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**Analyzing Tax Policy and Economic Growth by Using
Semi-Parametric Approach**

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Abstract. Due to complexities in measuring the impact of tax policy on economic growth, there is need to explore functional relationship between response and predictors. Semi-parametric approaches are often very handy in modeling relationships which are non-linear but cant be completely described either through parametric or non-parametric approaches. To determine the effects of tax policy on economic growthfunctional, cubic smoothing spline method is used along with cross validation test to control the smoothing parameter. To replace the functional form of smoothing coefficients into linear mixed model, maximum likelihood estimation is used. Results indicate that proposed methodology is robust in determining functional form and in achieving increasing average marginal tax rates has negative impact on economic growth results. Empirical results indicate that high AMTRs and population growth rate reduce the performance of economic growth in the developing countries. A reduction on dependence of AMTRs in South Asian countries is needed.

Keywords: Spline smoothing method, Semi-parametric, Tax structure, Economic growth, Average marginal tax rate.

JEL. H26, O40, C14, H71.

1. Introduction

Comparison of full- and semi-parametric statistical techniques that have been widelydiscussed in literature. Bearing the sensitivity of tax system and its impact on economic growth in mind, a number of statistical techniquis provide us with more powerful and least biased understanding of the data. There are a number of theoretical frameworks which narrate that economic growth in the long run may or may not be affected by taxes. Neoclassical (exogenous) economists believe that economic growth is not affected by taxes in the long run Solow (1956). Contrary to this, endogenous growth models King & Rebelo (1990), Barro & Sahasakul (1986), advocate that taxes affect the economic growth through investment in human and physical capital.

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There exists a lot of literature on the nexus between economic growth and tax system, and tax policy Barro (1990), King & Rebelo (1990). However, there exists a lacuna in case of empirical analysis using rigorous statistical techniques. In this context, researchers' primary concern is to find those factors which are responsible for determining tax revenue collection and lead to economic growth.

The dichotomy between tax policy and growth is mainly due to the inadequate tax measures which lead to inconclusive results in an important source of economic growth. The construction of adequate number of variables is the primary obstacle for estimating the impact of taxation on economic growth Mendoza *et al.* (1997). Secondly, appropriateness of statistical techniques that speaks about the data is another issue.

This paper contributes in two ways to the pertinent literature. First, by calculating Average Marginal Tax Rate (AMTR)¹ on the data available, and, second, to investigate the effects of taxation on economic growth by applying additive mixed models (a semi-parametric approach) along with full parametric approach on panel data available for Pakistan, India, Sri Lanka, Maldives and Nepal.

Though, Easterly & Rebelo² (1992), and Padda & Akram³ (2009) adopted different statistical techniques but found negative relationships between income tax rates and economic growth for developing countries. Neil (2008) explained that higher growth in GDP is associated with more share of government expenditure and less share of taxes in countries having low level of income. He concluded that the effect of fiscal policy variables: taxes, government expenditure and budget on economic growth depends upon the country specific factors. Ricardo (1990) found that there is negative association between taxes and economic growth by taking into consideration the developed and developing countries. However, the benefits of taxes in terms of reducing deficit lead to higher economic growth. Schultz (1981) investigated that taxes affect the economic activity which could lead to economic development and growth. Irrespective of the fact that taxes are considered engine of economic growth via reducing deficit but due importance was not given to the tax measures in general and in particular to the AMTR and ATR in the developing economies.

The objective of the current study is to fill the gaps found in the relevant literature by determining the impacts of taxation on economic growth in selected South Asian countries, and to examine which of the two tax rates: AMTR or ATR⁴ is more appropriate by using full- and semi-parametric modelling.

Our study shows two main results. First, in order to increase economic growth a substantial tax cut in prevailing tax level is essential in developing countries. However, taxation rate and economic growth relation is non-linear. Second, the use of multiple statistical approaches has proved ideal for policy formulations in terms of tax mechanism at a country level.

The study is organized as follows. Section 2 discusses about problems and calculation of AMTRs. Section 3 describes tax system in Asian economies. Section 4 is about the methodology that has been adopted in estimating our model. Section 5 contains information on data and variables. Section 6 is about the empirical results. Section 7 is based on comparison of the results of full-parametric and semi-parametric approaches, whereas section 8 concludes the argument.

¹ Average marginal tax rate is progressive taxation i.e. as you make more money, you keep less of each dollar.

² Easterly & Rebelo (1992) estimated AMTRs for some developing and industrialized countries.

³ Padda & Akram (2009) compared the tax policies adopted by neoclassical and endogenous growth models and their effects on economic growth.

⁴ Average tax rate is fixed taxation i.e. no matter you make how much money, you have to pay a fixed amount as tax.

1.1. Average Marginal Tax Rates Calculation Problems

To calculate the AMTRs by using the microeconomic data is simple, but the use in macroeconomic data is somewhat complex and found rare. We shall briefly explain the method that has been used to construct the AMTRs before using the macro data to calculate the AMTRs.

Seater (1982; 1985), calculated AMTRs ‘by taking the ratio of change in tax revenue ($T_i - T_{i-1}$) and change in total income before tax deduction ($Y_i^b - Y_{i-1}^b$) for every income class i weighting with the share of the income class W_i and summing up for all classes’. Due to non-availability of data for South Asian region, we are restricted to follow the following formula to calculate AMTRs by foregoing the weightage and assuming all income groups equal:

$$AMTR = \sum_{i=1}^n \frac{T_i - T_{i-1}}{Y_i^b - Y_{i-1}^b} \quad (1)$$

1.2. Tax System in Asian Economies

The article at hand includes the data of India, Maldives, Nepal, Pakistan and Sri-Lanka. The economic features of these countries are different. On account of the absence of any particular organizing mechanisms for the formulation of economic policies for the region as a whole, it is inevitable to understand the tax mechanism of each country separately. As a result, the tax structure, composition of taxes and overall taxes differ from country to country. Though it is very difficult to make a similar analysis for the whole region but efforts could be made to highlight taxation issues related to the South Asian economies. The low level of tax burden is the most common feature of this region, but, as already mentioned that tax to GDP ratio varies from country to country, tax rates show both sides of the picture. On one side, the low tax rate is an incentive for investors which boosts the economy and short-run growth becomes faster. On the other side, low tax collection may persuade the policy makers to deteriorate public expenditure in many sectors of the economy like education, health, fiscal interest structure and public service sectors. So the economy follows the progressive tax system that will discourage the investment. The economic activity generated by the public sector depends upon the volume of tax collection.

1.3. Evolution of Data

While the limited data to construct AMTRs is available for south Asian Countries, tax statistics allow constructing these measures 1991- 2010. Before the description and analysis of data, it is important to understand how changes have occurred over time in the tax system of South Asian countries, and this is discussed in the following paragraph.

In 1979, the income tax ordinance act was formulated in Pakistan. In 2001, a number of tax reforms were introduced by the FBR to raise tax revenue like the LTU (large tax-payer units), MTU (medium tax-payer units), USAS (universal self-assessment system), and VAT (value-added tax system). These reforms lead to reduce tax/GDP because of the narrowing down the tax base. Although, these reforms increase the tax revenue adequately in absolute term but tax to GDP ratio went down which adversely affected the economic growth. The impact of these reforms in selected economies is shown by using the AMTR and ATR in figures 1 and 2. Pakistan faced the highest tax burden in the South Asian region. It is the only country in South Asian region that has extensive tax-paying rates. It is known for low tax/GDP and narrow tax base. The tax to GDP ratio was 13.7 percent and 13.1 percent in 1980s and 1990s respectively. In 2006-7, it reduced to 10.6 percent of GDP. So, the government was forced to depend upon deficit financing due to

low tax revenues. To construct AMTRs for Pakistan, data has taken form World Development Indicators (WDI). Pakistan is ranked second in South Asia in the ease of paying taxes in the period of 1990. In 2001, universal self-assessment system ordinance (USAS) passed tax slabs for different levels of income that are prevailing today. Due to the amendment in 1979, income tax ordinance has affected the average tax rates and overall tax rates in this scenario. AMTRs show the decreasing trend as shown in figures 1 and 2.

To construct the AMTRs for India, Maldives, Nepal, and Sri Lanka, the data have been taken from world development indicators (WDI). India ranks lowest in ease of paying taxes due to smaller tax base. In India Finance Act 1961, income tax law prevailed till 1970s. The tax revenue/GDP ratio was in narrow band (6 to 10 percent) from the period of early 80s to the mid of the first decade of 21 century, while it was 9.2 percent in 2007. Figure 2 shows AMTRs for India are considerably low at the end of 1999, while in the early 2000 they show slightly increasing trend due to increase in statutory tax rate. In 2005, Finance Act was introduced as an important tax reform. One of these was fringe benefit tax in the union budget. It increased the burden of tax agreements as well as tax rates.

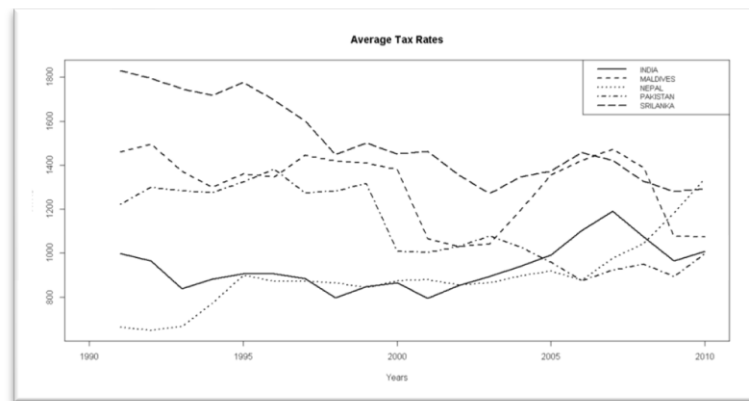


Figure 1. Average Tax Rates (ATRs) of South Asian countries

Maldives ranks first worldwide in terms of ease in the process of paying taxes and is well ahead of other countries in South Asia. It has small economy, and domestic companies are exempted from taxes on labour, profit and consumption. So, it shows the constant pattern in the figure.

Nepal has ranked middle in terms of the ease of the process of paying taxes. Its tax rates are relatively higher in the South Asian region, although lower than the regional averages. Due to policy change it shows the flexibility of increasing trend.



Figure 2. Average Marginal Tax Rates (AMTRs) of South Asian countries

In Sri Lanka, tax/GPD was 18 percent in 1970s and 80s. Due to unfavourable events this ratio kept on declining and reached up to 14.2 percent only in 2007. These circumstances led to cut down in the expenditures on key sectors like education and health. SriLanka has ranked fourth overall in South Asia with regard to ease of paying taxes. Figure 2 shows the constant decreasing trend due to continuous change in policies from 2000 to 2009. Policy change was influencing tax rates and statutory income tax.

2. Methodology

To investigate the effects of taxmechanism of different countries on their economic growth, we have used additive mixed model approach using AMTR. We have included, in our analysis, those control variables that are based on growth theory. We consider some control variables which are frequently used in regression analyses and many economists have the consensus that these variables have some impact on economic growth. There might be non-linear effect of tax policy on economic growth as stated by Bevan (2005), and Bania, *et al.* (2007).

General multiple regression model (Barro, 2008) with y response variable and k predictor variables can be written as:

$$y_{it} = \beta_0 + \beta_1 c_{i1} + \dots + \beta_k c_{ik} + \mu_i \quad (2)$$

where error (μ) is assumed independently and identically distributed (iid). We extend the linear model by replacing the linear form $\alpha + \sum \beta_1 c_{i1}$ to the additive form $\sum f_j(E_{it})$ where f_j are smooth functions of the covariates E_{it} . The model permits the stretchy specification of the dependence of the response on the covariates, and the model specification through the 'smooth function' as mentioned above.

$$R_i = f_1(E_{i1}) + \dots + f_g(E_{ig}) + \beta_{g+1} c_{i(g+1)} + \dots + \beta_k c_{ik} + \mu_i \quad (3)$$

A generalized additive model (Hastie & Tibshirani, 1986; 1990) is a model having independent variables with smooth functions alongwith linear predictors. We assumed observations $R_i; (c_{i1}, \dots, c_{ik}), i = 1, \dots, n$ of a continuous dependent variable R_i and covariates c_{i1}, \dots, c_{ik} linear predictor modelled through the outcome of R_i . Moreover, we have observations $(E_{i1}, \dots, E_{iq}), i = 1, \dots, n$ of continuous covariates E_{i1}, \dots, E_{iq} , non-parametrically modelled and we observed the outcome of E . The functional form of $f_1(E_{i1})$ and the independent variables E_{i1}, \dots, E_{iq} show the non-linear effects. We limit ourselves in the penalization methods and their equivalent Bayesian approach in estimation process. To address the issue of identification which are very common in additive models, we fixed level of the functions. This is generally guided by 'centering the functions around zero,' such that

To determine the functional form, we used some constraints which define the basic functions by utilizing the cubic smoothing spline. To control the smoothing parameter, we used generalized cross validation test⁵. Prior information used in the form of spline coefficients that replace the functional form of semi-parametric model and results in the form of linear mixed model. Its estimation is carried out by

⁵ Here, the notion is that the degree of smoothness from the spline may be the best possible predictor of any dataset to which it has not been fitted. For more detail, see Hastie & Tibshirani (1990). Generalized Additive Models and Wood 2006. Generalized Additive Models: An Introduction with R.

maximum likelihood theory ⁶ (Searle, *et al.* 1992; McCulloch, 2001). To control the serial correlation and unobserved heterogeneity due to the multiple observations per country, we used country specific random effect.

We limit ourselves in the penalization methods which equivalent to Bayesian approach in the estimation process. To address the issue of identification which are very common in additive model, we fixed level of the functions. This is generally guided by “centering the functions around zero” such that:

$$f_j(E_j) = b_j(E_j)\beta_j \tag{4}$$

Non-parametric function is estimated by penalized least squares (PLS) using the cubic spline $\beta(\cdot)$ which is based on the selection of a number of knots and the further estimation has been carried out by using penalized smoothing splines. Thus cubic smoothing spline $\beta(\cdot)$ shows the higher dimensions and gives poor result. To overcome this problem, we impose penalty on the coefficient vector b_j and commonly using the quadratic penalty $\lambda_j b_j^t D_j b_j$ with D_j , the penalty matrix⁷ and λ_j , the penalty parameter, shows the amount of smoothness. The main advantage of the cubic smoothing spline is that quadratic form can penalize the integration of second-order derivative of the function $f_i(\cdot)$.

Following Wahaba (1978), Wong & Kohn (1996) and Wood (2003), we need prior information on $b_j \sim N(0, \lambda_j^{-1} D_j^{-1})$ with likelihood (data) in Bayesian statistics. In this case prior information is a quadratic penalty matrix and likelihood data. We combine both to get posterior distribution coefficients and credible intervals using time posterior distribution. The equation (5) is called the linear mixed model (see, for example, Searle, *et al.* 1992; McCulloch, 2001) and the derivation of the parameters $\sigma_\varepsilon^2, \lambda_j$ and β_j ($j = q + 1, \dots, p$) can be carried out with the help of maximum likelihood in R software and all implementations are available in R-package *gamm* (see Wood, 2010).

$$y \mid b_1, \dots, b_j \sim N\left(\beta_0 + \sum_{j=1}^q \beta_j(c_j) b_j + \sum_{j=q+1}^p c_j \beta_j, \sigma_\varepsilon^2\right) b_j \sim N(0, \lambda_j^{-1} D_j^{-1}), j = 1, \dots, q \tag{5}$$

Now we include the country specific random effects that control the heterogeneity and serial correlation. More specifically, we replace model (5) by

$$y_{it} \mid b_1, \dots, b_j \sim N\left(\beta_0 + \sum_{j=1}^q \beta_j(c_{jit}) b_j + \sum_{j=q+1}^p c_{jit} \beta_j + \gamma_{i0}, \sigma_\varepsilon^2\right) \tag{6}$$

$$b_j \sim N(0, \lambda_j^{-1} D_j^{-1}), j = 1, \dots, q$$

$$\gamma_{i0} \sim N(0, \tau_0^2)$$

where subscript *it* corresponds to the *t*th observation (in time) drawn from the *i*th country and γ_{i0} is the latent-country specific effect and (6) becomes the linear mixed model. Our empirical model drawn from the above theoretical considerations is defined as follows:

$$RGDPC_{it} = \alpha + f(AMTR_{it}) + \beta_{cit} + \gamma_{i0} + e_{it} \tag{7}$$

⁶ Application is available in R package ‘*gamm4*’.

⁷ See Wood 2006 for details on penalty matrix.

where RGDP_{it} is the real per capita GDP for country *i* and at time *t*, α_i is the regression constant AMTR measure, c_{it} is the vector of covariates, β the vector of regression coefficients of the covariates, γ_{i0} the country specific effect controlling the unobserved heterogeneity, e_{it} is the error term (iid). The set of control variables is discussed in the following section.

Table 1. Control Variable and Data Sources

| Growth determinant | Proxy variable | Denotation | Data source |
|---------------------------|---|------------|-------------|
| Per capital GDP | Real per capital GDP | Gdp.level | PWT |
| Growth rate of population | Population growth rate | POP | PWT |
| Savings rate | Share of investment as a percentage of GDP | INV | PWT |
| Human capital | Tertiary education | COM | BL |
| Trade openness | Sum of exports and imports as a percentage of GDP | OPEN | PWT |

Notes: Read: PWT = Penn world table, BL = Barro Lee

3. Description of Variable and Data Sources

3.1. Description of Variables

The choice of control variables in our panel regression model can be based on Barro regressions explained in eq. (2). Most economists believe that these control variables may have an effect on the economic growth and the influence of these variables on countries under study will determine whether these countries are in their steady state or not. For example population growth rate has no impact on the balance of per capita income growth rate in neoclassical growth models. This paper used per capita GDP growth (RGDP_{it}) as dependent variable. The ambiguity may arise about selection of per capita GDP as dependent variable instead of real GDP (RGDP). Because the per capita GDP growth is helpful in estimating the tax policy's effects on economic welfare of a country (Arin *et al.* 2013). Human capital is difficult to measure and there are different proxies used for human capital. The earlier literature has mostly used the adult literacy rate, primary and secondary school enrollment rates (Barro, 1991, Levin & Renelt, 1992, Mankiw *et al.*, 1992). The investment in human capital has been affected by taxes (Trostel, 1993). The recent studies found that higher education is a proper measure of human capital (Gemmell, 1996; Griffith, 2004). Hence we are using the 'tertiary education completion rate' as a proxy variable for human capital. We have taken these rates from the Barro and Lee educational attainment dataset. A country's growth is well recognized by its relationship with the volume of trade (Jones, 2002, Weli, 2009). Therefore, we have also included the trade openness in our regression models. The population growth rate is commonly used as a control variable in growth regressions because the population growth rate is an important determinant of per capita income (Mankiw *et al.*, 1992, Arin *et al.*, 2013). The real per capita growth has an important determinant of savings and most of the economists agree at this point. We construct the savings rate via the share of investment as a percentage of GDP (Arin *et al.*, 2013).

4. Estimation Results

Our initial statistical model is given by,

$$RGDP_{it} = \alpha_i + \beta_1 (AMTR_{it}) + \beta_2 (INV_{it}) + \beta_3 (POP_{it}) + \beta_4 (OPEN_{it}) + \beta_5 (COM_{it}) + e_{it} \tag{8}$$

Table 2. Estimation results from the parametric and semi-parametric models

| Variable Name | Coefficients (SE) | | |
|---|-------------------|------------------------------|------------------------------|
| | Full Parametric | Semi Parametric (using AMTR) | Semi Parametric (using ATRs) |
| Intercept | 0.064*** (0.001) | 0.067*** (0.002) | 0.0667*** (0.002) |
| ATR | 0.003 (0.812) | | -0.003*** (0.001) |
| AMTR | -0.06** (0.003) | -0.003*** (0.001) | |
| POP | -0.103*** (0.037) | -0.143*** (0.016) | -0.129*** (0.017) |
| INV | 0.027*** (0.005) | 0.028*** (0.002) | 0.031*** (0.002) |
| OPEN | 0.003*** (0.001) | 0.001 (0.001) | 0.001 (0.001) |
| COM | 0.001*** (0.0001) | 0.001*** (0.0001) | 0.001*** (0.0001) |
| Coefficients of Correlation - Semi Parametric Model | | $\rho_{(Inv,Int)} = -0.099$ | $\rho_{(Inv,Int)} = -0.121$ |
| | | $\rho_{(Pop,Int)} = -0.087$ | $\rho_{(Pop,Int)} = -0.057$ |
| | | $\rho_{(Com,Int)} = -0.124$ | $\rho_{(Com,Int)} = -0.152$ |
| | | $\rho_{(AMTR,Int)} = 0.106$ | $\rho_{(ATR,Int)} = 0.035$ |
| | | $\rho_{(AMTR,Pop)} = -0.019$ | $\rho_{(ATR,Pop)} = -0.076$ |
| | | $\rho_{(Pop,Inv)} = -0.24$ | $\rho_{(Pop,Inv)} = -0.24$ |
| | | $\rho_{(Com,Inv)} = -0.104$ | $\rho_{(Com,Inv)} = -0.14$ |
| | | $\rho_{(AMTR,Inv)} = 0.044$ | $\rho_{(ATR,Inv)} = -0.29$ |
| | | $\rho_{(Com,Pop)} = 0.107$ | $\rho_{(Com,Pop)} = -0.067$ |
| | | $\rho_{(AMTR,Com)} = 0.046$ | $\rho_{(ATR,Com)} = 0.591$ |

Table 2 contains the estimated results of full- and semi-parametric models. Results of the full parametric model have been shown in column 2 while columns 3 and 4 shows the results of semi-parametric model using AMTRs and ATRs respectively. Coefficients of correlation of the covariates particularly with AMTR and ATR depicts the strength and magnitude of the covariates. All the control variables are used in rates so we did not check the time series statistics. But all variables become significant when AMTR is used as tax measure.

The estimated coefficient that corresponds to AMTR is -0.003 which reveals some theoretical understanding that if the developing country increases the AMTRs, growth will be depressed. However, if we consider AMTR variable complementary with the variable population and substitute with all other variables (which is the real case), our regression results go along the economic theory.

The estimated coefficient for investment rate is 0.028 which indicates productive use of investment. It suggests that if investment is made in the areas of key concern, short-run economic growth rates increases due to low tax rates. Empirical literature also supports positive impact of the investment (Hall & Jorgenson, 1969; Schumpeter, 1942; Cullen & Gordon, 2002).

World market is firmly connected with the economic system (through their generous exports and imports) the position of imbalances current account tackles relatively easily. Gentry & Hubbard (2000) found that low tax rate generate the ideas of growth. Increased tax rate implies that larger part of earning income will go to the government rather than investors. So it depresses the economic growth rate.

Human capital has been taken as proxy of tertiary education completion ratio which shows positive relationship with economic growth rate. Heckman *et al.*, (1998) shows that the increasing trend of income taxes and tax rates decreases the education rate and also depress the growth rate. Trostel (1993) stated that a constant tax rate does not affect the education rate and growth rate.

Giving first preference to the coefficient of AMTR, it is highly significant. The negative sign having the theoretical background states that if the developing countries increase AMTR (e.g. Capital mobility, national taxes, development traps) they will drop revenues from such resources. This trade-off is not difficult to understand. Nonetheless, Young (2004) finds out that AMTR has been significant and has negative affect on economic growth. Economic growth would be enhanced by slowing down the tax rate because a small tax cut did not affect the economic

growth. Higher AMTRs affect the economic growth largely rather than the lower ones moderating tax rates, give detrimental effects on economic growth.

Population also have a negative impact on economic growth in these group countries. Leuthold (1991) also revealed the negative and significant impact of population on per capita GDP growth rate for a set of 8 African countries. Ghura (1998) measured that population growth rates affect the real per capita GDP adversely and significantly. However, in the developing countries like south Asian countries, the case is different where such population growth rates has depressed the economic growth.

The smooth effects of taxes on economic growth is shown in Figure 3 using the scale of 'linear predictor with 2 standard error confidence band'. The increase in AMTR at the lower level of taxation affects more adversely than at higher levels of taxation. An increase the AMTR -0.4 to -0.2, measured by AMTR depresses the economic growth rate by roughly 2.94 percentage points. This effect has very important consequences on the economic growth.

Without considering the real functional form of these effects, we find out the compact empirical mark for nonlinearities of the effects of taxation on economic activity. The income effects and of reduction in wage rate is most relevant reason of the non-linear growth effects of taxes. The substitution effects and income effects are generated along reduction in net wage rate (after tax wage rate) by an increase in AMTRs. It gives an incentive to the people to opt leisure instead of working time. Simultaneously, people might be forced for more work due to the decrease in disposable income (after tax income).

The exogeneity of the covariables is one of the major assumptions in econometric studies. It is stated by $E(\varepsilon_{it}|X) = 0$, if X is considered to be exogenous. The corresponding covariates are considered to be endogenous, if the above assumption does not hold true. Endogenous coefficients become biased when employing OLS regression. Some of the possible reasons of heterogeneity can be precluded in our estimation because our mixed model approach avoids classical OLS regression assumptions. It takes serial correlation along with unobserved heterogeneity with a latent variable in the models into account. Thus, Hausman test cannot be used due to difference in model structure.

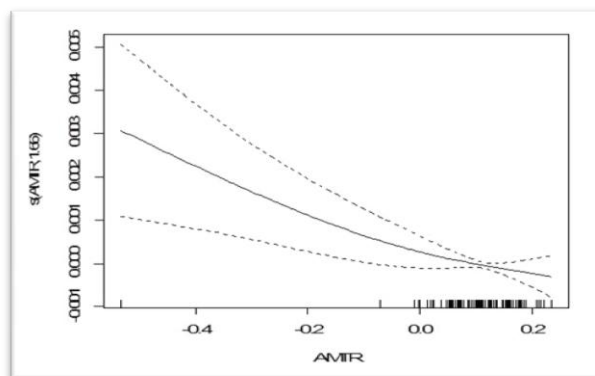


Figure 3. Smooth effect of $f(AMTR)$

4.1. Performance of the Semi-Parametric Approach

Section 5 contains the results of statistical models' coefficients along with their interpretation. The other parts of the models are worth studying in order to know the superiority of the model.

It is known that conventional approaches are not superior to be used as estimation strategy. To confirm this phenomenon, we have compared the used

estimation strategy with the conventional approaches. To do this, we have used AMTRs in place of ATRs as a measure of tax policy. Secondly, we have studied semi-parametric estimation approach by employing nonlinear effects of tax policy on economic growth. To confirm the existence of nonlinear effect and to prove the better use of AMTRs, we have compared this approach with the conventional approach i.e. OLS on the basis of Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

4.2. Average Marginal Tax Rates Versus Average Tax Rates

The existing literature is pervasively with the Average Tax Rate (ATR) as a measure of tax policy effects on economic growth. By using ATR, we re-estimate the growth regression i.e.

$$RGDPC_{it} = \alpha_i + f_i(ATR_{it}) + \beta X_{it} + \gamma_{i0} + e_{it}$$

The average tax rate (ATR_{it}) is used as a proxy of the share of tax revenue in GDP of a country i in year t . All the procedure that has been adopted on AMTR is used on ATR (results are shown in Table 2).

4.3. Discussion on Semi - Parametric Results by Using Average Tax Rates

The coefficient of ATR is measured as the share of taxes in gross domestic product of a country i in year t , shows significant results, but indicates the depression in economic growth. In other words, one unit increase in the ATR depresses the growth by 0.002 percentage points. Rest, all control variables are significant.

The smooth effects on scale of ‘linear predictor with 2 standard error confidence band’ are displayed to investigate the effects of tax on economic growth. Figure 4 shows the functional effect of ATR. Irrespective of similarities of the shape of fitted curve to the AMTR model and ATR, but the fitted model become relatively poor performance by using ATR. It suggests that for analysing tax mechanism AMTRs measures are more appropriate as compared to ATR because AMTRs gives more efficient results and for empirical analyses of the penalties of tax policy.

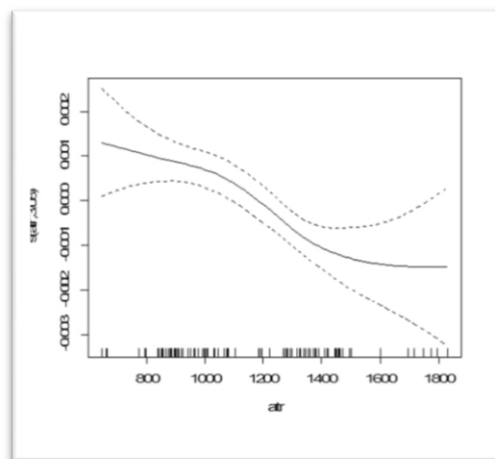


Figure 4. Smooth effect of $f(ATR)$

4.4. Linear Versus Non-Linear Estimation Approach

Table 2 indicates semi-parametric results in comparison to parametric result. The results differ slightly. In semi-parametric model trade openness variable remains insignificant. In all models the coefficient of investment share and population growth rate has the same sign and size. The increase in AMTRs decreases the economic growth. Semi-parametric model can be compared with

parametric one by applying Akaike's information criterion (AIC which is -979.192 for semi-parametric model and -881.7845 for parametric model) & Bayesian information criterion (BIC which is -956.3023 for semi-parametric model and -863.5483 for parametric model). Complexity of the model can be described by relying on the log-likelihood fitted model. Complex models are penalized, especially by BIC. The better model fit is indicated by the lower value of information criteria as 'smaller is better'. In the light of available results semi-parametric results are superior to parametric counterpart.

5. Conclusions

This study was designed to estimate the effect of tax mechanism on economic growth of the some South Asian countries. Due to non-availability of data on AMTR we constructed this variable for the five South Asian countries. By using the most relevant and meaningful tax measure the pooled data set make it possible to investigate the effects of taxes on the economic growth. Results show that AMTR affect economic growth negatively and significantly while investment, trade openness and education effect positively and significantly by using the parametric approach. We examined that there exists a non-linear pattern in the graph of residual estimated by parametric methodology. To overcome this issue, we moved toward the spline and generalized cross validation test. By using spline it is observed that population effect the economic growth negatively while investment, trade openness and education affect the economic growth positively. Finally, by applying the Semi parametric approach we found that the AMTR as well as population affect the economic growth negatively and significantly, while investment and education affect the economic growth positively and significantly. The same procedure was applied to the tax measure. i.e. average tax rate. We found the AMTR was the most relevant tax measure.

Tax policy shows the nonlinear effects on economic growth. At the lower level of taxation, increasing the AMTR, it affects more adversely, than the higher levels of taxation.

Results show that actual structure of taxes play very important role to determine the effects of tax cuts and tax increase. If the taxes prevailed at high levels, minor tax cuts may not generate any effect on the economic growth. So it suggests that to increase the economic growth a substantial tax cut in prevailing tax level is essential in developing countries. As in developing countries the AMTRs affects the economic growth adversely, developing countries should introduce tax reforms in a way that will lead to reduce dependence on AMTRs.

References

- Adam, C.S., & Bevan, D.L. (2005). Fiscal deficits and growth in developing countries. *Journal of Public Economics*, 89(4), 571-597. doi. [10.1016/j.jpubeco.2004.02.006](https://doi.org/10.1016/j.jpubeco.2004.02.006)
- Arin, K.P., Berlemann, M., Koray, F., & Kuhlenkasper, T. (2011). The taxation-growth-nexus revisited, *HWWI Research Paper*, No.104. [Retrieved from].
- Bania, N., Gray, J.A., & Stone, J.A. (2007). Growth, taxes, and government expenditures: growth hills for US states. *National Tax Journal*, 62(2), 193-204.
- Barro, J., & Sahasakul., A. (1986) Average marginal tax rates for social security and the individual income tax. *Journal of Business*, 59(4),555-566. doi. [10.1086/296354](https://doi.org/10.1086/296354)
- Barro, R.J. (1991) Economic growth in a cross section of countries. *The Quarterly Journal of Economics*,106(2), 407-443. doi. [10.2307/2937943](https://doi.org/10.2307/2937943)
- Barro, R.J. (2000). Inequality and growth in a panel of countries. *Journal of Economic Growth*, 5(1), 5-32. doi. [10.1023/A:1009850119329](https://doi.org/10.1023/A:1009850119329)
- Barro, R.J. (2008). Inequality and Growth Revisited, *ABD Working Paper*, No.11. [Retrieved from].
- Bengoa, M., & Sanchez-Robles, B. (2005). Does equality reduce growth? Some empirical evidence. *Applied Economics Letters*, 12(8), 479-483. doi. [10.1080/13504850500120177](https://doi.org/10.1080/13504850500120177)
- Carroll, R., & Prante, G. (2012). Long-run macroeconomic impact of increasing tax rates on high-income taxpay. Tax Foundation Press. [Retrieved from].
- Coen, R.M. (1969). Tax policy and investment behavior. *American Economic Review*. 59(3), 370-379.
- Easterly, W., & Rebelo, S. (1993). Fiscal policy and economic growth. *Journal of Monetary Economics*, 32(3), 417-458. doi. [10.1016/0304-3932\(93\)90025-B](https://doi.org/10.1016/0304-3932(93)90025-B)
- Fahrmeir, L., Kneib, T., Lang, S., & Marx, B. (2013). *Regression Models; Methods; Applications*, Springer.
- Gemmell, N. (1996). Evaluating the impacts of human capital stocks and accumulation on economic growth. *Oxford Bulletin of Economics and Statistics*, 58(1), 9-28. doi. [10.1111/j.1468-0084.1996.mp58001002.x](https://doi.org/10.1111/j.1468-0084.1996.mp58001002.x)
- Grace, W. (1978). Improper priors, spline smoothing and the problem of guarding against model errors in regression. *Royal Statistical Society. Series B (Methodological)*, 40(3), 364-372.
- Gray, J.A., & Stone, J.A. (2012). Debt and nonlinear and fiscal policy: Evidence from the states. *MPRA Working Paper*, No.39731. [Retrieved from].
- Griffith, R., Redding, S., & Simpson, H. (2009). Technological catch-up and geographic proximity. *Journal of Regional Science*, 49(4), 689-720. doi. [10.1111/j.1467-9787.2009.00630.x](https://doi.org/10.1111/j.1467-9787.2009.00630.x)
- Hausman, J.A. (1978). Specification tests in econometrics. *Econometrica*, 46(6), 1251-1271. doi. [10.2307/1913827](https://doi.org/10.2307/1913827)
- Heckman, J.J. (2000). Policies to foster human capital. *Research in Economics*, 54(1), 3-56. doi. [10.1006/reec.1999.0225](https://doi.org/10.1006/reec.1999.0225)
- Heller, P. (1975) A model of public fiscal behavior in developing countries aid, investment, and taxation. *The American Economic Review*, 65(3), 429-445.
- Seater, J.J. (1985) On the construction of marginal federal personal and social security Tax rates in The U.S., *Journal of Monetary Economics*,15(1),121-135. doi. [10.1016/0304-3932\(85\)90057-1](https://doi.org/10.1016/0304-3932(85)90057-1)
- Jaimovich, N., & Rebelo, S. (2013) Non-linear effects of taxation on growth. *NBER Working Paper*, No.18473. doi. [10.3386/w18473](https://doi.org/10.3386/w18473)
- Jones, C.I. (1994). Economic growth and the relative price of capital. *Journal of Monetary Economics*, 34(3), 359-382. doi. [10.1016/0304-3932\(94\)90024-8](https://doi.org/10.1016/0304-3932(94)90024-8)
- Jones, L.E., Manuelli, R.E., & Rossi, P.E. (1993) Optimal taxation in models of endogenous growth. *Journal of Political Economy*, 101(3), 485-517. doi. [10.1086/261884](https://doi.org/10.1086/261884)
- Kanaoka, M. (2012). Have the lessons learned from the Asian financial crisis been applied Effectively in Asian economies?, *International Journal of Economics and Finance*, 4(2), 103-115. doi. [10.5539/ijef.v4n2p103](https://doi.org/10.5539/ijef.v4n2p103)
- Karagianni, S., Pempetzoglou, M., & Saraidaris, A. (2012). Tax burden distribution and GDP growth: Non-linear causality considerations in the USA. *International Review of Economics & Finance*, 21(1), 186-194. doi. [10.1016/j.iref.2011.06.002](https://doi.org/10.1016/j.iref.2011.06.002)
- Koester, R.B., & Kormendi, R.C. (1989). Taxation, aggregate activity and economic growth: Cross country evidence on some supply-side hypotheses. *Economic Inquiry*, 27(3), 367-386. doi. [10.1111/j.1465-7295.1989.tb02011.x](https://doi.org/10.1111/j.1465-7295.1989.tb02011.x)
- Kuhlenkasper, T., & Kauermann, G. (2010). Female wage profiles: An additive mixed model approach to employment breaks due to childcare, Hamburg Institute of International Economics, HWWI Research. [Retrieved from].
- King, R.G., & Levine, R. (1993). Finance, entrepreneurship and growth. *Journal of Monetary Economics*, 32(3), 513-542. doi. [10.1016/0304-3932\(93\)90028-E](https://doi.org/10.1016/0304-3932(93)90028-E)
- Lee, Y., & Gordon, R.H. (2005). Tax structure and economic growth. *Journal of Public Economics*, 89(5), 1027-1043. doi. [10.1016/j.jpubeco.2004.07.002](https://doi.org/10.1016/j.jpubeco.2004.07.002)
- Levin, R., & Enelt, D. (1992) A sensitivity analysis of cross-country growth regressions. *American Economic Review*, 82(4), 952-963.

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- Li, W., & Sarte, P.D. (2004). Progressive taxation and long-run growth. *American Economic Review*, 94(5), 1705-1716. doi. [10.1257/0002828043052196](https://doi.org/10.1257/0002828043052196)
- Mendoza, E.G., Razin, A., & Tesar, L.L. (1994). Effective tax rates in macroeconomics: Cross-country estimates of tax rates on factor incomes and consumption. *Journal of Monetary Economics*, 34(3), 297-323. doi. [10.1016/0304-3932\(94\)90021-3](https://doi.org/10.1016/0304-3932(94)90021-3)
- Mahdavi, S. (2008). The level and composition of tax revenue in developing countries: Evidence from unbalanced panel data. *International Review of Economics & Finance*, 17(4), 607-617. doi. [10.1016/j.iref.2008.01.001](https://doi.org/10.1016/j.iref.2008.01.001)
- McCulloch, C.E., & Searle, S.R., & Neuhaus, J.M. (2001). *Generalized, Linear and Mixed Models*, Wiley, Interscience.
- Padda, I., & Akram, N. (2009) The impact of tax policies on economic growth evidence from Asian economies. *The Pakistan Development Review*, 28(4), 961-971.
- Rivera-Batiz, L.A., & Romer, P.M. (1991). International trade with endogenous technological change. *European Economic Review*, 35(4), 971-1001. doi. [10.1016/0014-2921\(91\)90049-O](https://doi.org/10.1016/0014-2921(91)90049-O)
- Ruppert, D., Wand, M.P., & Carroll, R.J. (2003). *Semiparametric Regression*, Cambridge University Press.
- Schumpeter, J. (1942). *Creative Destruction. Capitalism, Socialism and Democracy*, Herper perennial Modern Classics.
- Solow, R.M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65-94. doi. [10.2307/1884513](https://doi.org/10.2307/1884513)
- Trostel, P.A. (1993). The effect of taxation on human capital. *Journal of Political Economy*, 101(2), 327-350. doi. [10.1086/261878](https://doi.org/10.1086/261878)
- Wahba, G. (1978). Improper priors, spline smoothing and the problem of guarding against model errors in regression. *Journal of the Royal Statistical Society. Series B (Methodological)*, 40(3), 364-372.
- Zagler, M., & Durnecker, G. (2003). Fiscal policy and economic growth. *Journal of Economic Surveys*, 17(3), 397-418. doi. [10.1111/1467-6419.00199](https://doi.org/10.1111/1467-6419.00199)



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