Macroeconometric Approach: Optimal Taxation Policies for Economic Growth in Emerging Asia

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Abstract: Innovative and evidence-based public economic policies are vital for the provision of efficient public services in emerging economies. Many developing countries require privation of optimal taxation system to promote economic growth. The research question intends to identify the optimal taxation policies and impact of taxation on economic growth in emerging Asia. Rationale for the research is to provide pragmatic evidences to build up tax systems that generate optimal tax revenues in an equitable manner and facilitation of taxation for economic growth. Macroeconometric approach is used to (i) estimate the Laffer curve for Asia with Generalized Method of Moments (GMM) in factors affecting optimal taxation. (ii) Fully Modified OLS (FMOLS), Dynamic OLS (DOLS) and Conical Cointegration Regression (CCR) are used to estimate the cointegration equation for the impact of taxation on economic growth using the World Bank data from 1990 to 2015. The empirical results indicate, across estimation methods and specifications, that the determinants of optimal taxation over estimation of Laffer curve are tax-rate, tax-rate^2 and debt negatively significant, while tax-rate*debt, unemployment rate, foreign direct investment, and openness are positively significant. Further, comparative empirical evidences show that the positive economic growth promoting factors is tax revenue, trade openness and foreign direct investment, whereas negatively significant factors are tax-rate, unemployment rate and debt. The implications of the study are to deliberate on the macroeconomic determinants of the optimal taxation for reform the tax systems in emerging Asia. Finally, the paper guides policymakers to reform tax systems with empirical evidences on impacts of public economic policies to improve optimal taxation for the economic growth in Asia.

Keywords: Optimal taxation, Economic Growth, Generalized Methods of Moments estimation.

JEL: B23, C51, E60, E62, F43, H21, O47

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1. Introduction

The phenomenon about the optimal taxation policies has recently emerged among many developing countries that are concerned on the internal control of the economies. To facilitate the economic growth in terms of public economic perspective, existing taxation policies need to be revised to achieve the maximum tax revenue through optimal tax rate. In fiscal policy analysis of the government has been devoted to explain the optimal taxation and economic growth in developed countries. Nevertheless, the literature shows a gap in developing countries to provide empirical evidences to foster the economic growth with adoption to the optimal taxation policies and reforms.

Literature provides three main fiscal functions of government are to (i) provide public goods and services (ii) to redistribute income and (iii) to stabilize the economy. Many Asian governments remain severely involved in the provision of public goods and in the redistribution of income for the economic growth. But underline facts inhibit the economic growth with the lack of studies for the factors governing the optimal taxation policies. Because, many literature recognizes that high levels of taxation impede economic growth and that lower taxes can raise the rate of economic growth. However, nations with high rates of economic growth pay for this progress with more income inequality. Therefore, it is thoroughly implicit that a tax rate, which maximizes the growth rate, having a trade-off between income inequality and economic growth, consists of income distribution that maximizes the growth rate.

Finding a set of appropriate growth promoting fiscal policies is a complicated task since different countries face different constraints in terms of institutional, structural, and socio-economics. Focusing on GDP per capita, the growth of the South Asian countries have been studied, in the latter part of the study, after analyzing the Laffer curve for Asian countries. Tax systems, the combination of tax policy and tax administration, are central to successful fiscal policy and the overall management of the public sector. Inefficiencies in tax systems make the governments difficult to spending in economic growth such as public infrastructure and investment in human capital; in contrast, very high tax burdens can also be unfavorable to economic growth.

Serious econometric issues are raised in empirical approach for parameter estimation to obtain the robust results with the use of time series data. These issues like endogeneity center around the likely non-random nature of the distribution of the residuals obtained from time series estimation. Therefore, it needs a number of macroeconometric approaches to test and estimate the accurate coefficients while detecting and correcting these problems. This paper also used newly developed econometric methodologies while resolving all those empirical issues to obtain the robust estimations. Lastly, this paper intended to build empirical evidences for tax reform in Asia with determinants of optimal taxation and its impact on economic growth. It also includes examination of individual country performances of tax systems in the region.

The outline of the remainder of this paper is as follows. Section 2 provides an explanation of literature review. Section 3 presents the Data and Empirical

Methodology, in particular, the estimation model, methodology process, and section 4 gives the estimation of results and discussion. Section 5 and 6 present conclusion and policy recommendations respectively. Finally, in section 7, possible future researches are identified.

2. Literature Review

2.1 Laffer Curve for Optimal Taxation

Optimal taxation for the policies is achieved with the implementation of tax rate at the optimal point, in which increase or decrease of the tax rate from the point where revenue is maximum, is low revenues based on the arguments provided in the literature. On the basis of above explanation, Laffer curve concept has been developed and the following graph (1) shows the relationship between the revenue and tax rate.

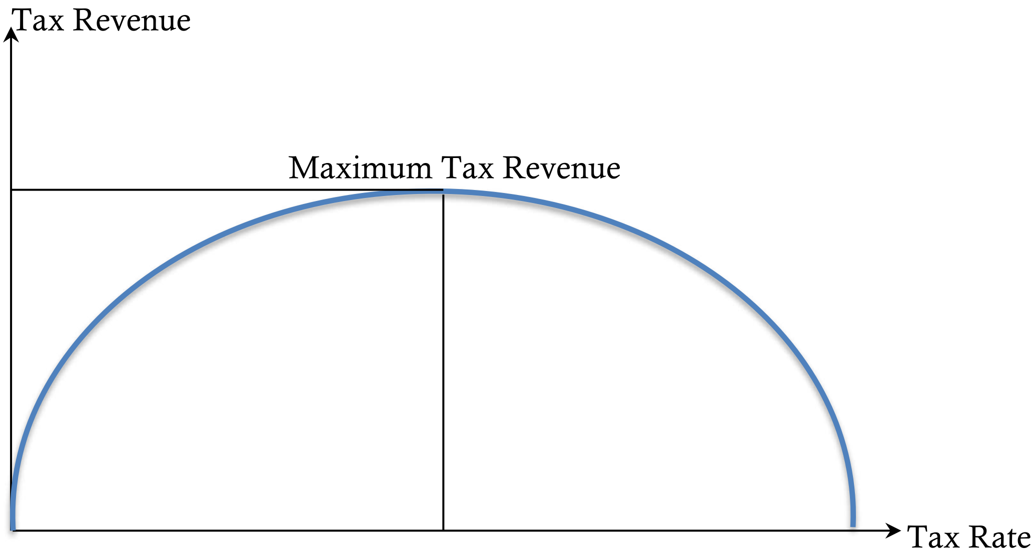

Figure 1: Laffer curve that determines the relationship between tax revenue and tax rate.

Subsequently, the theoretical results from Malcomson (1986), it assumes that the relationship between tax rate and tax revenue is not continuous for all tax rates instead an inverted U-shape. It is tested for inverted U-shaped Laffer curve after employing a U-test to estimate this relationship. Spiegel and Templeman (2004) found that even if an individual Laffer curve has one single peak an aggregated Laffer curve can have multiple peaks due to income inequalities between individuals, and will also test for more complex shapes. However, the U-test can be used to find the more complex shapes having its start at the origin. Further, including a lagged tax rate variable in the model also controls the dynamic effect of a change in tax rate in the model. The theory provides a ground, as tax revenue is the function of tax rate, which makes the Laffer curve potentially downward sloping.

$$Tax\ revenue = f(Tax\ rate) \qquad (1)$$

$$y_{it} = \alpha_i + \beta_1 Tax_{it} + \varepsilon_{it} \qquad (2)$$

Where y_{it} is tax revenue and Tax_{it} is the tax rate for given country in given year. The correct specification of the functional form will depend crucially on the specification of $f\ (Tax)$. If revenue is linearly decreasing in the tax rate it implies that the Laffer curve has the traditional inverted U-shape.

From this functional analysis, it is evident that the Laffer curve is multiplicative, and specified functional form is nonlinear. However, the data does not support the whole range of possible tax revenues and tax rates, as the conventional estimation of reduced form with a specification linear in its arguments is specified as multiplicative specifications forcing to consider the origin. Therefore, the model is not reflected the accurate estimation of the rate of change in tax revenue from a change in the tax rate. To adjust for the possibility of nonlinearities, higher order polynomials of the tax rate in the specification is also included. Include a quadric term is the standard way to test if there are nonlinearities and a negative and significant coefficient on the quadric term indicates an inverted U-shape. Lind and Mehlum, (2010) also pointed out that these conditions are not sufficient to conclude that the data supports an inverted U-shape, typically a squared term could be significant for any convex relationship. Further it states that a test for the U-shape needs to prove that the function is increasing in low values of the data and decreasing in high values.

In this setting, according to Lind and Mehlum (2010), to get necessary and sufficient conditions for an inverted U-shape the following hypotheses are tested.

$$H_0^L: \beta_1 - \beta_2 f'(Tax_l) \geq 0\ vs. H_0^L: \beta_1 - \beta_2 f'(Tax_l) < 0$$
$$H_0^H: \beta_1 - \beta_2 f'(Tax_h) \leq 0\ vs. H_0^H: \beta_1 - \beta_2 f'(Tax_h) > 0$$

With the assumption of only one extreme point, the test is performed if the slope is positive in the beginning and negative at the end of an interval $[Tax_h, Tax_l]$ where the interval is the data range [min (*Tax*), max (*Tax*)].
The baseline specification is:

$$lny_{it} = \alpha_i + \beta_1 Tax_{it} + \beta_2 Tax_{it}^2 + \beta_3 X_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Further details of the model equation (3) are discussed at the empirical methodology section of the paper.

2.2 Optimal Taxation and Economic Growth

Economic growth in emerging Asia is a challenge that faces by the governments in public economic policies for development. It is an argument that a government of certain size is vital for economic progress. Internal control of the economies leads to attain the growth objectives while it is an ambiguous to decide the taxation systems in macroeconomic perspectives. In literature, a number of seminal studies have been focused on optimal taxation policies that foster economic growth of developing economies. However, very few studies, for Asian countries, have been conducted to assess the macroeconomic impacts of tax revenue on economic growth. Therefore, this study, in addition to support with the existing literature, contributes to develop a scope of estimation of optimal taxation and determinants of economic growth.

The public economic policy instruments, such as tax rate changes, have both positive and negative implications in neoclassical and endogenous growth theories. The neoclassical theory predicts that permanent changes in government policies have no permanent effect on the growth, implies that changes in a country's tax structure should have only transitory impact on its long-run economic growth (Ramsey, 1928; Solow, 1956; Cass, 1965 and Barro, 1979). In contrary, the policy effects according to the endogenous growth theory are argues that changes in tax rate may have an impact on growth (Romer, 1986, 1990; Lucas, 1988; Rebelo, 1991; Jones, Manuelli, and Rossi, 1993; Aghion and Howitt, 1992; Kim, 1992 and Gomme, 1993). United Nations (2000) stated that tax revenue contributes substantially to economic growth, thus national tax systems need to be streamlined to ensure optimal tax revenue through equitable and fair distribution of tax burden deciding the tax rates. Many developing countries are under severe budgetary pressure because of demand for government expenditure.

The empirical literature suggests both direct and inverse relationship between tax revenue and rates of growth. Thus, future economic output will be higher with the optimal rate of taxation and hence future tax revenues would be higher with a lower rate of taxation. Karras (1999) analyzed the effect of tax policies on economic growth for a panel of eleven OECD countries. The results support the theoretical predictions of the neoclassical growth theory and inconsistent with that of endogenous theory. Tomljanocich (2004) has found the impact of tax policies on economic growth empirically testing whether tax policies have transitory or permanent impact on the growth rate of output for the U.S. The quest for the optimum taxation rate where tax revenues are maximized for economic growth has been the essence of the various theories. Islahi (2006) identifies the economic effect of tax rates on revenues, proposed that lower tax rate positively impact on work, output and employment. The optimum tax theory propounded by Mirrlees (1971) seeks to stipulate a given rate of the tax at which a given amount of government revenue can be raised, with minimum distortion in an economy. Review of prior empirical works investigated the effects of taxes on economic growth. Ugwunta and Ugwuanyi (2015) reported a positive but insignificant relationship between non-distortionary taxes and economic growth of sub-Saharan Africa with applied panel data estimation under the fixed effect assumptions. N'Yilimon (2014) using unit root test on panel data proposed the absence of a non-linear relationship between taxation and economic growth of West Africa. Anne (2014) adopted Ordinary Least Squares, Unit Root tests, Johansson Cointegration Test, Vector Error Correction Model (VECM), and finds a negative but insignificant effect of income taxes on the Kenyan economy. Wisdom (2014) applied the Co-integration and Granger Causality tests, and finds that tax revenue exerted a positive and statistically significant impact on economic growth of Ghana both in the long-run and short-run. Confidence and Ebipanipre (2014) used econometric models to show that tax reform is positively and significantly related to economic growth in Nigeria. The rationale for this study is further emphasized by the disparity in the findings to use macroeconometric approaches for the optimal taxation policies for economic growth as a panel data estimation in emerging Asia.

3. Data and Empirical Methodology

This macroeconometric approach follows previous empirical studies in Laffer curve that is based upon the estimation of a function in which tax revenue depends upon tax rate, and additional exogenous variables. However, this study extends with several econometric approaches in validating the empirical estimation to derive a function for economic growth and taxation policies. Starting from a basic model with macroeconomic data that cover different time periods, different explanatory variables, several different estimation methods are employed, but focusing on estimators that attempt to control for endogeneity, omitted variable bias, simultaneity, and measurement error.

3.1 Data

The dataset includes forty-one Asian countries over the period of 1990-2015. Based on the availability of data for Asian region, annual data on tax revenues, tax-rates, government expenditure, real GDP per capita, inflation, total population growth, old dependency ratio, young dependency ratio, foreign direct investment, unemployment rate, debt, trade openness, workforce and education expenditure, population density are generated from various years of the World Development Indicators of the World Bank; all nominal values are converted to constant 2015 U.S. dollars using the CPI. Further, financial data are obtained from the IMF Government Financial Statistics database. All nominal variables are expressed in real terms.

3.2 Empirical Approaches

Panel Unit Root tests, Levin-Lin-Chu test, Im-Pesaran-Shin, ADF Fisher-type, and PP-Fisher type, are performed with the variables to identify the stationarity of the times series data. The results of the tests are included in the appendix.

3.2.1 Estimation of Laffer Curve for Asia

The basic model for estimating the Laffer curve can be expressed in terms of:

$$y_{it} = \alpha_i + \beta_1 Tax_{it} + \beta_2 Tax_{it}^2 + \beta_3 X_{it} + \varepsilon_{it} \quad \text{......(4)}$$

Where y_{it}= the log of tax revenue; X_{it}= the vector of exogenous variables, that is X and α_i = the period specific intercept terms to capture changes common to all sectors; ε_{it} = the time variant idiosyncratic error term. The baseline model can be expanded with the use of integration of Z variables as follows:

$$y_{it} = \alpha_i + \beta_1 Tax_{it} + \beta_2 Tax_{it}^2 + \beta_1^*(Tax_{it} * Z_{it}) + \beta_2^*(Tax_{it}^2 * Z_{it}) + \beta_3 X_{it} + \varepsilon_{it} \quad \text{......(5)}$$

However, in order to incorporate the dynamic nature of tax revenue into the model, it can rewrite econometric equation as an AR (1) model in the following form if *ln. (rev)* is considered as y and in the equation (4):

$$y_{it} - y_{it-1} = \alpha_i + \vartheta y_{it-1} + \beta_1 Tax_{it} + \beta_2 Tax_{it}^2 + \beta X_{it} + \varepsilon_{it} \quad (6)$$

Equivalently, above equation can be written as:

$$y_{it} = \alpha_i + (\vartheta + 1) y_{it-1} + \beta_1 Tax_{it} + \beta_2 Tax_{it}^2 + \beta X_{it} + \varepsilon_{it} \quad (7)$$

It can be also expressed as in first differences:

$$\Delta y_{it} = \alpha_i + (\vartheta + 1)\Delta y_{it-1} + \beta_1 \Delta Tax_{it} + \beta_2 \Delta Tax_{it}^2 + \beta \Delta X_{it} + \Delta \mu_{it} \quad (8)$$

Because of the endogeneity issue, if $y_{t-1}$is endogenous to the error terms through μ_{it-1} and it, therefore, cannot be estimated the above specification by OLS. To overcome this problem, an instrumental variable needs to be used for Δy_{it-1}. Two approaches, Instrumental Variable (Anderson and Hsiao, 1982) and two GMM[2] estimators (Arellano and Bond, 1991), first and second step respectively, can be used. Moreover, the first step GMM estimator is used since it has shown to result in more reliable inferences. The asymptotic standards errors from the two-step GMM estimator have found to have a downward bias (Blundell and Bond, 1998). The results from estimating equation (5), extended with a lag term, using the Arellano-Bond (1991) first step GMM estimator. The various estimated equations passes all diagnosis test related to Sargan Test of Over-identifying restrictions and the Arellano-Bond test of 1st order and 2nd autocorrelation. The issue of non-stationarity of the variables is less serious since panel data techniques are employed (Garcia Mila, McGuire and Porter, 1996).

The dynamic GMM estimator allows, under specific set of assumptions, to control for all of these potential problems. The joint endogeneity is addressed using instrumental variables as lagged values of the explanatory variables. The first-differenced GMM estimator, proposed by Arellano and Bond (1991), instruments the right-hand-side variables in the first-difference equations using levels of the series in lag. However, subsequent evidence (Arellano and Bover, 1995, and Blundell and Bond, 1998) suggested that when the explanatory variables are persistent over time, the lagged levels of these variables are weak instruments for the equations in differences and suggests an estimator that reduces potential biases and imprecision associated with the difference estimator. This GMM-system estimator combines in a system the previous regressions in differences instrumented by lagged values, with an additional set of equations in levels, by using lagged first differences as instruments.

[2] The generalized method of moments (GMM) estimator is a workhorse of modern econometrics and is discussed in all the leading textbooks, including Cameron and Trivedi (2005, 2010), Davidson and MacKinnon (1993, 2004), Greene (2012, 468–506), Ruud (2000), Hayashi (2000), Wooldridge (2010), Hamilton (1994), and Baum (2006).

3.2.2 Cointegrating Regression Equation Estimation

First, Pedroni panel cointegration test has been performed to identify whether there is a cointegration relationship between economic growth and tax revenues and exogenous variables. Then, the cointegration equation for tax revenue and economic growth is estimated using newly developed econometric approaches: Fully Modified Ordinary Least Squares (FMOLS) of Phillips and Hansen (1990), Dynamic Ordinary Least Squares (DOLS) technique of Stock and Watson (1993) and Conical Cointegration Regression (CCR) of Park (1992). These methodologies provide a robust estimation of results and have the ability to produce reliable estimates in different sample sizes.

3.2.2.1 Dynamic Ordinary Least Squares (DOLS) Estimator

Dynamic Ordinary Least Squares (DOLS) is attributed to Saikkonen (1991) and Stock and Watson (1993), which is a simple approach to constructing an asymptotically efficient estimator that eliminates the feedback in the cointegrating system. Econometrically, DOLS involves augmenting the cointegrating regression with lags and leads of so that the resulting cointegrating equation error term is orthogonal to the entire history of the stochastic regressor innovations:

$$y_t = X_t'\beta + D_{1t}'\gamma_1 + \sum_{j=-q}^{r} \Delta X_{1+j}' \, \delta + v_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Under the assumption that adding q lags and r leads of the differenced regressors soaks up all of the long-run correlation between v_{1t} and v_{2t}, least-squares estimates of θ=(β', γ') have the same asymptotic distribution as those obtained from FMOLS and Conical Cointegration Regression (CCR). Computing the usual OLS coefficient covariance, but replacing the usual estimator for the residual variance of with a θ estimator of the long-run variance of the residuals can compute a v_{1t} estimator of the asymptotic variance matrix. Alternately, you could compute a robust HAC estimator of the coefficient covariance matrix.

3.2.2.2 Fully Modified Ordinary Least Squares (FMOLS) Estimator

The cointegration regression is estimated on the basis of Vector Autoregression model results. Fully modified ordinary least square (FMOLS) is suitable for estimation when the series are cointegrated at first difference I (1). FMOLS is attributed to Phillips and Hansen (1990), providing optimal estimates of cointegrating regressions. It modifies least squares to explicate serial correlation effects and the endogeneity in the regressors that ascend from the existence of a cointegrating relationship (Phillips and Hansen, 1990).

$$X_t = \hat{\Gamma}_{21} D_{1t} + \hat{\Gamma}_{21} D_{1t} + \hat{\epsilon}_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

$$\Delta X_t = \hat{\Gamma}_{21} \Delta D_{1t} + \hat{\Gamma}_{21} \Delta D_{1t} + \hat{v}_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Let $\widehat{\Omega}$ and $\widehat{\Lambda}$ be the long run covariance matrices computed using the residuals $\hat{v}_t = (\hat{v}_{1t}, \hat{v}_{2t})'$. Then the modified data can be defined as:

$y_t^* = y_t - \widehat{\omega}_{12}\widehat{\Omega}_{22}^{-1}\widehat{v}_2$……………………………………………………………..(12)

An estimated bias correction term:

$\lambda_{12}^* = \lambda_{12} - \widehat{\omega}_{12}\widehat{\Omega}_{22}^{-1}\widehat{\Lambda}_{22}$……………………………………………………….(13)

The FMOLS estimator is given by:

$\hat{\theta} = \begin{bmatrix}\hat{\beta} \\ \hat{\gamma}_1\end{bmatrix} = (\sum_{t=1}^{T} Z_t Z_t')^{-1} \left(\sum_{t=1}^{T} Z_t y_t^* - T\begin{bmatrix}\hat{\lambda}_{12}^* \\ 0\end{bmatrix}\right)$…………………………………….(14)

Where $Z_t = (X_t', D_t')$. The key to FMOLS estimation is that the construction of long-run covariance matrix estimation $\widehat{\Omega}$ and $\widehat{\Lambda}$. Before describing the options available for computing $\widehat{\Omega}$ and $\widehat{\Lambda}$, it is useful to define the scalar estimator:

$\widehat{\omega}_{1.2} = \widehat{\omega}_{11} - \widehat{\omega}_{12}\widehat{\Omega}_{22}^{-1}\widehat{\omega}_{21}$…………………………………………………………(15)

Which can be interpreted as the estimated long-run variance of $\hat{v}_{1t}$conditional on $\hat{v}_{2t}$. It can apply a degree-of-freedom correction to $\widehat{\omega}_{1.2}$.

3.2.2.3 Conical Cointegration Regression (CCR) Estimator

The CCR estimator is based on a transformation of the variables in the cointegrating regression that removes the second-order bias of the OLS estimator in the general case. The long-run covariance matrix can be written as:

$\Omega = \lim_{n \to \infty} \frac{1}{n} E(\sum_{t=1}^{n} u_t)(\sum_{t=1}^{n} u_t)' = \begin{bmatrix}\Omega_{11} & \Omega_{12} \\ \Omega_{21} & \Omega_{22}\end{bmatrix}$…………………………………….(16)

The matrix Ω can be represented as the following sum:

$\Omega = \Sigma + \Gamma + \Gamma'$……………………………………………………………………..(17)

Where:

$\Sigma = \lim_{n \to \infty} \frac{1}{n} \sum_{t=1}^{n} E(u_t u_t')$…………………………………………………………..…(18)

$\Gamma = \lim_{n \to \infty} \frac{1}{n} \sum_{k=1}^{n-1} \sum_{t=k+1}^{n} E(u_t u_{t-k}')$,……………………………………….………(19)

$\Lambda = \Sigma + \Gamma = (\Lambda_1, \Lambda_2) = \begin{bmatrix}\Lambda_{11} & \Lambda_{12} \\ \Lambda_{21} & \Lambda_{22}\end{bmatrix}$…………………………………………….………(20)

The transformed series is obtained as:

$y_{2t}^* = y_{2t} - (\Sigma^{-1}\Lambda_2)' u_t$……………………………………….………………….(21)

$y_{1t}^* = y_{1t} - (\Sigma^{-1}\Lambda_2\beta + (0, \Omega_{12}\Omega_{22}^{-1})')' u_t$…………………………..………………..…(22)

The canonical cointegration regression takes the following form:

$$y_{1t}^{*} = \beta' y_{2t}^{*} + u_{1t}^{*} \quad (23)$$

Where:

$$y_{1t}^{*} = u_{1t} - \Omega_{12}\Omega_{22}^{-1}u_{2t} \quad (24)$$

Therefore, in this context the OLS estimator of (22) is asymptotically equivalent to the ML estimator. The reason is that the transformation of the variables eliminates asymptotically the endogeneity caused by the long-run correlation of y_{1t} and y_{2t}. In addition (23) shows how the transformation of the variables eradicates the asymptotic bias due to the possible cross correlation between u_{1t} and u_{2t}.

4. Results and Discussion

Before presenting the relationships between the variables, the following table (1) provides the summary statistics of the explanatory variables in the study. Then, the Laffer curve is estimated using difference-GMM and system-GMM estimators in the proceeding results of the analysis. The panel unit root tests have been performed and the results are presented in the table (5) in the Annex.

4.1 Summary of Variables

Table 1: Summary statistics of the variables

Log-transformed Variables	Mean	Standard Deviation	Min	Max	Observations
Revenue	2.78e+13	1.12e+14	5000000	1.15e+15	1045
Tax	12.6244	5.5691	0.0858	31.7820	1045
Young	53.2588	20.3140	15.5184	113.3084	1063
Old	7.8275	4.7366	0.8106	43.3239	1063
Education	3.8142	1.5361	0.9985	14.1988	1003
Debt	4.55e+10	1.33e+11	5527000	1.77e+12	919
Govt_Exp	101.4482	18.3591	49.3153	208.8089	979
Investment	2.39e+09	2.24e+8	2.32e+7	1.45e+11	996
Inflation	39.7582	218.9782	-27.2060	4107.297	1010
GDP per capita	8510.737	13660.98	98.0318	94944.09	1024
Population growth	2.1152	1.9942	-3.3394	17.6247	1062
Labour Force	4.16e+07	1.29e+08	57094	8.06e+08	1022
Population density	345.0077	981.7571	1.405897	7806.7730	1063
Openness	46.7499	28.7695	0.0156	209.3877	1020

4.2 Estimation of Laffer curve for Asia in determining the Optimal Taxation

Given the availability of the data, proposed empirical equation for the Laffer curve is estimated and the results are shown in the table (2).

Table 2: GMM Estimation Results of Laffer Curve

Dependent Variable: Ln (Revenue)	Difference GMM (1)	(2)	System GMM (3)	(4)
Tax	-0.204***	-2.026**	-1.132***	-2.118***
	(0.07)	(0.07)	(0.23)	(0.18)
Tax^2	-1.024**	0.004	-0.638**	-1.199**
	(0.00)	(0.00)	(0.00)	(0.01)
Tax^3		-0.003**		0.333
		(0.00)		(0.81)
Tax^4		0.198**		1.092**
		(0.02)		(0.01)
Tax*Debt	0.152**	-0.182**	0.561**	0.299**
	(0.00)	(0.02)	(0.41)	(0.00)
Tax^2*Debt	-0.117	-0.136	-1.226**	-1.138**
	(0.08)	(0.02)	(0.00)	(0.00)
Lag (Tax)	0.008	-0.106	-0.788*	-0.559*
	(0.01)	(0.01)	(0.02)	(0.01)
Ln (lag (Rev))	1.058***	0.971***	0.216**	0.811**
	(0.02)	(0.09)	(0.00)	(0.02)
Young	0.397	0.368	0.459*	0.292
	(0.01)	(0.00)	(0.00)	(0.00)
Old	0.035*	0.618**	-0.529	-0.342*
	(0.00)	(0.04)	(0.01)	(0.06)
Education	-0.003	-0.018	0.558	0.243*
	(0.00)	(0.00)	(0.04)	(0.08)
Unemployment	0.326***	2.168***	1.492**	1.730**
	(0.01)	(0.01)	(0.03)	(0.05)
Debt	-0.516***	-0.811**	-4.316***	-1.660***
	(0.00)	(0.05)	(0.03)	(0.09)
Govt.Expen	-0.008	-0.027**	-0.790**	-0.347**
	(0.00)	(0.09)	(0.01)	(0.02)
Investment	0.114**	1.008**	0.127***	0.673***
	(0.01)	(0.00)	(0.01)	(0.09)
Inflation	-0.541	0.538	-0.436**	-0.680**
	(0.03)	(0.00)	(0.01)	(0.01)
Population growth	-0.492	-0.759	0.116	0.290
	(0.00)	(0.06)	(0.03)	(0.05)
Openness	0.898***	0.907***	2.050**	1.421**
	(0.08)	(0.07)	(0.02)	(0.00)
Constant	0.227**	0.641**	0.434**	0.872**
	(0.05)	(0.03)	(0.00)	(0.00)
N	358	358	358	358
No of countries	41	41	41	41
Adj. R^2	98.53	99.91	76.84	62.81

Durbin-Watson statistic	0.86	0.36	0.74	0.59
Sargan Test: p-value	0.426	0.810	0.526	0.723
AR (1)	0.005	0.005	0.006	0.003
AR (2)	0.461	0.593	0.531	0.683

Cluster robust standard errors in parenthesis. a * denotes statistical significance at the 10 percent level and a ** denotes statistical significance at the 5 percent level and a *** denotes statistical significance at the 1 percent level. Both time and year fixed effects are used. Instrumental variables: Lag variable of the explanatory variables are used as instrumental variables in the model in addition to the GDP per capita, government consumption expenditure, labour force and population density. Adjusted sample 1991-2014.

In comparison to two GMM estimations, system GMM increased efficiency of the estimation. First, the system GMM uses more instruments than the difference GMM; therefore, the use system GMM with a dataset with a large number of countries is assumed. Second, in a panel with fixed effects including the equation in levels requires a new assumption – the first-differenced instruments used for the variables in levels should not be correlated with the unobserved country effects. Roodman (2006) discusses how this assumption depends on assumptions about the initial conditions. It is preferred to include in the levels equation only variables, which are uncorrelated with the fixed effects. Overall, the results of the GMM dynamic panel data estimation provide a strong correlation of the tax revenue and GDP per capita growth.

In particular, as in the above table (2), two different approximations, Difference-GMM and System-GMM, are estimated for the Laffer curve. The explanatory variables in the difference-GMM estimation (1) revealed that Tax, Tax^2, and Debt are negatively significant, while Tax*Debt, Ln (lag (Revenue)), Unemployment rate, Investment and Openness are positively significant. Equation (2) revealed that Tax, Tax^3, Tax*Debt, Debt, Government expenditure are positively and significantly associated with the tax revenue, whereas Tax^4, Ln (lag (Revenue)), Old dependency, Unemployment rate, foreign direct investment, and Openness are positively determined the revenue.

System-GMM estimation (1) shows that Tax, Tax^2, Tax^2*Debt, Lag (Tax), Debt, Government expenditure, Inflation are negatively significant determinants, whereas Tax*Debt, Ln (lag (Revenue)), Unemployment rate, foreign direct investment, and Trade openness are positive causes of the tax revenue in South Asian countries. Equation (2) disclosed that Tax, Tax^2, Tax^2*Debt, Debt, Government expenditure, Inflation are negatively significant causes, but Tax^4, Tax*Debt, Ln (lag (Revenue)), Unemployment rate, foreign direct investment and Trade openness are positive dynamics of the tax revenue in the emerging Asia.

The following figure (2) provides the relationship between tax revenue and tax rate for the Asia. The U test result indicates that the extreme point is 16.8 of the tax rate as indicated in the figure.

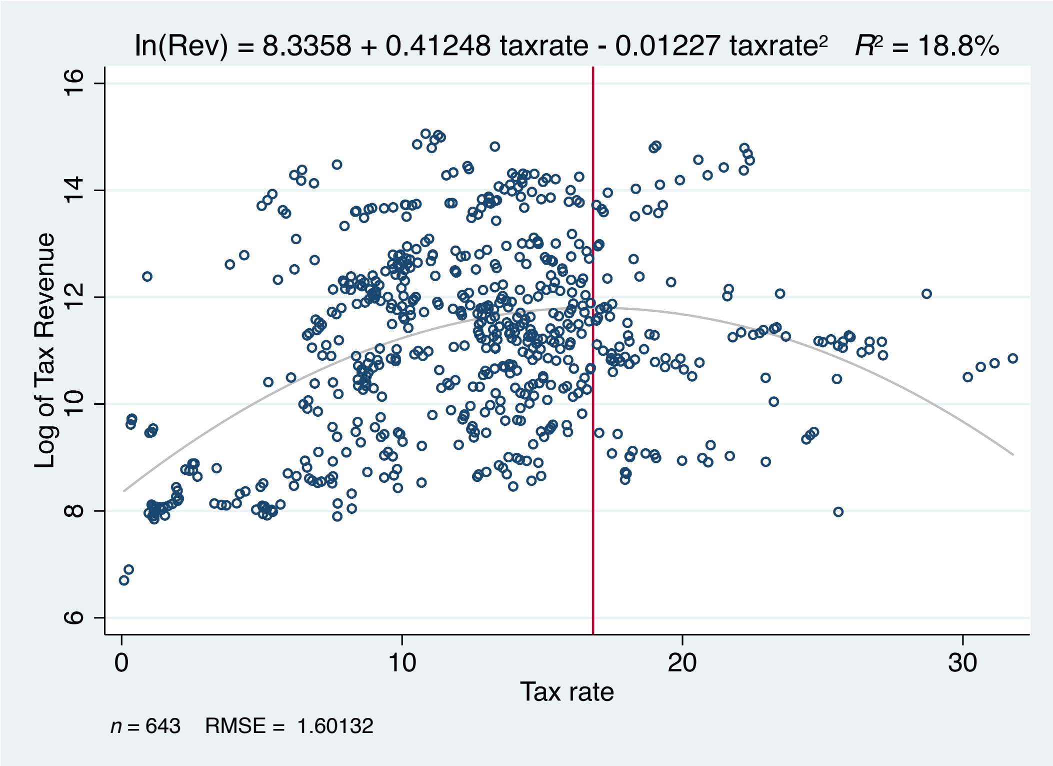

Figure 2: Estimated Laffer curve for the Asia

4.3 Impact of Taxation on Economic Growth

The impact of tax revenues on economic growth in emerging Asia is estimated based on the Pedroni panel cointegration test. Thereby, the existence of cointegrating relationship between the dependent and explanatory variables is verified. Then, the estimation of cointegration regression is performed to establish a dynamic cointegration correlation of the exogenous variables.

Table 3: Results of Pedroni panel cointegration test

Test Name	Test statistic	Significance level for rejection of the null hypothesis (No cointegration)	Weighted Statistics	Significance level for rejection of the null hypothesis (No cointegration)
Intercept				
Panel rho statistic	-3. 4243***	0.0004	-2.1952**	0.0423
Panel PP-statistic	-3.6232***	0.0002	-1.7425**	0.0368
Panel ADF-statistic	-4.3452***	0.0000	-2.3164**	0.0293
Group rho statistic	-0.2001	0.4245		
Group PP-statistic	-1.8524**	0.0153		
Group ADF-statistic	-2.7418**	0.0347		

Intercept and Trend				
Panel rho statistic	-2.4691**	0.0391	-3.0265**	0.0491
Panel PP-statistic	0.5363***	0.0004	-1.6644**	0.0063
Panel ADF-statistic	-1.2628**	0.0264	-2.0852**	0.0025
Group rho statistic	-4.7426**	0.0091		
Group PP-statistic	-2.5739**	0.0411		
Group ADF-statistic	-3.4362**	0.0094		

** indicates the rejection of the null hypothesis (no cointegration) at lest the 0.05 level of significance and a *** indicates the rejection of the null hypothesis (no cointegration) at lest the 0.01 level of significance.

Table (3) shows the Pedroni panel cointegration test estimates to ascertain that the existence of cointegrating relationship between the dependent and explanatory variables. Therefore, it permits to use the cointegrating regressions to recognize the interrelationships among those variables.

The following table (4) presents the comparative results of the three cointegrating regression estimations after the existence verified above. Therefore, the estimators are shown a prevalence of long-run relationship between the economic growth and the exogenous macroeconomic variables.

Table 4: Results of the long-run relationship based on FMOLS estimator, DOLS estimator and CCR estimator (ln.D(GDPpc) is dependent variable)

Variables	FMOLS estimator	DOLS estimator	CCR estimator
D.lnRev	0.6018***	0.6032***	0.4780***
	(0.02)	(0.55)	(0.97)
D.lnTax	-0.4832***	-0.0782**	-0.6211**
	(0.06)	(0.79)	(0.00)
D.lnUnemp	-0.1264**	-0.4324**	-0.4060
	(0.07)	(0.17)	(0.07)
D.lnDebt	-0.1938***	-0.9173***	-0.2871***
	(0.05)	(0.43)	(0.01)
D.lnGov_exp	0.2380	-0.5434**	0.9134
	(0.04)	(0.37)	(0.27)
D.lnInvest	0.5214***	0.0420***	0.9021***
	(0.07)	(0.07)	(0.80)
D.lnInf	0.0010	-0.0361**	0.4000**
	(0.00)	(0.01)	(0.67)
D.lnPop	0.0811	0.1859	-0.6115**
	(0.01)	(0.19)	(0.21)
D.lnTO	0.2172**	0.4580**	0.4190**

	(0.02)	(0.24)	(0.00)

Note: estimates refer to (fixed-effects) long-run elasticity of output with respect to the relevant regression. Standard errors are in parenthesis and a * denotes statistical significance at the 10 percent level and a ** denotes statistical significance at the 5 percent level and a *** denotes statistical significance at the 1 percent level. NT=286 for 1991-2014.

Results of all three estimation techniques (FMOLS, DOLS and CCR) for cointegrating regression show a positive relationship between GDP per capita and tax revenues. However, DOLS has increased explanatory power of tax revenue while the adjusted R^2 is highest using CCR. Further, the nature of relationship between GDP and Tax revenue that is found to be positive and significant using all three cointegration equation estimation techniques. Besides, the cointegrating regressions revealed that the tax rate, unemployment rate, and debt are negatively associated with the GDP growth in the all three models with significant levels. Conversely, trade openness and foreign direct investment are positively significant in all three comparative models. Thus, it is evidence that the GDP growth is affected by the increase of tax revenue, trade openness and foreign direct investment directed the policymakers to pay attention for the optimal taxation in emerging Asian countries. Based on the empirical evidences, increase of tax rate, unemployment rate and debt decrease the growth in those regions. Therefore, these factors need to be contemplated with the optimal taxation policies for fostering economic growth.

In particular, FMOLS shows that positive relationship with revenue, foreign direct investment, trade openness, where as negative correlation with tax-rate, unemployment, and debt. DOLS revealed that a positive impact of revenue, foreign direct investment, trade openness, while a negative association with tax-rate, unemployment, debt, government expenditure, and inflation on growth. CCR revealed that revenue, foreign direct investment, inflation and trade openness have positive correlation, where as negative correlation with tax-rate, debt and population growth.

5. Conclusion

The empirical analysis of relationship between tax revenue and tax rate is imperative to provide the pragmatic evidences for optimal taxation policy. Hence, in this paper, Laffer curve is estimated to identify the factors determining the optimal taxation and the long run relationships between economic growth and tax revenue from 1990 to 2015, employing the recently developed econometric methods, GMM and cointegrating regression of DOLS, FMOLS and CCR to Pedroni cointegration.

The advantage of the GMM estimation of Laffer curve approximation is that it counts for the many econometric issues like endogeneity. The results of the GMM approach, difference-GMM and system-GMM, revealed a strong correlation in Laffer curve equation. It is found that many macroeconomic variables in the GMM models have significant effect on the tax revenue with consistent coefficient signs as in economic literature. From the estimated Laffer curve results, the determinants of optimal taxation are tax-rate, tax-rate^2 and debt negatively, while unemployment rate, foreign direct investment, and openness are positively significant predictors of the tax revenue. Furthermore, the results suggest that tax revenue and tax rates are strongly significant with the expected signs. To complement the findings of the GMM analysis, various diagnostic tests were performed to establish a robust estimation. The empirical results of the GMM provide support for a robust long-run relationship between the variables, indicating that tax-rate and tax-rate^2 are negatively related to tax revenue in Asia.

Pedroni cointegration shows that the existence of cointegration in GDP growth, revenue and exogenous variables. In the long run, cointegration regression results imply that there is long run relationship among economic growth and tax revenue, when other macro-variables are an endogenous. Further, comparative cointegrating evidences show that the positive economic growth promoting factors is tax revenue, trade openness and foreign direct investment, whereas negatively significant factors are tax-rate, unemployment rate and debt. In particular, DOLS shows that positively revenue, foreign direct investment, trade openness, while negatively tax-rate, unemployment rate, debt, government expenditure, and inflation; FMOLS shows that positively revenue, foreign direct investment, trade openness, where as negatively tax, unemployment rate, debt; CCR shows that revenue, foreign direct investment, inflation, trade openness, where as negatively tax-rate, debt, and population.

One of the significant evidence of this study is that the Laffer curve estimation is that the maximum revenue depends on tax rate, and explanatory macroeconomic variables in emerging Asia. Therefore, the optimal taxation policies for this region can be implemented with the fiscal policy adjustments of the particular country focusing on individual country specific estimated-coefficients. Further, long run cointegrating estimates provide the fact that with the increase of determining factors, GDP growth has been increased. Therefore, the research evidences suggest the policymakers to design the appropriate public economic policies with the use of pragmatic findings for Asia.

6. Policy Recommendations

The findings from the study can be inferred to provide recommendations to the fiscal policies for policymakers in Asia. The implications of the study are cautious on the macroeconomic determinants of the optimal taxation to reform the tax systems. Provided that, the determinants, especially tax-rate, have negative impacts on the tax revenue in the Laffer curve for Asia. Therefore, it implies that increase of tax-rate effects in decrease of maximum tax revenue in the region. Robust estimated determinants are vital for preparing the taxation policies for the economic growth. However, the fiscal policy concentration is that the policymakers should be aware that a persistent increase of tax rates exerts a negative externality to the economy reducing growth in the long run. In order to address the optimal taxation for the generation of required revenue, approximation of Laffer curve can be used as a policy instrument. It can be generated three major recommendations based on the empirical evidences of the study.

(i) It is recommended to develop a tax system for Asia that generate optimal tax revenue with adjustment of the tax rates based on this study for Asian countries in general, and in particular for the specific countries, from the research.

(ii) Increase of tax rate will eventually decrease the maximum revenue it can be achieved while considering other controlling macroeconomic determinants.
(iii) Growth promoting factors of the economy can be facilitated to achieve optimal taxation with the adjustment of tax revenue for the economic growth in the region.

7. Future Research

This paper suggests that the research on macroeconomic factors need to be considered for each country separately since the constraints for the country is varied. Further, it can be important to use of the results at the macroeconomic level for individual countries to advocate the optimal taxation policies to reform the tax systems in cross-country analysis, with may be structural equation models. Moreover, country specific Laffer curve estimation to provide specific governing factors of divergence of economies can be suggested.

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Appendix:

Table 5: Results of the Panel Unit Root Tests

Variables	Type	Level	Levin-Lin-Chu test	Im-Pesaran-Shin	ADF Fisher-type	PP-Fisher type
Revenue	Intercept	Level	1.10	19.00	0.22	0.13
		Difference	-4.58***	-5.95***	68.45***	137.50***
	Intercept + Trend	Level	1.80	11.80	0.24	5.14
		Difference	-4.33***	-6.96***	8.67***	32.50***
Tax	Intercept	Level	10.80	11.89	0.54	0.16
		Difference	-2.82***	-6.66***	6.51***	113.29***
	Intercept + Trend	Level	1.26	4.81**	7.23	2.83
		Difference	-6.18***	-15.95***	-66.15***	97.10***
Education	Intercept	Level	1.98	14.06	0.51	-0.11
		Difference	-0.55***	-9.90***	60.72***	197.59***
	Intercept + Trend	Level	7.20	16.84	0.53	0.21**
		Difference	-5.55***	-12.11***	28.22***	431.60***
Debt	Intercept	Level	4.88	21.55	3.26	5.17
		Difference	-14.44***	-6.72***	40.75***	150.44***
	Intercept + Trend	Level	6.81	-13.43**	3.00	5.41
		Difference	-4.58***	-5.95***	-68.35***	426.70***
GDP per capita	Intercept	Level	-16.99**	-10.00**	2.44	0.91
		Difference	-5.87***	-8.62***	21.09***	231.91***
	Intercept + Trend	Level	8.87	21.04	-5.15**	1.19**
		Difference	3.46***	-7.91***	28.42***	98.62***
Young	Intercept	Level	3.52	6.11	9.13	4.21
		Difference	-7.08***	-3.78***	6.44***	717.59***
	Intercept + Trend	Level	0.88	17.52**	4.27	8.11
		Difference	-3.32***	-6.71***	78.40***	111.30***
Old	Intercept	Level	7.94	9.87	3.28	1.11
		Difference	-6.39***	-4.07***	-41.68***	231.94***
	Intercept + Trend	Level	12.13	-16.76**	0.83	2.43**
		Difference	-3.18***	-4.91***	28.49***	300.20***
Unemployment	Intercept	Level	12.75	-15.65**	0.41	0.21
		Difference	-14.51***	-9.91***	37.13***	591.30***
	Intercept + Trend	Level	8.85	7.89	3.63	7.66
		Difference	-7.58***	-5.15***	41.92***	711.32***
Government Expenditure	Intercept	Level	7.82	7.86	4.21	0.10
		Difference	-2.58***	-3.62***	36.51***	64.58***
	Intercept + Trend	Level	-11.93	-16.20**	0.91	0.90**
		Difference	-8.76***	-15.64***	63.00***	281.73***
Investment	Intercept	Level	-9.74	23.09	4.21	0.06
		Difference	-14.93***	-12.88***	60.31***	189.09***
	Intercept	Level	7.61	5.99	1.43	0.16

	+ Trend	Difference	-3.90***	-12.13***	20.52***	330.40***
Inflation	Intercept	Level	-11.53	12.03**	12.91	3.91
		Difference	-2.33***	-6.41***	21.04***	412.91***
	Intercept + Trend	Level	10.00	15.31	2.27**	1.09
		Difference	-7.11***	-5.90***	38.12***	209.31***
Population growth	Intercept	Level	9.21	12.32**	4.44	-0.99**
		Difference	-9.18***	-12.02***	60.41***	192.75***
	Intercept + Trend	Level	15.15**	19.00	4.59	1.17
		Difference	-14.18***	-13.53***	82.15***	121.92***
Population density	Intercept	Level	11.94	18.94	4.15	7.19
		Difference	-24.51***	-4.91***	26.50***	199.30***
	Intercept + Trend	Level	1.80**	11.30	-4.26**	3.71
		Difference	-13.88***	-12.05***	47.03***	324.59***

*** indicates the rejection of the null hypothesis of non-stationary (Levin, Lin and Chu(2002), Im, Pesaran and Shin(2003), Fisher-Type test using ADF and PP-test (Maddala and Wu(1999) and Choi(2001)) or stationary (Hadri(1999)) at least at the 1 percent level of significance.