 0.693%. The impact of economic freedom on taxes-to-GDP ratio is positive and significant which means that this variable have a positive impact on taxes-to-GDP ratio. Its value is 0.869 which means that 1% increase in economic freedom will increase the taxes-to-GDP ratio by .869%. The impact of employment is found to be positive and significant. Its value is 0.801 which means that 1% increase in employment in the country will lead to an increase of 0.81%

in the taxes-to-GDP ratio.

Table 6: Results of The Random Effect Model with Taxes-to-GDP ratio as a Dependent Variables

Variables	Coefficient	St. Err.	p-value
LNGINI	-2.806	0.483	0.001*
LNGDP	0.693	0.081	0.001*
LNECOF	0.869	0.276	0.002*
LNEMP	0.801	0.215	0.001*
Constant	-7.634	1.655	0.001*
Wald Chi-square	205		
Prob. (chi^2)	0.000		
R^2 within	0.52		
R^2 between	0.06		
R^2 overall	0.22		
Source: Author's estimation			

Hausman Test for Deciding Between Pmg and Mg

The results of Hausman test are shown in table 7 for all the independent variables which we have used in the model. The hypothesis shows that both the PMG and MG models are not statistically different.

H_0: PMG is the best.

H1: MG is the best.

We have selected the PMG technique because the p-value is > 0.10. In view of the result of Hausman test, the H_0 cannot be rejected. Hence PMG is supported by the model.

Table 7: Hausman Test

Description	Coefficient
Chi-square test value	0.825
p-value	0.977
Source: Author's estimation	

Estimation of Pmg

In this research study we used PMG estimators for dynamic heterogeneous panels to find the equilibrium in the long run between the dependent and independent variables of the model. Pooled Mean Group is an intermediary method between dynamic FE and MG. By using both the short and long-run results the interaction between the results can be obtained. Interaction between the variables, in the long run, is based upon the cointegration link between non-stationary variables. The maximum likelihood PMG estimators that fit into ARDL is a contribution of Pesaran et al. (1999).

We can say that it is an equation of error correction terms that improves the economic meaning that the model is converging towards the long-run equilibrium. There are three key factors related to PMG which are necessary to be explained.

- First of all, stationarity should be checked for all the variables and no variable should be integrated of second order i.e. I(2). Similarly, as compared to ARDL, PMG is more appropriate if series are I(0) and I(1) or the have mixed order of integration (Kim et al., 2010).
- In addition, PMG employs an error correction term that, if it is negative and significant, indicates that the model is moving in the direction of the long-run equilibrium path.
- Lastly, the MG and PMG are the most effective methods for estimating a heterogeneous panel of this kind when the cross-section N is lower than time T.

We estimated for the SAARC countries and within the same regional block the countries are interdependent on one another in long run in many ways like trade, geographical nature, weather, and fiscal and monetary policies. Due to this, long-run results are plausible but in the short run, results may differ because every country has its country-specific effects and traits. Hence, there is a chance that country-specific economic and institutional differences may exist. An ECM-based ARDL model for Model 2 is given below. Hence for the best analysis, PMG econometric technique for panel data was chosen. The results of PMG are shown in table 7.

Equation No. 3

$$(lntax)_{it} = \alpha_0 + \sum_{i=1}^{n} \alpha_{i2}\, lntax_{i,t-1} + \sum_{i=0}^{n} \beta_{i2}\, lngini_{i,t-1} + \sum_{i=0}^{n} \gamma_{i2}\, lngdp_{i,t-1} + \sum_{i=0}^{n} \delta_{i2}\, lnecof_{i,t-1} + \sum_{i=0}^{n} \varepsilon_{i2}\, lnemp_{i,t-1} + \cup_{it}$$

The long-run and short-run relations are shown in equation 7.3 and equation 7.4. Here, α_{i2}, β_{i2}, γ_{i2}, δ_{i2}, ε_{i2}, ϵ_{i2} are the long-run coefficients and U_{it} is an error term. The equation is estimated for an ARDL (1, 0, 0, 0, 0, 0) model. Similarly, in equation 7.4, α_{i2}, β_{i2}, γ_{i2}, δ_{i2}, ε_{i2}, ϵ_{i2} are the short-run coefficient having θ as the error correction term, i represent cross-sections, and t represents time.

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Equation No. 4

$$(\Delta lntax)_{it} = \alpha_1 + \sum_{i=1}^{n} \alpha_{i2}\, \Delta lntax_{i,t-1} + \sum_{i=0}^{n} \beta_{i2}\, \Delta lngini_{i,t-1} + \sum_{i=0}^{n} \gamma_{i2}\, \Delta lngdp_{i,t-1} + \sum_{i=0}^{n} \delta_{i2}\, \Delta lnecof_{i,t-1} + \sum_{i=0}^{n} \varepsilon_{i2}\, \Delta lnemp_{i,t-1} + \sum_{i=0}^{n} \theta\, ECT_{i,t-1} + \cup_{it}$$

Table 8: Long-run & Short-run estimation

Dependent Variable: Taxes-to-GDP ratio				
Long-run Results Based on PMG				
Variables	Coefficient	SE	Z	p-value
LNGINI	-1.305	0.625	-2.090	0.037**
LNGDP	0.599	0.130	4.600	0.000*
LNECOF	-0.277	0.437	-0.630	0.526
LNEMP	0.561	0.360	1.560	0.101***
Short-run Results Based on PMG				
Variables	Coefficient	SE	Z	p-value
ECM (-1)	-0.248	0.079	-3.130	0.002*
ΔLNGINI	2.314	2.185	1.060	0.290
ΔLNGDP	0.369	0.320	1.150	0.249
ΔLNECOF	0.002	0.238	0.010	0.993
ΔLNEMP	-0.332	0.636	-0.520	0.601
Constant	-0.561	0.190	-2.960	0.003**
Source: Author's estimation				

To measure the results in the form of elasticities all the short-run and long-run coefficients are estimated in the form of a natural logarithm. The results of PMG are stated in Table 8 which shows that in the long run impact of GINI coefficient is negative and significant which means that 1% decrease in inequality will lead to an increase in the taxes-to-GDP ratio of 1.305%. The impact of economic growth is positive and significant which means that 1 percent increase in GDP per capita will increase taxes-to-GDP ratio by 0.59%. Employment is considered as an important variable in the taxes-to-GDP ratio model. Employment is showing a positive and significant impact on taxes-to-GDP ratio which means that with 1% increase in employment, taxes-to-GDP ratio will increase by 0.566%. The impact of economic freedom is negative and insignificant with a value of -0.277. The error correction term is negative and significant which means that the model is converging toward the long-run equilibrium path. The ECM coefficient value is observed to approve the theory (with a negative sign) and implies that 24.81% convergence from short-run to long-run equilibrium occur annually by the concerned independent variables. In the short run, the impact of economic growth is consistent with the results of long-run elasticities, and the impact of corruption is also consistent with the theory in the short run.

Cointegration Results of Westerlund Method

We have taken into account the cointegration among the variables, the basic time factor and permission for heterogeneity is taken into consideration using the panel cointegration technique. For this purpose, the Westerlund ECM panel cointegration test was conducted. Table 9 provides the results of four statistics (Gt, Ga, Pt, Pa). The Ga and Gt are the test statistics. These statistics start from a weighted average of the individually estimated t-ratio respectively. Rejection of H_0 should therefore be taken as evidence of cointegration of at least one of the cross-sectional units. The Pa and Pt test statistics pool information over all the cross-sectional units. Rejection of H_0 should therefore be taken as evidence of cointegration for the panel as a whole.

Its H_0 is nonexistence of cointegration among the panel and the H_1 of the Westerlund test is existence of cointegration among the panel. The first two tests of Gt and Ga show that cointegration exists in the panel as a whole. Whereas the cointegration of at least one unit is tested with Pt and Pa. The results lead to rejection of H0 and acceptance of the alternative hypothesis with the conclusion that the panel is cointegrated as shown by four tests.

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Table 9: Cointegration Result by Westerlund (2008)

Statistics	Value	z-value	p-value
Gt	-1.668	0.739	0.0000*
Ga	-3.527	2.188	0.9987
Pt	-3.946	0.014	0.0000*
Pa	-4.022	0.701	0.0000*
Source: Author's estimation			

Causality Analysis

The Dumitrescu-Hurlin (DH) causality test finds the existence of causality among the variables, whether there is any causality running between the dependent variable, taxes-to-GDP ratio and its determinants such as, GINI, GDP, employment, and corruption in the SAARC countries. Table 10 shows the results of causality test. It can be seen from the table that there is one-way causality existing between employment and taxes-to-GDP ratio. GDP and Corruption are causing GINI, and employment is also causing GDP, and a two-way causality is seen between GINI and tax-to-GDP ratio. Similarly, tax is causing GDP and GDP is causing taxes-to-GDP ratio. Employment is causing GINI and GINI is causing employment. Hence there is found one-way causality as well as two-way causality. Hence, we can say that a linkage is seen among the variables of the model. Finally, a causal relation is found among many variables of the model

Table 10 Results of Dumitrescu-Hurlin causality

Null Hypothesis: Ho	z-stat	p-value	Inference
LNGINI ⇎ LNTAX	2.24654	0.0247	Two-way causality exists.
LNTAX ⇎ LNGINI	5.74581	0.0002	
LNGDP ⇎ LNTAX	2.17840	0.0294	Two-way causality exists**.**
LNTAX ⇎ LNGDP	2.06207	0.0392	
LNECOF ⇎ LNTAX	0.46662	0.6408	No causality exists.
LNTAX ⇎ LNECOF	-0.28876	0.7728	
LNEMP ⇎ LNTAX	0.71571	0.4742	One way causality exists.
LNTAX ⇎ LNEMP	3.66949	0.0002	
LNGDP ⇎ LNGINI	7.63638	0.0000	One way causality exists.
LNGINI ⇎ LNGDP	0.77536	0.4381	
LNECOF ⇎ LNGINI	0.58267	0.5601	One way causality exists.
LNGINI ⇎ LNECOF	2.43352	0.0150	
LNEMP ⇎ LNGINI	10.8834	0.0000	Two-way causality exists.
LNGINI ⇎ LNEMP	1.83817	0.0660	
LNCORR ⇎ LNGDP	1.20842	0.2269	No causality exists.
LNGDP ⇎ LNECOF	1.46397	0.1432	
LNEMP ⇎ LNGDP	-1.35939	0.1740	One way causality exists.
LNGDP ⇎ LNEMP	6.53116	0.0000	
LNEMP ⇎ LNECOF	0.70509	0.4808	No causality exists.
LNECOF ⇎ LNEMP	0.62811	0.5299	
Source: Author's estimation			

Diagnostic Analysis

The examination of cross-sectional dependence (CSD) among the panelists is the first step of the empirical analysis in panel data estimation. More specifically, the countries panel includes groups of comparable nations that are labeled as transitional, emerging, developing, and developed. This classification is the result of a number of interconnected factors, such as globalization, financial integration, and international trade. Ignoring the CSD problem in panel data estimation may increase the likelihood of forecasting error and result in erroneous findings. As a result, this study used Pesaran's cross-sectional dependence tests to look at whether CSD was present in the panel and discovered that it was not. Secondly, Slope heterogeneity is required to be test to verify that either the slopes are heterogeneous or not, hence Yamagata slope heterogeneity found that slopes are heterogeneous among the panels. Similarly, no issue of multicollinearity and heteroskedasticity is found all the results are shown in table 11

Table 11: Results of Diagnostic Tests

Robustness Analysis	Vif	Prob	Remarks
Slope heterogeneity Yamagata	----- -	0.268	No slope heterogeneity
Breusch-Pagan Cook-Weisberg test	----- -	0.9147	No Heteroskedasticity
Multicollinearity	2.45	-------	No Multicollinearity
Pesaran's cross-sectional Dependence	----- -	0.218	No cross-sectional dependence
Source: Author's estimation			

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Yellen, J., Akerlof, G., Blanchard, O., Romer, D., & Stiglitz, J. (2014). *Many targets, many instruments: where do we stand?* (Vol. 1). Cambridge, The MIT Press. Comisión Económica para América Latina y el Caribe (CEPAL) Anexo Cuadro A.