Tax-to-GDP Ratio and the Relation of Tax Revenue with GDP: Nepalese Perspective

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Abstract

This study aims to show the tax-to-GDP ratio condition and explore the relation of tax revenue with Nepal's GDP. It is based on the secondary data that is collected from various published sources. Descriptive and exploratory research designs are used to explore the relationship between tax revenue and GDP. Some statistical and econometric tools like mean, depression, correlation, Johnsen Co-integration Test, Vector Error Correction Model (VECM), serial correlation, heteroskedasticity test, and normality test are used. There is a high degree of the positive relationship between tax revenue and GDP of Nepal. The tax revenue and GDP are co-integrated, or they have a long-run association ship. The tax-to-GDP ratio of Nepal lies in the high rank among the various developing countries. So, tax to GDP ratio alone cannot ensure its economic growth. It is advised to the concerned authorities to increase the income to increase the tax revenue; otherwise, it increases the general public's dissatisfaction with the government.

Keywords: Correlation, tax-to-ratio, Johnsen co-integration test, economic growth, VEC model

Introduction

Nepal has abundant economic development potential by utilizing water resources, development of tourism, and agriculture. But Nepal is the least developed country with a 1047 USD level of PCI, whereas 18.7 percent of people live below the poverty line. Nearly 66% of people are engaged in agriculture, and 27.6% of the total GDP comes from agriculture. (NPC, 2019) Nepalese economy is many times smaller than the economy of advanced countries. Nepalese economy is 256 times smaller than the economy of China. Similarly, the Nepalese economy is 189, 748, and 104 times smaller than the economy of Japan, the USA, and India, respectively (Adhikari, Acharya et al., 2019). In the name of the federal system's implementation, the central, federal, and local governments have increased the tax rate and tax net. Therefore, Nepalese people are compelled to pay high taxes as compared to their economic status. Due to this reason, the tax-to-GDP ratio is more than the neighboring countries.

The tax-to-GDP ratio measures a nation's tax revenue relative to the size of its economy. A tax-to-GDP rate is a gauge of a nation's tax revenue relative to its economy's size as measured by (GDP). The ratio provides a useful look at a country's tax revenue because it reveals potential taxation relative to the economy. It also enables a view of the overall direction of a nation's tax policy. The Tax-to-GDP ratio represents the size of a country's tax kitty relative to its GDP. It means the size of the government's tax revenue is expressed as a percentage of the GDP. The higher the tax to GDP ratio, the better financial position the country will be in. A lower tax-to-GDP rate constrains the government to spend on infrastructure and puts pressure on the government to meet its fiscal deficit targets (Carneo & Vergallia, 2016). The ratio represents that the government can finance its expenditure. A higher tax to GDP ratio means that the government can cast its fiscal net wide. It reduces a government's dependence on borrowings. Developed nations typically have higher tax-to-GDP rates than developing nations. Developing countries should have a tax-to-GDP ratio of at least 15% to ensure they have the money necessary to invest in the future and achieve sustainable economic growth (IMF, 2019).

The tax-to- GDP is not only one indicator of economic growth. If tax revenues rise less than GDP or fall further, the tax-to-GDP ratio will go down. Therefore, the tax-to-GDP ratio does not necessarily mean that the amount of tax revenues has increased in nominal or real terms. (OCED, 2019). The policymakers use the tax-to- GDP ratio to compare the tax receipts from each year because it offers a better measure of the rise and fall in tax revenue. The tax-to-GDP ratio of developed countries is nearly 34% in 2018, whereas the European Union's tax-to-GDP ratio is 40%. As a percentage, tax revenue generally rises and falls faster than GDP, but the ratio stays relatively consistent (IMF, 2019).

As the country’s revenue collection has recorded high growth each passing year, Nepal’s tax-to-GDP ratio has peaked among South Asian countries. It is on par with emerging market economies like South Korea. Usually, if the country faces an economic crisis, the government will try to recover the problem using monetary or fiscal policy. In fiscal policy, the government will use either taxes or government spending based on the situation. A high inflation rate in a country will force the government to increase the taxation of goods and services due to an increase in the price and stabilize the consumption also aggregate expenditure. With that, the excise tax on some products may be affected by the inflation rate (Tanzi, 1989).

According to the Ministry of Finance (Economic Survey, 2019/20), the government collected revenue worth Rs 738.6 billion in the last fiscal year (2018/19), which was 25.29 percent of the country’s Gross Domestic Product (GDP). Nepal’s tax-to-GDP ratio is already at

par with the developed countries. The tax- to GDP ratio of India seems weaker where the country was hit with two temporary shocks- the country's currency exchange initiative and glitches in the implementation of national GST (IMF, 2018), the tax to GDP ratio seems satisfactory as compared to the other macroeconomic indicators, Normally, tax to GDP ratio of Nepal is increasing, It can give a clear indication of the direction of travel of tax policy and administration in any given country, which can then be used to measure against economic growth and development. But the statistical conclusion is far from reality. Many economists believe that high taxes are bad for economic growth (Yi & Suyono, 2014). Taxes are one of the significant revenues for a country where taxes are collected from citizens, companies, investors, and so on to generate an economy. There have several impacts of tariffs due to economic growth, whether it is positive or negative impacts.

The Tax-to-GDP ratio of Nepal does not seem lower as compared to other macroeconomic indicators of economic development. The higher tax-to-GDP rate indicates that an economy's tax buoyancy is substantial, increasing its GDP size. The country can invest in infrastructure from its resources, and there is not high pressure on the government to meet the fiscal deficit from internal and external borrowing. But in Nepal, the tax-to-GDP ratio is high, and also the government is compelled to run the developing activities from public borrowing and grants. Such type of controversial problem is facing by the Nepalese economy.

Due to the high tax-to-GDP ratio, the government's private sector is disappointed with the government and advising the government to lower the tax rate and expand the tax net to create a conducive investment environment. The high tax-to-GDP ratio discouraged investors from increasing their business. Only a tax increase- to- GDP ratio is not the panacea to the economy's financial problems. Many socialistic economists assume that increased rate hampers economic growth. Various studies emphasize the numerical value of tax-to- GDP ratio. But critical analysis is absent. Similarly, various studies are holding on to the functional relationship between GDP and tax revenue. Tax and GDP are interdependent with each other. This study's main objective is to show and compare Nepal's tax-to- GDP ratio with neighboring countries and the world's most developed countries. It further aims to identify the degree of the relationship between GDP and tax revenue in Nepal.

Literature Review

There are so many studies about the tax- to-GDP ratio and the measurement of the relationship between tax revenue and GDP. Most of the reviews are related to the impact of GDP on tax revenue. This section aims to allow the comparison between this paper's findings

and the previous literature to conclude. Some important literature related to tax-to-GDP and the correlation between GDP and tax revenue is reviewed.

The IMF (2018) observed a comparative analysis of the tax-to-GDP ratio of Asian countries and found the tax-to-GDP ratio range in 15 to 20%. It advises the Asian countries to keep the tax-to- GDP ratio threshold around 15 percent. It also saw that most region countries consistently fall below a ratio of 15 percent of their GDP. Dadson, Bayraktar et al. (2012) studied the tax capacity and tax effort by employing a cross-country study from a sample of 110 developed and developing countries to give a broad guideline for tax reform. The use of tax effort and actual tax collection benchmarks allows the ranking of countries into four different groups like low tax collection and low tax effort, high tax collection and high tax effort, high tax collection and low tax effort and inadequate tax collection and high tax effort. Chigbu, Akujuobi et al. (2012) examined the relationship between tax revenue and Nigeria's economy. They analyzed the level of economic growth that has impacted positively on tax revenue in Nigeria. The general conclusion is that macroeconomic instability and the degree of economic activities are the main drivers of tax buoyancy and tax effort in Nigeria. They found that taxation is an important instrument to improve economic growth.

Brender and Navon (2010) analyzed the relationship of the GDP with tax revenues. The paper found the uncertainty in predicting Israel's tax revenue and concluded that the long-run tax revenue and GDP are elastic. Hakim and Bujang (2012) observed that the total tax revenue to GDP ratio is higher in the high-income countries than in the low and middle states. In addition to that, Mashkoor, Alis et al. (2010) empirically investigated that saving causes real GDP growth unidirectional. The direct tax to GDP ratio granger causes real GDP growth significantly. OECD (2019) studied the tax-to-GDP ratio of its 37 member countries and found that the rounding the OECD average tax-to-GDP ratio was 34.3 percent in 2018. France had the highest tax-to- GDP ratio (i.e., 46.1%) in 2018, and Denmark had the second highest (44.9%) tax-to- GDP ratio. Mexico had the lowest (16.1%) tax-to-GDP rate among the member countries OECD countries.

Iriqat and Anabtawi (2016) studied the relationship between GDP and tax revenue in developing countries as a Palestine case study. They found the impact of macroeconomics variables on tax revenue and the correlation between tax revenue and GDP variables changes from one period to another. The result confirmed that the balance of trade negatively affects tax revenue. Two of the early studies by Hinrisch (1966) and Musgrave (1969) examined the relationship between the ratio of tax revenue to GDP (TAX/GDP). They found it was relatively low in developing countries. Yi and Suyono (2013) observed that the maximization of tax revenue is incompatible with the maximization of GDP with the proposition that ‘high tax is

bad for economic growth' and use the tax multiplier to analyze this negative correlation frequently. But both tax revenue and GDP have achieved both developments, and the tax elasticity has been more than once in recent years. They concluded that there is a negative impact of an increase in tax revenue in economic growth. The best tax-to-GDP ratio lies between 10-15% of the total GDP. Adhikari (2020) examined the contribution of income tax in Nepal's revenue generation after 2068 to 2073 B.S. The focus of the article was in the area of tax revenue collection. It was found that the ratio of income tax on GDP was increasing every year since the study period. This study's main conclusion was that income tax revenue's contribution is insufficient to generate funds for tax revenues.

Materials and Methods

Research Design

This study is based on a descriptive and exploratory research design. The variables are explored, described, and analyzed to prove the objectives and research questions. Quantitative data are used to describe and explore the result.

Sources and Scope of Data

Data used for this study are secondary time-series data obtained for a twenty-one-year period from 1998 to 2018. Data are collected from various published sources like economic survey, the financial review of NRB, various NPC plan documents, and CBS, Nepal.

Model Formulation

The tax revenue of the economy is affected by the size of the GDP. The researcher assumes the hypothesis that there is no relationship between GDP and the flow of tax revenue. To confirm the idea, let us consider the linear regression equation: -

$$TXR=f(GDP) \quad (1)$$

$$TAX\ REV= \beta + \beta_2\ GDP + \varepsilon_t \quad (2)$$

$$LNTXR=\beta_1+\beta_2\ LNGDP +\varepsilon_t \quad (3)$$

$$D(LNTXR)= \beta_1+\beta_2\ [LNGDP(-i)] +\varepsilon_t \quad (4)$$

Where; tax revenue is a dependent variable, whereas GDP is an independent variable at a particular time. β_1 is the intercept term, and β_2 represents the slope and coefficient of regression. The coefficient of regression β_2 indicates how a unit changes in the independent variable affects the dependent variable. The error tern ε is incorporated in the equation to cater to other factors that may influence tax revenue flow. In equation 4. i shows the maximum

number of lags. i=1,2,3……n. The Vector Error Correction Model (VECM) is mainly used to analyze whether the GDP is significant to explain tax revenue. Some other econometric tests like Johnsen Co-integration Test, Granger Causality Test, serial correlation, heteroskedasticity, and normality examination are used. Before doing all these, lag selection criteria and unit root tests have been performed.

Vector Error Correction Model (VECM)

A VECM is a restricted Vector Autoregression (VAR) designed for non-stationary series known as co-integrating relations. If two variables are co-integrated, the relationship between the two can be expressed as an ECM. The VEC has co-integrating ties built into the specification to restrict the endogenous variables' long-run behavior to cover their co-integrating relationship while allowing for short-run adjustment dynamics. The co-integrating term is the error correction term because the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments (Gujarati,2015). The co-integrating equation can be introduced as:

$$Y_{2,t} = \beta_{Y1,t} \quad (5)$$

The corresponding VEC model is:

$$\Delta Y_{1,t} = \alpha_1(Y_{2,t-1} - \beta Y_{1,t-1}) + \varepsilon_{1,t} \quad (6)$$

$$\Delta Y_{2,t} = \alpha_2(Y_{2,t-1} - \beta Y_{1,t-1}) + \varepsilon_{2,t} \quad (7)$$

In these equations, it is assumed that there are only two variables with one co-integrating equation and no lag difference term. In this model, the only right-hand side variable is the error correction term. In the long run, this term is zero. When Y_1 and Y_2 deviated from long-run equilibrium, the error correction term will be non-zero, and each variable adjusts to restore the equilibrium relation partially. The coefficients α_1 measures the speed of adjustment of the i-th endogenous variables towards the equilibrium.

This study's main objective is to show and compare Nepal's tax-to- GDP ratio with neighboring countries and the world's most developed countries. It further aims to identify the degree of the relationship between GDP and tax revenue in Nepal.

Presentation and Analysis

Analysis of tax-to-GDP ratio

Table 1 presents the tax revenue and gross domestic product in monetary terms from 1989/90 to 2018/19. These data are taken from different Economic surveys published by the Ministry of Finance, Government of Nepal.

Table 1

Size of tax and GDP of Nepal and tax-to-GDP ratio (Amount in Ten Million)

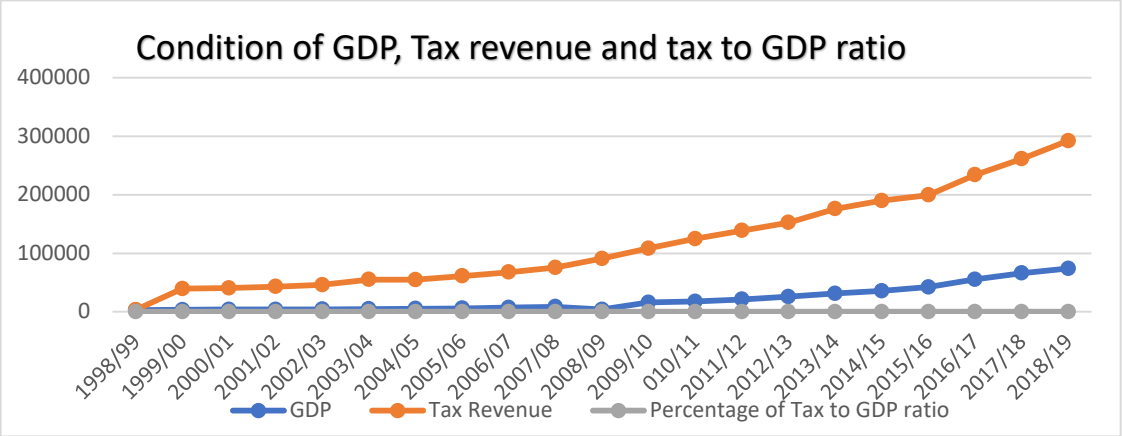
Fiscal Year	Tax Revenue	GDP	Tax to GDP Ratio (Tax/GDP)	Percentage
1998/99	2875.3	3301.8	0.0871	8.71
1999/00	3315.2	39356.6	0.0842	8.42
2000/01	3886.5	40563.2	0.0959	9.59
2001/02	3933.1	43039.7	0.0913	9.13
2002/03	4258.7	46032.5	0.0925	9.25
2003/04	4817.3	55069.9	0.0875	8.75
2004/05	5410.5	54848.5	0.0986	9.86
2005/06	5743	61111.8	0.094	9.4
2006/07	7112.7	67621	0.1051	10.51
2007/08	8515.6	75525.7	0.1128	11.28
2008/09	4055.1	90952.8	0.0446	4.46
2009/10	15978.5	108334.5	0.1475	14.75
010/11	17722.7	124848.2	0.142	14.2
2011/12	21172.3	138748.2	0.1526	15.26
2012/13	25921.5	152522.1	0.17	17
2013/14	31244.1	175873.8	0.1765	17.65
2014/15	35595.6	189908.9	0.1874	18.74
2015/16	42109.7	199356	0.2111	21.11
2016/17	55386.7	233948.2	0.2368	23.68
2017/18	65949.2	261210.2	0.2525	25.25
2018/19	73860.4	292097.4	0.2529	25.29

Source: Economic Survey of Nepal 2002/03, 2007/08 & 2019/20

Table 1 shows that the tax-to-GDP ratio of different fiscal years from1998/99 to 2018/19. The Tax-to-GDP rate ranges from 8.42 to 25.29 percent. The tax-to-GDP ratio was found lowest (8.42%) in the fiscal year 1999/00, and the highest proportion was found (25.29%) in the fiscal year 2018/19. The tax-to-GDP ratio was found in increasing trend from the budgetary year 2011/12, but there is some fluctuation from the fiscal year 1998/99 to 2010/11. The average percentage of tax- to-GDP ratio was found 13.92 percent for 21 years. The average tax revenue and GDP were found 20898.27 and 116870.0 ten million respectively during 21 years in Nepal. Figure 1 shows the trend of change in the percentage of tax-to-GDP ratio.

Figure 1

Condition of tax revenue, GDP, and Tax to GDP ratio (In ten million)



Source: Economic Survey of Nepal 2002/03, 2007/08 & 2019/20

Descriptive statistics are measured to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures. Descriptive statistics are used to present quantitative descriptions in a manageable form. Table 2 shows the descriptive statistics of the studied variables.

Table 2

Descriptive statistics from the actual data

Description	GDP	Tax revenue	Tax to GDP ratio (Percent)
Mean	116870.0	20898.27	13.91857
Median	90952.80	8515.600	11.28000
Maximum	292097.4	73860.40	25.29000
Minimum	3301.800	2875.300	4.460000
Std. Dev.	81710.28	22022.60	6.109101
Skewness	0.677695	1.191842	0.589242
Kurtosis	2.347256	3.219697	2.200505
Jarque-Bera	1.980264	5.013938	1.774516
Probability	0.371528	0.081515	0.411783
Sum	2454271.	438863.7	292.2900
Sum Sq. Dev.	1.34E+11	9.70E+09	746.4223
Observations	21	21	21

Table 2 throws the ideas of descriptive statistics of tax revenue and GDP derived from actual data. The GDP ranges from 3301.8 to 292097.4 ten million rupees. But the tax revenue ranges from 2875.3 to 73860.4 ten million rupees, and the tax- to- GDP ratio ranges from 4.46 to 25.29 percent during the study period. The standard deviation of tax revenue is smaller than GDP. So, the mean tax revenue is more representative than the GDP. The tax to GDP ratio

seems more than neighboring countries and the advanced countries of the world. In table 3, some countries' tax-to-GDP rate is presented to know Nepal's situation.

Table 3

Tax-to-GDP Ratio of Different Countries

Countries	India	China	Japan	America	UK	Russia	Bhutan	Canada	Nepal
Tax-to-GDP ratio	10.9	9.21	34.3	24.3	33.5	11.7	12.03	33.0	25.29

Source: World Bank Report, 2019

Table 3 compares the tax-to- GDP ratio with the neighboring and the most developed countries of the world. The tax-to- GDP ratio of china is at the lowest point, followed by India. The tax-to-GDP ratio of Japan is at the highest point among the sampled countries. It is commonly assumed that a more tax-to-GDP rate shows a better financial position and can finance its expenditure. On the other hand, the lower tax-to-GDP ratio reduces the tax burden to the general public and investors that encourage private investment. An increase in private investment induces increased personal profit and employment and ultimately improves its economic growth. Nepal’s tax-to-GDP ratio seems much higher in comparison to its overall financial condition. The lower tax-to-GDP ratio indicates two things: first, the government emphasizes reducing the tax burden. Second, government policies become a failure or take time to show its influence.

Measurement of Relation of Tax Revenue with GDP

It was found that the mean of tax revenue and GDP was found 20898.27 and 116870.0 ten million, respectively. The average tax-to-GDP ratio was 13.92 for 21 years from 1998/99 to 2018/19. The standard deviation of tax revenue and GDP was 22022.60 and 81710.28, respectively. Similarly, the standard deviation of the tax-to- GDP ratio was found at 6.11. The correlation coefficient between tax revenue and GDP was 0.98. So, tax revenue and GDP have a strong relationship. Recall that the correlation measures the strength of association between two variables. The standard deviation of tax revenue is less than the standard deviation of GDP. So, the mean of tax revenue is more representative because standard deviation is extremely useful in judging the mean's representativeness. The coefficient of GDP variation (67.55) is less than the coefficient of variance of tax revenue (98.37%). Therefore, tax revenue is more variable or more heterogeneous, or less consistent than the GDP of Nepal. The relation of mean, SD, CV, and the correlation between GDP and tax revenue is presented in table 4.

Table 4

Statistical Measurement of Tax Revenue and GDP

Description	Tax revenue(T)	GDP (G)	Tax-to-GDP ratio
Mean	20898.27	116870.0	13.92
Standard Deviation	22022.60	81710.28	6.11
Coefficient of variation	98.37	67.55	32.92
Correlation coefficient (r)		0.98	

Note. Authors' Estimation Results using Microsoft Office Excel, 2010

The value of correlations was found 0.98. The coefficient of indetermination (K) =1-r^2 = [K=1-$(0.98)^2$].

The standard error $[(1 - r^2/\sqrt{N}]$ was found 3882.87.

Probable Error (PE_r) =0.6745×$\frac{1-r^2}{\sqrt{N}}$ =0.6745× $\frac{1-(0.98)2}{\sqrt{21}}$ =0.0059

Now, 6×PE_r = 6× 0.0059 = 0.0354

Since r = 0.98>6×PE_r. So, the correlation(r) is highly significant.

Unit Root Test

Table 5

Outcomes of the Augmented Dickey-Fuller Test

Variables		Level			First difference		
	Description	Intercept	Trend & intercept	None	Intercept	Trend & Intercept	None
LNGDP	t value	-3.021	-3.658	-1.559	-3.031	-3.675	-1.960
	ADF test	-4.859	-35.660	-1.959	-48.221	-44.059	-20.626
	P value	0.0011	0.000	0.966	0.000	0.0001	0.0001
LNTXR	t value	-3.029	-3.658	3.017	-3.029	-3.673	-1.960
	ADF test	0.304	-3.286	-1.960	-7.088	-7.057	-5.351
	P value	0.972	0.097	0.998	0.000	0.0001	0.000

Where LNGDP= Gross Domestic Product after taking log.

LNTXR= Total tax revenue after taking log.

The decision of stationary or non-stationary data is made by unit root testing. The Augmented Dickey-Fuller (ADF) test is used for the conclusion of the stationary condition of data. At the first difference of data, the P-value of all variables is less than 0.05 or 5%, and the absolute value of ADF rest is greater than the critical value of t-statistics at 5%. Therefore, at first difference data, we can run the system equations. The outcomes of the ADF unit root test are presented in Table 5.

Lag selection

Lag selection is the process of identifying the period of one variable that can affect the other variable. All methods of lag selection, like Hannan Quinn (HQ) information criteria, Schwarz (SC) criteria Final Prediction Error (FPE), Akaike Information Criteria (AIC), and Sequential modified LR test Statistics are suggesting lag 1 for the operation system equations. The asterisk (*) value indicates the suggestion of taking lag for system equations like the Johnsen Co-integration test, Granger causality test, and Vector error correction model (VECM),

Table 6

VAR Lag Order Selection Criteria

Endogenous variables: LNGDP LNTXR

Exogenous variables: C

Sample: 1 21

Included observations: 16

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-13.66256	NA	0.024292	1.957821	2.054394	1.962766
1	27.75950	67.31086*	0.000228*	-2.719938*	-2.430217*	-2.705102*
2	29.74826	2.734539	0.000303	-2.468532	-1.985664	-2.443805
3	31.31507	1.762663	0.000447	-2.164384	-1.488368	-2.129766
4	33.65648	2.048738	0.000651	-1.957060	-1.087898	-1.912552
5	38.93769	3.300752	0.000769	-2.117211	-1.054901	-2.062812

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Johnsen Co-integration Test

All variables are stationary at the first difference, so we can run Johnsen co-integration test to check whether the tax revenue and GDP are cointegrated or not. Johnsen test of Co-integration is a procedure for test co-integration or association ship of time-based variables. The following table shows the outcomes of the Johnsen Co-integration Test derived from trace statistics and Max-Eigen statistics.

Table 7

Outcomes of Johnsen Co-integration Test
Sample (adjusted): 3 21
Included observations: 19 after adjustments
Trend assumption: Linear deterministic trend
Series: LNGDP LNTXR
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.588819	16.89507	15.49471	0.0306
At most 1	0.000492	0.009347	3.841466	0.9226

Trace test indicates one co-integrating equation at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.588819	16.88572	14.26460	0.0188
At most 1	0.000492	0.009347	3.841466	0.9226

Max-eigenvalue test indicates one co-integrating equation at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Where LNGDP= Gross Domestic Product after taking log.
LNTXR= Total tax revenue after taking log.

According to the Johnsen co-integration test result, one cointegrating equation is at a 5% significance level. Based on the trace method, the P-value of saying none co-integrated equation is 0.0306 or 3.06%, which is below 5%. Therefore, the null hypothesis is rejected. It means that the variables are co-integrated, and they have a long-run relationship. In the Max-Eigen statistics method, the p-value is 0.0188 or 1.88%, below 5%. So, we can reject the null hypothesis of saying none co-integrated equation in the system. Therefore, both trace statistics and Max-Eigen statistics Prove that all variables have a long-run association ship and co-integrated. Based on the result of the Johnsen co-integration test, it is necessary to follow VECM to analyze the impact and relation of GDP to tax revenue.

Vector Error Correction (VEC) Model

The presence of co-integration between variables suggests a long-run relationship among the variables under consideration. Then, the VEC model can be applied. The VECM

directly estimates the speed at which a dependent variable returns to equilibrium after a change in another variable. The following table 8 shows the outcomes of the VEC model.

Table 8
Vector Error Correction Estimates
Sample (adjusted): 3 21
Included observations: 19 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
LNTXR (-1)	1.000000	
LNGDP (-1)	-1.643165	
	(0.07606)	
	[-21.6027]	
C	9.447146	
Error Correction:	D(LNTXR)	D(LNGDP)
CointEq1	-1.061615	-0.078082
	(0.26639)	(0.05526)
	[-3.98515]	[-1.41298]
D (LNTXR (-1))	-0.057195	0.028481
	(0.19109)	(0.03964)
	[-0.29931]	[0.71850]
D (LNGDP (-1))	0.071257	-0.029126
	(0.10420)	(0.02162)
	[0.68385]	[-1.34748]
C	0.156388	0.107500
	(0.06865)	(0.01424)
	[2.27804]	[7.54878]

The long-run relationship between tax revenue and GDP for one cointegrating vector for Nepal in the period of 1998/99 to 2018/19 is displayed below:

$$D(LNTXR)= 0.156388-0.057195D(LNTXR(-1)) +0.071257D(LNGDP(-1)) \quad (8)$$

(0.06865) (0.19109) (0.10420)

Table 8 shows the various coefficients, standard error, and corresponding t-statistics. The VECM converts the data in the first difference automatically. There is only one co-integrating equation. There are eight short-run coefficients in the whole VEC model. The VEC model establishes the independent variable's relation, whether significant to explain the dependent variable. For example, D(LNGDP (-1)) is significant to explain D(LNTXR(-1)) or

not. To make a decision, we have to follow the instructions of the model with a Probability value.

The model with Probability Value

Table 9

The VEC model with a Probability value
Dependent Variable: D(LNTXR)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 3 21
Included observations: 19 after adjustments
D(LNTXR) = C(1)*(LNTXR(-1) - 1.64316461344*LNGDP(-1) +
9.44714621812) + C(2)*D(LNTXR(-1)) + C(3)*D(LNGDP(-1)) + C(4)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-1.061615	0.266393	-3.985152	0.0012
C(2)	-0.057195	0.191090	-0.299307	0.7688
C(3)	0.071257	0.104200	0.683849	0.5045
C(4)	0.156388	0.068650	2.278042	0.0378
R-squared	0.633353	Mean dependent var		0.163350
Adjusted R-squared	0.560024	S.D. dependent var		0.361159
S.E. of regression	0.239559	Akaike info criterion		0.164630
Sum squared residual	0.860828	Schwarz criterion		0.363460
Log-likelihood	2.436011	Hannan-Quinn criter.		0.198280
F-statistic	8.637094	Durbin-Watson stat		2.213385
Prob(F-statistic)	0.001437			

Table 9 shows the VEC model with probability values. The value of R^2 is 0.633353 or 63.34%, which is more than 60%. So, the independent variables are nicely fitted. The probability value of F statistics is 0.001437 or 0.14%, which is less than 5%. So, the independent variables have a combined effect on the dependent variable. In other words, D(LNTXR(-1)) and D(LNGDP(-1)) have a combined effect to determine the D(LNTXR). The first coefficient (C_1) is called the error correction term. The error correction term is negative and significant. The error correction term is significant because its p-value is 0.0012 or 0.12%. It proves the validity of the long-run association ship between variables. There is long-run causality running from the independent variables to the dependent variable. Only coefficients C (1) and C(4) are independently significant to explain the dependent variable. But the p-value of F statistics is less than 5%. So independent variables are jointly substantial to justify the dependent variable. Lag difference 1, the LNTXR, and LNGDP have jointly determined Nepal's tax revenue (LNTXR).

The vector error correction model indicates the positive relationship between tax revenue and GDP in Nepal. The value of R^2 is 63.34%. It means 63.34% tax revenue depends upon GDP, an independent variable, meaning that the regression line is fitted. The coefficient and F- statistics are significant at a 5% level of significance. There is no serial correlation in the regression equation because the probability value of observed R^2 is more (24.29%) than 5% (Annex I). According to the probability value (0.9850), there is no heteroskedasticity problem, and the regression error correction terms have the same variance (Annex II). Again, Annex III shows the Jarque-Bera normality test results with a joint probability of 0.8355 indicates that residuals are normally distributed.

Conclusion and Policy Implementation

The tax- to- GDP ratio of Nepal is expanding and near the level of most developed countries. The tax- to- GDP ratio of Nepal (25.29%) is more than the tax-to- GDP ratio of India (10.9%), China (9.21%)., America (24.4%), and Russia (11.7%) but less than the tax to GDP ratio of Japan (34.4%) and the United Kingdom (33.3%). It means that the tax-to-GDP ratio is not a single and powerful indicator of economic development. It proves the conclusion of socialistic economists that high taxes are bad for economic growth. The tax revenue is highly dependent on the GDP of Nepal. The correlation coefficient is 0.98. It means there is a high degree of positive correlation between tax revenue and GDP of Nepal. 63.34 percent variation in tax revenue depends upon GDP, and the rest 36.66 percent variation from other factors. The coefficient of tax revenue variation is more than the coefficient of GDP variation, i.e., $C.V_T > C.V_G$ such that 98.37% >67.55%, so tax revenue is more variable than GDP. The Tax-to-GDP ratio cannot ensure economic development or the fulfillment of financial resources. There is a positive relationship between tax revenue and GDP. Therefore, it is necessary to increase GDP for the increment of tax revenue. More tax rate in comparison to the increment of GDP may hamper the economic growth of the nation.

It is proved from Nepal's economic condition that the higher tax-to-GDP ratio alone cannot ensure its high economic growth. It is necessary to advise the government to expand the tax net rather than solely focusing on custom revenue and income tax. The government effort has to put in tax diversification. The maximization of tax revenue is possible at the maximizing condition of GDP. A very high tax-to-GDP ratio discourages investment. So, it is necessary to decrease the tax rate to allow investors to expand their investment. To determine the tax rate, it is essential to consider the impact on private investment.

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ANNEXURE

ANNEX-I

Serial Correlation

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.082325	Prob. F(1,14)	0.3158
Obs*R-squared	1.363461	Prob. Chi-Square (1)	0.2429

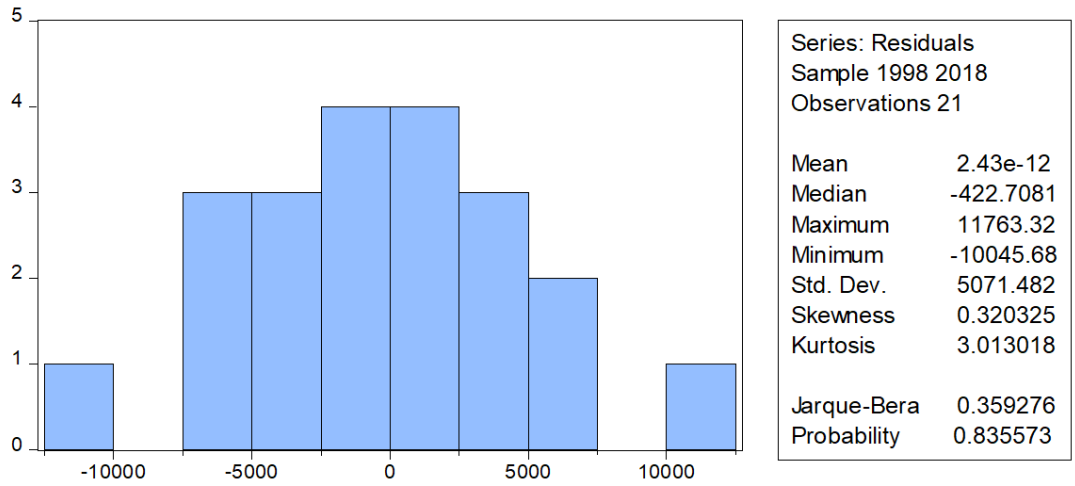
ANNEX-II

Heteroskedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey		
F-statistic	0.069202	Prob. F(4,14)
Obs*R-squared	0.368387	Prob. Chi-Square (4)
Scaled explained SS	1.450399	Prob. Chi-Square (4)

ANNEX-III

Normality Test



Note. Authors' Estimation Results using E-views 10