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Impact of Total Factor Productivity and Income Inequality on Tax

Arifa Saeed*, Dr. Hafiz Khalil Ahmad**

** Ph.D. Economics Scholar, National College of Business Administration & Economics, Lahore arfasaeed@gmail.com*
*** Professor Department of Economics, Government College Women University, Sialkot hafizkhalil62@yahoo.com*

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ABSTRACT

Nexus of total factor productivity, inequality, and taxes (selected SAARC Countries) along with other control variables like corruption, consumption expenditure, capital, and labor. For short and long-run elasticities along with different estimation techniques are applied. TFP (Total factor Productivity) data of SAARC (South Asian Association for Regional Cooperation countries) were unavailable, so only Pakistan, India, Bangladesh, and Sri Lanka are estimated. Tax to GDP (Gross Domestic Product) ratio is low, and income equality is negative as it will decrease the tax revenue, and increase in anti-corruption policies will increase tax revenue, an increase in TFP will reduce in tax revenue, increase in employment, there will be an increase in tax to GDP ratio and consumption expenditure is found negative and significant on tax The results confirm that most of the variables of the long-run elasticities are significant. All the models are robust because there is no slope heterogeneity, heteroscedasticity, multicollinearity, and cross-section dependence among the variables.

Introduction

Numerous studies have been conducted over time to gauge the effect of inequality, taxation, and Gross Domestic Product (GDP) / Total Factor Productivity (TFP) with other variables. There was an attempt in this paper to analyze the impact of total factor productivity and income inequality on taxes.

Total Factor Productivity & Inequality (Kuznets growth)

"It has been argued that inequality is necessary for accumulation and that it, therefore, contains the seeds of eventual increases in everyone's income", Adelmann and Robinson (1989). According to 'trickle-down' theories, inequality allows for higher returns for the upper class and eventually enables them to accumulate wealth. This may be redistributed, but if the upper class saves more than the transition from top to bottom, the accumulation of capital and sluggish growth will decrease **(**Fields 1989, Persson and Tabellini 1994). Some argued that increased inequality would slow growth. (Alesina and Rodrik 1994) Increased tension over distributional issues and the ability of the government to impose higher taxes to address them are both caused by high levels of inequality. These taxes also slow growth by lowering the rate of return on private assets, which hinders capital accumulation. In this section, inequality and growth are examined from the perspective of earlier authors.

Birdsall et al. (1995) presented a cross-economy regression analysis and concluded that investing in education and building institutions boosts augmented growth by knocking down inequality.

Clarke (1995) empirically tested democratic and non-democratic countries with different inequality measures, and with various regression analyses, a negative association between inequality and growth was

Correspondence concerning this article should be addressed to Arifa Saeed, arfasaeed@gmail.com

found. The sign or significance level is the same with the addition of inequality and regime type.

Deininger (1998) concluded that asset inequality snubs long-term growth. The investment is significant for all different quintile groups whereas, schooling or other variables do not have

Shahbaz and Islam (2011) found a connection between income inequality and financial development in the case of Pakistan. The financial development and value-added in the manufacturing sector are negatively associated with income inequality. Whereas economic growth and trade openness were linked positively with income inequality, however, there exists a weak relationship. Financial instability was also responsible for to increase in income inequality in Pakistan.

Aslam and Sadaf (2015) divided the performance of Pakistan's economy into two periods, from 1970-90 and 1990-2012. According to their calculations, results are unsatisfactory in the case of inclusive growth.

Islam (2017) empirically investigates the Japanese data for 45 years by using four alternative techniques for estimating inequality and growth. Furthermore, this study explores different channels through which income inequality significantly obstructs economic growth.

Taxation & Inequality

The key objective of the public sector is to increase revenue through taxes to fulfill its expenditure. Countries regulate the composition of their taxes and its rate. The theory of optimal taxation presents that tax design tries to maximize social welfare through redistribution ability Diamond and Mirrlees (1971). Its trends may change with time in terms of tax rate and tax share in revenue. According to (Bahl and Bird 2008, and Atkinson and Stiglitz 1976) indirect taxes are more in fashion than direct taxes in the care of developing countries, as they are easier to control Saez (2002). On the other hand, developed countries depend on direct taxes because of their formalized structures.

Oueslati et al. (2017), with the help of panel data from 34 OECD countries, explored the macroeconomic relationship between environmentally-motivated taxes and income inequality. They contend that this relationship differs when a clear transfer of taxation that improves revenue share from energy taxes. There is an inverse and significantly stronger relationship between income inequality and the proportion of GDP to energy taxes. The consumption tax is positively associated with GDP per capita. In the case of Kenya, it is one of the main contributors to the total tax revenue and thus in Kenya's poverty reduction and welfare. Mania (2017) also concluded that trade taxes negatively influence GDP per capita, which means improvement in its rate reduces the volume of international trade, therefore depressing the GDP per capita.

Does Inequality Constrain the Power to Tax? This question is empirically answered by Islam et al. (2018) by taking data from OECD countries from 1870-2011. Empirically in their model, inequality is significant with a negative coefficient. By adding control variables, the effect of inequality on the tax ratio remains negative, which means inequality decreases the income tax ratio. The coefficient of democracy (Polity) remains negative in different a model, which shows having no impact on increasing the income tax ratio, but by introducing at least a 10-year lag, the results are positive. The effect of inequality on indirect taxes is also calculated where inequality reduces the indirect tax ratio but this may lead to the expansion of indirect taxes or modify the tax mix (i.e., a ratio of direct to indirect taxes) in support of less 'visible' taxes. Whereas the government expenditure ratio is restricted due to inequality

Taxation and Growth /TFP

In this section, these variables are investigated Lefer curve. There is a significant and negative correlation between economic growth and marginal and average tax rates. [Skinner (1987), Koester and Kormendi (1989)]. The negative effects of these variables can fade off by controlling endogeneity [Peltzman (1980), Rabushka (1985)] and economic growth and per capita income [Landau (1983), Baumol (1986)]. Thus reductions in the "progressivity" of tax rates bring a parallel and upward shift in the growth path.

Kemal (2007) investigates the long-term relationship between informal and formal economies. Although a causal relationship between the formal and underground economy has been observed, the reverse is not true. Tax collections can be increased by reducing the number of legal documents required, strengthening institutions, improving administration, and controlling smuggling through tax rationalization of tax evasion. Lutfunnahar (2007) discovered that developing countries have lower tax collections than developed countries.

Mahdavi (2008) analyzes the unbalanced panel data for 43 developing countries, including Pakistan, using advanced estimation techniques from 1973 to 2002. The findings reveal that the financial assistance harmed non-tax revenue, whereas the share of the agricultural sector in total income has a significantly positive connection towards tax collection. The percentage of the economy in the trade sector has a favorable impact on tax, and the population that belongs to the old-age group has a negative relationship with both income and sales tax. Both the literacy rate and urbanization have a favorable influence on tax revenue. Tax collections are negatively affected by population density, monetization, and inflation rate.

Correspondence concerning this article should be addressed to Arifa Saeed, arfasaeed@gmail.com

Methodology

A stepwise process is used to solve the issue with specific goals to achieve research goals. The research methodology, which includes the research design, data collection sources, tools for analysis, and presentation techniques, is designed to achieve the purposes of this thesis.

Data Collection

This study is undertaken to analyze the present taxation system, total factor productivity, and inequality in selected SAARC countries. A secondary data technique is applied, and data is extracted from various sources, i.e., WDI Reports, ICTD (2021), and the World income inequality database.

Econometric Methods

The research question is answered with an econometric technique. It helps the researcher to investigate the research hypotheses and objectives of the study. The aim of the research design is to provide appropriate and exact results about the research problem. Analytical & descriptive analysis is employed to investigate the research problem. The Panel data analysis for the POLS. Fixed Effect (FE) model, Random Effect (RE) model & Housman Test after that, we perform the Panel ARDL technique like Mean group (MG, Pooled Mean Group (PMG), and Housman test to decide among those that which one is the best MG of PMG. By using these techniques, we try to find the short-run and long-run elasticities. Cross-sectional dependence test Pesaran (CSD) is be applied to find either cross-sectional dependence exist among those are the main design of the paper.

POLS Regression Analysis

As explained above, the first method is to test the impact of dependent variables were GDP, TFP and TAX, and GINI, respectively. For our dynamic testing analysis, either the set of selected independent variables have any effect on the dependent variable. For this purpose, we will estimate the dynamic relationship among these variables. The POLS is defined as

$$Y = \beta_0 + \beta_1 X_i + \beta_2 X_2 + \cdots \ldots \ldots \ldots \ldots \ldots . + U_n$$

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

$$Y_{it} = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots \ldots \ldots \ldots \ldots + \varepsilon_i$$

Breusch and Pagan LM test.

$$y = \alpha + \beta_1 x_1 + \cdots \ldots \ldots \ldots . + \beta_n x_n + \mu_t var(u / x) = \sigma^2$$

$$v{\sim}(u / x) = \sigma^2 f(x)$$

$$= \sigma^2(\alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \cdots \ldots \ldots \ldots \ldots + \alpha_p x_p) \ldots \ldots \ldots$$

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

H_o: POLS Regression is best.

H_1: RE model is best.

The Fixed Effect (FE) Model

Each unit has unique characteristics that can affect the predictor variables, which in turn can tell us how variables may influence other variables. The FE model demonstrates that the time-invariant behaviors are specific for each person and are not correlated with other characters of the same person. As each entity is unique, the error term and constant for each should not be associated with those of the other entities.

The FE equation is:

$Y_{it} = \beta_1 x_{it} + \alpha_i + \mu_{it}$ … … … … … … … …. (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. But in the paper, only equation 1 method is used for the FE model.

Random Effect (RE) Model

RE model is not correlated with the independent variables across entities: "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,). The specification of the RE model is:

$Y_{it} = \beta_1 X_{it} + \alpha_i + \mu_{it} + \epsilon_{it}$ $t = 1, 2, 3 \ldots . , T$ … … … … … … … … (2)

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

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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 impact the independent variables. The problem with the RE model is that it is biased for omitted variables in the model.

The Hausman Test Comparing the FE and RE Models

After getting the results of RE and FE, we must now choose the best technique. Hausman test is applied to check the acceptant of H_o means random effects is best (Greene, 2008). It is used to examine whether the errors are correlated with the regressors. Consider the linear model $y = b_1 x + \varepsilon$ where y is the dependent variable, x is the vector of regressors, b is a vector of coefficients, and ε is the error term. According to Hausman's research, the covariance between an efficient estimator and the difference between an efficient and inefficient estimator is zero. Panel data can also be used to distinguish between FE and RE models. Due to its higher efficiency, RE is preferred over FE, because it is at least consistent.

H_0: RE model is best.

H_1: FE model is best.

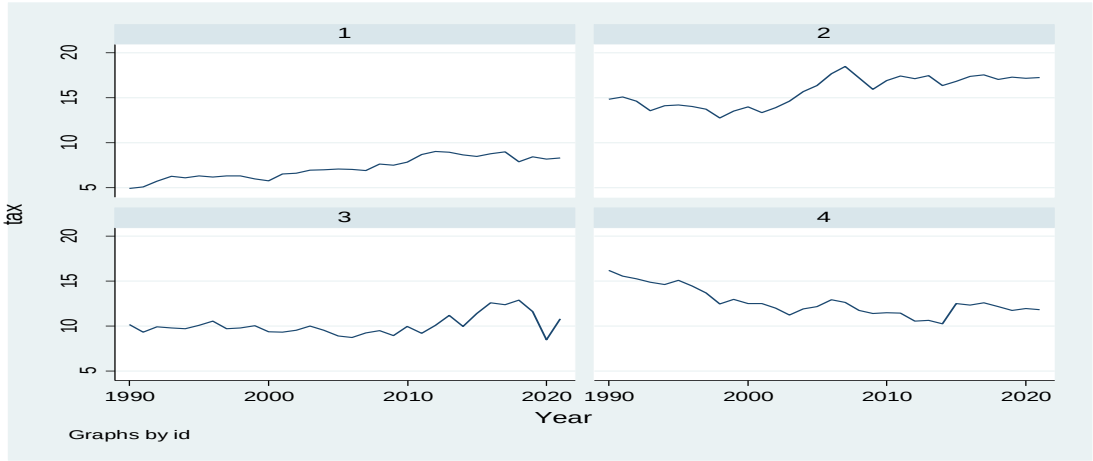
Panel Unit Root Tests

It is essential to check the unit root problem among the variables before applying the econometric technique. The order of integration means either the variables are stationary at first difference or the level because the unobserved country-specific effect may exist among the cross-section Rauf et al. (2018). Similarly, Khan et al. (2019) also mention the same test. Thus, in this paper, we used two-second generation tests (a) the Fisher ADF unit root test **(**Maddala and Wu, 1999) and (b) the Fisher PP unit root test. The second-generation test addresses the problem of cross-sectional dependence given by Pesaran (2007).

Estimation:

The Panel data analysis is done for four SAARC countries with tax to-GDP ratio as a dependent variable from 1990 to 2021 from various sources. This analysis is done based on TFP,, its dynamic relationship between TFP, tax, and Gini coefficient, along with control variables. Above mentioned econometric techniques and research methodology is applied in the study for the achievement of desired objectives.

Figure 1 *Figure of the SAARC Countries TAX*



Note: 1 Bangladesh, 2 India, 3 Pakistan, 4 Srilanka.

Figure 1 is calculated based on the Tax to GDP ratio from 1990 to 2021; we saw in this figure four SAARC countries are showing four shapes. In SAARC countries, the Tax to GDP ratio is low and offers a very slow increasing trend over time. India showed a constant movement till 2000, and after that, a continuously increasing trend concerning the time graph also showed a better tax-to-GDP ratio in India as compared to other countries. Pakistan is showing a continuous constant trend till 2015, and after the little improvement in policies regarding tax has shown little improvement but is slow. Sri Lanka is offering a drastic trend, a sharp and continuous decline till 2012, then it has shown a little improvement. Due toweak tax institutions, no tax culture and habits among the businessman and common man, money laundering, and poor financial command and control system, a cause of very poor tax to-GDP ratio compared to developed countries.

Model, Variables, and Description

The economic model is developed to capture the Impact of TFP and income inequality on tax in the case of Four SAARC countries.

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Tax = f (Gini, GDP, Corruption, Total factor productivity, Consumption expenditure, Employment)

$$LNTAXit = \beta_0 + \beta_1 LNGINI_{it} + \beta_2 LNGDP_{it} + \beta_3 LNCORR_{it} + \beta_4 LNTFP_{it} + \beta_5 EMP_{it} + \beta_6 LNCEXP_{it} + U_{it}$$

Here i used for cross-section and t for time.

Table 1: *Variables and Description*

Variables	Definition	Sources
LNGDP	Natural Log of GDP per capita (Constant 2015 $).	WDI
LNCORR	Natural Log of corruption.	WEF
LNTAX	Natural Log of Total Tax Revenue % GDP	ICTD-2021
LNGINI	Natural Log of GINI coefficient.	WIID
LNTFP	Natural Log of total factor productivity.	ESOF
EMP	Employment in agriculture.	WDI
LNCEXP	Natural Log of total consumption expenditure.	WDI

Statistical Summary

Table 2, shown below, indicates the descriptive statistics for six countries' variables.

Table 2: *Summary Statistics*

	LNGINI	LNTFP	LNGDP	LNCEXP	LNTAX	LNCORR	EMP
Mean	0.55822	1.24223	7.12401	4.379362	2.387781	3.992470	46.35637
Median	0.55222	1.20809	7.12439	4.387108	2.433128	4.007333	43.73000
Maximum	0.63361	1.65380	8.34880	4.548967	2.916656	4.189655	69.51000
Minimum	0.46067	0.92326	6.23851	4.183921	1.593819	3.711130	24.98000
Std. Dev.	0.03897	0.23665	0.53436	0.086513	0.318809	0.096030	10.86653

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 first difference, and no variable is at the second difference. Table 3 shows the variables showing mixed levels of integration.

Table 3 *Stationarity Analysis*

Series	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*
LNCEXP	22.78*	67.99*	14.92	51.72*
LNTFP	9.38	40.76*	8.49	40.76*
LNGDP	4.20	38.13*	8.52	25.57*
EMP	4.37	56.36*	21.50*	44.89*
LNCORR	14.91	67.91*	16.14	48.03*
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*

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LNCEXP	19.66*	114.47*	10.61	99.00*
LNTFP	22.28*	72.96*	6.50	72.98*
LNGDP	1.45	71.52*	5.71	58.61*
EMP	1.04	82.03*	8.03	75.65*
LNCORR	17.06	140.70*	24.02**	670.61*
Here: *** p<.01, ** p<.05, * p<.1				

Estimation of Results

The estimation has been done stepwise first of all, the regression analysis was conducted by regressing (POLS), (FE) and (RE) after that, brush-pagan LM test was used to decide between POLS and RE. After that Hausman test is used to decide whichever is best means FE or RE. Secondly, to find the short-run and long-run elasticities, the Pooled mean group and Mean group are applied, and the Hausman test is used to decide one of those for reporting of results.

The Pooled OLS regression model for the tax to GDP ratio and variables

These are the ordinary least square regression results without dummy variables called pooled OLS regression. It is assumed that slopes and intercepts are constant and no country-specific effects exist among the countries. We have started our analysis by applying Pooled OLS in which our dependent variables are Tax to GDP ratio and independent variables like Gini, GDP total factor productivity, corruption, employment and consumption expenditure, etc., having data set from 1990 to 2021 for four SAARC countries. First of all, we will decide between POLS and Random effect by using the Brush pagan LM test that which is best. In model 6, β_0 is our intercept and $\beta_1, , \beta_2, \beta_3, \beta_4, \beta_5,$ and β_6 are slope coefficients, and U_t is the error term of the model. All the dependent and independent variables are in Log form (Natural log). Our model fits the data well; the results are reported in table 10.4. Our significance level is 5 percent, Prob > F is 0.0000 R-Square is 0.63, which is good. The constant term shows the intercept term of the model, which is -2.689, and the slope coefficient of other independent variables like Gini, GDP, total factor productivity, corruption, and employment and consumption expenditure. The values are -2.075, 0.721, 1.645, -.825, 0.021, and -1.238. In this model, all the variables are significant. R Square is good, and the probability value of F-stat shows the overall model is significant individual Standard errors t-values and p-values are also shown in the table. The sign of GDP is positive and significant; it shows that if there is a 1 percent change in output, there will be a 0.721 percent increase in tax revenue, which means that with the increase in GDP, the tax revenue will increase. The impact of income equality is negative and significant. It means that if there is a 1% increase in income inequality, it will decrease the tax revenue by 2.075%. The sign of corruption is positive and significant, meaning if there is a 1 percent increase in anti-corruption policies, the tax revenue will increase by 1.645 percent. Hence the sign of a very important variable is as per theory and expectation. The impact of total factor productivity is negative and significant means if there is a 1 percent increase in TFP, there will be a 0.825 percent decrease in tax revenue. The sign of employment is positive and significant, showing that if there is a 1-unit increase in employment, there will be a 0.021 percent increase in tax to GDP ratio. The effect of consumption expenditure is found to be negative and significant on tax it means that if consumption expenditure rises by 1 percent, the tax-to-GDP ratio will decline by 1.238 percent.

Table 4: *The Results of POLS Regression Model with Tax to GDP ratio as a Dependent Variables.*

Variables	Coefficient	SE	t-value	p-value	Comment
LNGINI	-2.075	.726	-2.86	0.005	Significant
LNGDP	.721	.131	5.50	0.002	Significant
LNCORR	1.645	.298	5.51	0.001	Significant
LNTFP	-.825	.107	-7.68	0.003	Insignificant
EMP	.021	.006	3.69	0.006	Insignificant
LNCEXP	-1.238	.276	-4.49	0.001	Significant
Constant	-2.689	2.283	-1.18	.241	Insignificant
Number of obs	128				
R^2	0.63				
F-test	33.75				
Prob > F	0.000				
Here: *** p<.01, ** p<.05, * p<.1					

Random Effect Model

RE model is calculated for four SAARC countries. The dependent variable in the model is the Tax to GDP ratio estimated for different independent variables like Gini, GDP, total factor productivity, corruption, and employment and consumption expenditure from 1990 to 2021. The results of the estimation of RE are shown in table 5 total number of observations is 128. The value of the Wald chi-square test is 201, the p-value is 0.0000, the intercept is -2.689, and the slope coefficient for Gini, GDP, total factor productivity, corruption, and employment and consumption expenditure, etc. are -2.075, 0.721, 1.645, -.825, 0.021, -1.238. In this model, all independent variables are significant. Values and signs of variables are consistent with results of POLS, R Square within, between, and overall is 0.14, 0.97, and 0.62. Here the Wald chi-square test also guides us about whether the Random effect is appropriate or not. In this case, the chi-square is 201, and its p-value is 0.000, which shows that we cannot accept H_o and RE model as not the best.

Table 5 *The Random Effect Model with Tax to GDP ratio and variables*

Variables	Coefficient	St. Err.	p-value
LNGINI	-2.075	.726	0.004*
LNGDP	.721	.131	0.002*
LNCORR	1.645	.298	0.004*
LNTFP	-.825	.107	0.001*
EMP	.021	.006	0.005*
LNCEXP	-1.238	.276	0.002*
Constant	-2.689	2.283	0.239
Wald Chi-square	201.49		
Prob > chi2	0.000		
R^2 within	0.14		
R^2 between	0.97		
R^2 overall	0.62		

*** p<.01, ** p<.05, * p<.1

BP-LM test for Random effects.

The B-P LM test for RE helps us decide between the POLS and Random effect and tells us which is the best suitable model for estimation and future prediction. We have Ho POLS is best, and Hi is Random effects are best. The results in table 6 for model 6 have Tax to GDP ratio as a dependent variable and its chi-square value is 0.0000, and its p-value is 1.0000, which clearly states that we cannot reject Ho; hence Pooled OLS is the best model for estimation.

Table 6 *Results B-P LM test for RE*

Variable	Statistics	Sd=Sqrt(var)
LNTAX	0.1016393	0.3188092
E	0.008167	0.0903714
U	0	0

Chi-bar2 = 1.0000

Hausman Test for Decision about PMG and MG.

The Hausman test results are shown in Table 7 for all independent variables used in the model. The hypothesis of the Hausman test shows that both the model of PMG and MG ate not statistically different.

Ho: PMG is best.

Hi: MG is best.

We have selected the PMG technique because the p-value is < 0.01 at a one percent level of significance; hence, we can reject the Ho in this case. Hence MG is supported by the model.

Table 10.7: *Hausman Test*

Description	Coefficient
Chi-square test value	24.262
p-value	0.0005

Estimation of MG (Mean Group)

This study has used the MG estimator developed by Pesaran and Smith (1995) as an alternative method in dynamic panel model analysis. Our research has also used PMG estimators for a dynamic heterogeneous panel to find the equilibrium in the long run between the dependent and independent variables of the model. PMG is an intermediary method between dynamic FE and MG. By using these, both the short and long-run results and the interaction between the results can be obtained. In the long run, interaction between the variables 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 improve the economic meaning that either the model is converging towards the equilibrium. There are three key factors related to PMG which are necessary to explain. First, the stationarity should be checked for all variables, and no variable should be at I(2).

Similarly, as compared to ARDL, PMG is more appropriate if series are integrated at I(0) and I(1) or the mix cointegration level Kim et al. (2010). Secondly, PMG uses error correction terms that should be negative and significant, showing that the model is converging towards the long-run path. Thirdly, when the cross-section N is less than time tthe MG and PMG are the best options to estimate a heterogeneous panel of this type. We are estimating for SAARC countries, and within the same regional block, the countries are interdependent on one another in the 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 there is a chance that country-specific economic and institution differences may exist. An ECM-based ARDL model for Model 6 is given below. Hence, the PMG econometric technique for panel data is chosen for the best analysis. The results of PMG are shown in table 10.8. The long-run and short-run relations are shown in equation 1 and equation 2. Here α_{i2}, β_{i2}, γ_{i2}, δ_{i2}, ε_{i2}, ϵ_{i2} are the short run coefficient and U_{it} is an error term the equation is estimated for an ARDL (1,0,0,0,0,0) model. Similarly, in equation 2, α_{i2}, β_{i2}, γ_{i2}, δ_{i2}, ε_{i2}, ϵ_{i2} are the short run coefficient having θ as an error correction term, i represent cross-sections, and t represents time.

Equation 1

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

Equation No. 2

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

Table 8: *Long-run & Short-run estimation*

Dependent Variable: Tax to GDP ratio				
Long-Run Estimation Based on MG				
Variables	Coefficient.	SE	Z	p-value
LNGINI	-2.730	1.171	-2.330	0.020**
LNGDP	-0.114	0.031	-3.710	0.000*
LNCORR	-0.840	0.361	-2.320	0.020**
LNTFP	0.104	2.465	0.040	0.966
EMP	-0.019	0.008	-2.310	0.021**
LNCEXP	-0.094	1.293	-0.070	0.942
Short-run Estimation Based on MG				
Variables	Coefficient.	SE	Z	p-value
ECM (-1)	-0.815	0.202	-4.030	0.000*
Δ LNGINI	-0.222	0.537	-0.410	0.679

Δ LNGDP	0.596	0.850	0.700	0.483
Δ LNCORR	0.130	0.174	0.750	0.454
Δ LNTFP	-1.128	1.221	-0.920	0.356
Δ EMP	-0.010	0.008	-1.250	0.210
Δ LNCEXP	0.310	0.779	0.400	0.691
Constant	10.150	8.417	1.210	0.228
Here: *** p<.01, ** p<.05, * p<.1				

To measure the results in elasticities, all the short-run and long-run coefficients are estimated in the form of the natural logarithm. The results of MG are stated in table 8. It shows that in the long run impact of the Gini coefficient is negative and significant, which means that a 1% increase in income inequality leads to a decrease in tax to GDP ratio by 2.730%. Corruption is a highlighted issue in SAARC countries hence it is used among other variables. It shows a negative and significant impact on the tax to GDP ratio means with a 1% increase in corruption will reduce the tax by 0.840%. The effect of GDP per capita is negative and significant means that a 1 percent increase in GDP per capita will reduce the tax-to-GDP ratio by 0.114%. Total factor productivity is considered a concerned variable in our dynamic analysis of the model, total factor productivity is showing a positive but insignificant impact on tax to GDP ratio means that with a 1% increase in total factor productivity, the tax-to-GDP ratio will increase by 0.104%. Employment is showing a negative and significant impact on tax, which means that if employment will increaseincreases by 1 percent, the tax to GDP ratio will fall by 0.019%. The effect of consumption expenditure is negative but insignificant on the tax-to-GDP ratio, which means that if the consumption expenditure increases by 1%, the tax-to-GDP ratio will reduce by 0.094%. The error correction term is negative and significant means that the model is converging toward a long-run equilibrium path. The ECM coefficient value is observed to approve the theory (with a negative sign) and found that 81.51% convergence from short-run to long-run equilibrium will occur annually with these concerned independent variables.

Cointegration Result by Westerlund (2008)

We have considered the cointegration among the variables, the basic time factor, and permission for heterogeneity are taken into consideration using the panel cointegration technique. For this purpose, the Westerlund ECM panel cointegration test was. Table 9 provides four statistics' results (Gt, Ga, Pt, Pa). The Ho of Westerlund is No cointegration among the panel. The first two tests of Gt and Ga show the cointegration of the panel as a whole. At the same time, the cointegration of at least one unit is tested with Pt and Pa. The results show that rejection of Ho and acceptance of the alternative hypothesis that the panel is cointegrated and shown by four tests.

Table 9 *Cointegration Result by Westerlund (2008)*

Statistics	Value	z-value	p-value
Gt	-1.494	1.384	0.0001*
Ga	-1.143	2.756	0.0000*
Pt	-0.977	2.279	0.9867
Pa	-1.132	1.735	0.0003*
*1 percent level of significance			

Causality Analysis

The DH causality test finds the causality among the variables and whether causality is running between the Tax to GDP ratio and its determinants in four SAARC countries. Table 10.10 shows the results of causality, and it is seen that there is one-way causality that exists from GDP, Gini, and employment to corruption way causality is also seen from Tax, Gini, and consumption expenditure to GDP. Similarly, one-way causality runs from employment to TAX and consumption expenditure to employment. Two-way causality is found between TFP, Employment, and corruption. In the same way from Gini to Tax, the two-way causality is also found, total factor productivity is causing Gini, and Gini is causing total factor productivity too.

Similarly, consumption expenditures are causing employment, and employment is causing consumption expenditure. It is seen that most of the variables show linkage among one another, and they cause one another most of the variables have shown one-way causality and others have shown two-way causality. Conversely, there is no causality found between consumption, tax, and corruption; similarly, no causality is found between employment and total factor productivity.

Correspondence concerning this article should be addressed to Arifa Saeed, arfasaeed@gmail.com

Table *10 Results of Dumitrescu-Hurlin causality*			
Null Hypothesis: Ho	z-stat	p-value	Inference
LNGDP ⇎ LNCORR	2.2677	0.0233	One way causality exists.
LNCORR ⇎ LNGDP	0.89855	0.3689	
LNTAX ⇎ LNCORR	0.24208	0.8087	No causality exists.
LNCORR ⇎ LNTAX	1.08617	0.2774	
LNGINI ⇎ LNCORR	3.05044	0.0023	One way causality exists.
LNCORR ⇎ LNGINI	1.34189	0.1797	
LNTFP ⇎ LNCORR	2.47320	0.0134	Two-way causality exists.
LNCORR ⇎ LNTFP	6.58151	0.0000	
EMP ⇎ LNCORR	1.41106	0.1582	One way causality exists.
LNCORR ⇎ EMP	2.14597	0.0319	
LNCEXP ⇎ LNCORR	1.46809	0.1421	No causality exists.
LNCORR ⇎ LNCEXP	0.09234	0.9264	
LNTAX ⇎ LNGDP	1.80450	0.0712	One way causality exists.
LNGDP ⇎ LNTAX	0.40110	0.6883	
LNGINI ⇎ LNGDP	1.54544	0.1222	One way causality exists.
LNGDP ⇎ LNGINI	0.45587	0.0000	
LNTFP ⇎ LNGDP	0.45576	0.6486	No causality exists.
LNGDP ⇎ LNTFP	0.1184	0.9060	
EMP ⇎ LNGDP	1.01262	0.3112	No causality exists.
LNGDP ⇎ EMP	1.24170	0.2143	
LNCEXP ⇎ LNGDP	0.00126	0.9990	One way causality exists.
LNGDP ⇎ LNCEXP	2.73564	0.0062	
LNGINI ⇎ LNTAX	1.87466	0.0608	Two-way causality exists.
LNTAX ⇎ LNGINI	3.27918	0.0010	
LNTFP ⇎ LNTAX	0.59140	0.5543	No causality exists.
LNTAX ⇎ LNTFP	0.57514	0.5652	
EMP ⇎ LNTAX	1.19314	0.2328	One way causality exists.
LNTAX ⇎ EMP	3.20728	0.0013	
LNCEXP ⇎ LNTAX	0.72382	0.4692	No causality exists.
LNTAX ⇎ LNCEXP	0.35498	0.7226	
LNTFP ⇎ LNGINI	3.83950	0.0001	Two-way causality exists.
LNGINI ⇎ LNTFP	2.1102	0.0348	
EMP ⇎ LNGINI	7.21955	0.0000	Two-way causality exists.
LNGINI ⇎ EMP	3.18287	0.0015	
LNCEXP ⇎ LNGINI	1.08214	0.2792	No causality exists.
LNGINI ⇎ LNCEXP	0.73497	0.4624	
EMP ⇎ LNTFP	0.18721	0.8515	No causality exists.
LNTFP ⇎ EMP	0.91909	0.3275	
LNCEXP ⇎ LNTFP	159804	0.1011	Two-way causality exists.
LNTFP ⇎ LNCEXP	246753	0.0135	
LNCEXP ⇎ EMP	164953	0.0990	One way causality exists.
EMP ⇎ LNCEXP	110443	0.2694	

Diagnostic Analysis

Table 11: ***Results of The Diagnostic Tests***			
Robustness Analysis	VIF	Prob.	Remarks
Slope heterogeneity Yamagata	------	0.300	No slope Heterogeneity
Breusch-Pagan Cook-Weisberg test	------	0.4976	No Heteroskedasticity
Multicollinearity	6.16	-------	No Multicollinearity
Pesaran's cross-sectional Dependence	------	0.152	No cross-sectional dependence

Conclusion & recommendations

The objective of the current study is to investigate the impact of TFP and income inequality on taxes in selected SAARC countries. The effect is analyzed by using panel data analysis ranging from 1990 to 2021. Estimation by including the variable of TFP is the chief novelty. The tax to GDP ratio is low and shows a slow increasing trend over time in selected countries. GDP is positive and significant, which means that a change in output will increase tax revenue. Thus, with the increase in GDP, the tax revenue will increase. The impact of income equality is negative means, and it will decrease the tax revenue. orruption is a positive and significant means increase in anti-corruption policies will increase tax revenue. Hence all this supports theory and expectation. The impact of total factor productivity is negative, and significant means an increase in TFP will decrease tax revenue. Due to the increase in employment, there will be an increase in the tax to

GDP ratio. The effect of consumption expenditure is negative and significant on tax. As SAARC countries and within the same regional block, trade, geographical nature, weather, and fiscal and monetary policies are independent in the long run. Thus, long run results are plausible but may vary in the short run. As every country has its country-specific effects and traits, country-specific economic and institutional differences may exist. The results confirm that most of the variables of the long-run elasticities are significant. Error correction term tells us about the convergence of the model is negative and significant in all six models, which are as per theory. Hence all six models are shoeing convergence toward the long-run path. Diagnostic tests are applied to all models independently and found the model is stable. because There is no slope heterogeneity, heteroscedasticity, multicollinearity, and cross-section dependence among the variables.

Policy Framework

Firstly, to lessen the damaging effects of income inequality on TFP, the government redefines countries' economic development policies.

Secondly, tax rates are changing over time in these countries, which has long-term harmful effects to economic growth. Low tax rates mainly cause their reliance on bond financing and foreign debt. Thus, the finest tax rate should be selected to finance the budget.

Thirdly, anti-corruption policies have a positive impact on economic growth. These policies will generate revenue for the government, leading to economic growth.

Fourthly, according to our research, total factor productivity will decrease with the increase in income inequality in SAARC countries. The natural negative link between growth and inequality, primarily caused by political instability, is what causes the negative relationship between inequality and growth.

Fifthly, inequality has a detrimental effect on growth. Around the world, the political left is typically associated with a desire to eliminate or lessen economic inequality. The primary rationale in favor of reduction stems from the notion that economic inequality weakens social cohesion and fuels social unrest, weakening society.

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Correspondence concerning this article should be addressed to Arifa Saeed, arfasaeed@gmail.com

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Correspondence concerning this article should be addressed to Arifa Saeed, arfasaeed@gmail.com