Tax Elasticity and Buoyancy in Nepal: A Revisit

Neelam Timsina*

Tax elasticity and buoyancy estimates are the dynamic tools for measuring the tax performance. This study makes a revisit to the studies carried out earlier to measure tax elasticity and buoyancy in Nepal, in the context of the structural changes that have taken place in the tax system in recent years. The main objectives of the study are to measure the elasticity and buoyancy of tax and to ensure whether or not the tax system in Nepal is elastic. The study has applied time series regression approach for this empirical measurement. This study reveals that the tax system in Nepal is inelastic (less than unity) in the period 1975-2005 with a more than unitary buoyancy coefficients, thus reflecting that the bulk of revenue collection emanates from discretionary changes in the tax policy, rather than from automatic responses.

I. INTRODUCTION

Revenue mobilization has a crucial role in fiscal policy implementation, especially in a developing country where the demand of public funds for public expenditure is high. It is a better source of resource mobilization than the other sources such as deficit financing and money creation. As tax revenue is the major source of domestic revenue in Nepal, the measurement of tax elasticity and buoyancy would be very beneficial in terms of reforms in tax structure as well as revenue administration. In addition to this, the study of tax elasticity and buoyancy is also useful for revenue forecasting.

Tax revenue may change due to a variety of factors, such as changes in income, changes in tax rate and tax base, changes in efficiency of tax assessment and collection, among others. The responsiveness of tax revenue to such changes can be explained with the help of tax elasticity and buoyancy. "Tax elasticity may be defined as the ratio of a percentage change in adjusted tax revenue to a percentage change in income i.e. nominal GDP. On the other hand, tax buoyancy refers to changes in actual tax revenues due to the changes in income as well as due to the changes in discretionary measures such as tax rates and tax bases"(Mukul, 1977, p. 63). This distinction between the tax elasticity and buoyancy is very useful in analyzing and evaluating whether future revenues will be

* Deputy Director, Research Department, Nepal Rastra Bank, E-mail: neelam@nrb.org.np

sufficient to meet the resource needs without changing the rates or bases of the existing tax. To measure the tax elasticity, historical tax series must be adjusted so as to eliminate the effects of tax revenues from discretionary changes. If there is no change in the tax rates and the tax base during the reference period, the buoyancy will be the same as elasticity.

Against this background, this study attempts to utilize the time series approach to empirically estimate the tax elasticity and buoyancy in Nepal for the period 1975 – 2005. The major components of tax revenue such as import duties, value added tax (VAT), income tax and excise duties are scrutinized. For the period prior to the launch of the VAT, the sum of sales tax, contract tax, entertainment tax and hotel tax is used for the elasticity estimation.

Alternatively, the buoyancy and the elasticity of tax revenues are also estimated by applying the partitioning approach. "Under this approach, tax elasticity and buoyancy coefficients are partitioned into tax to base and base to income components" (*Ibid*, p.66) In other words, tax elasticity and buoyancy are estimated with respect to the gross domestic product (GDP) as well as their respective proxy bases. "An advantage of using such a partitioning approach is the ability to identify factors responsible for rapid or lagged revenue growth. Factors that affect the tax to base elasticity such as tax rates, exemptions and improvements in tax administration are within the control of the fiscal authorities, thereby making this measure important for related purposes. The base to income elasticity, on the other hand, is determined largely by the way in which the economic structure responds to growth" (Yuthika, 1991, p. 76)

The study is organized as follows. With this introductory part, the second section highlights the rationale of the study as well the objectives. The third section discusses the data sources and limitations, the adjustment procedures, and the method of calculating the elasticity and the buoyancy. The fourth section discusses the methodology of the study. The fifth section presents the results while the last section draws the conclusion.

II. RATIONALE AND OBJECTIVES OF THE STUDY

Though several research studies were carried out in the past, it is very useful to revisit tax elasticity and buoyancy in the present scenario. A number of changes have taken place in the taxation front in Nepal in recent years. The VAT has come into enforcement and its rate has been changed twice. Income tax rates were changed many times and a new Income Tax Act was launched in 2002. Customs slabs and rates have been revised frequently. Many other tax reform measures have been applied in the recent years. This study of tax elasticity and buoyancy will thus be beneficial for tax planning and fiscal projection in the present Nepalese context.

Most of the earlier studies have followed a traditional approach to calculate elasticity and buoyancy of several taxes. Under this approach, tax revenue is assumed as a function of the GDP, which may not always reflect the clarity of the results in all the cases. For instance, revenue from import duties does not directly depend on the level of GDP. Rather, it depends on the value of import which in turn depends on the level of GDP. There is an indirect relationship between these variables. To see this type of relationship, it is recommended worldwide to follow the partitioning approach while estimating elasticity and buoyancy, rather than pursue the traditional approach. "An advantage of

using such a partitioning approach is the ability to identify factors responsible for rapid or lagged revenue growth"(*Ibid*, p.76).

In the partitioning approach, as discussed earlier, tax elasticity and buoyancy coefficients are partitioned into tax to base and base to income components. Generally, the product of tax to base elasticity coefficient and the base to income elasticity coefficient is equal to the overall elasticity coefficient drawn from the traditional approach. However, this may not happen always. This study attempts to verify whether or not the results obtained from both the approaches are similar.

This study differs from a number of previous studies as it has included all the major tax components, including excise duties. The author feels that it is not appropriate to exclude excise duty, the tax component with the share of over 13 percent on total tax revenue.

Hence, the principal objectives of the study are: a) to introduce the concept of elasticity and buoyancy of tax, b) to estimate the elasticity and buoyancy of tax in Nepal for the period 1975-2005, c) to seek the difference between the buoyancy and the elasticity of tax in Nepal, d) to investigate whether the results obtained through traditional approach and the partitioning approach are similar or different, and e) to ensure whether or not the tax system in Nepal is elastic.

III. Data Sources, Limitations, Adjustment Procedures and Elasticity and Buoyancy Calculation

The data on GDP, tax revenues and their proxy bases are taken from the *Budget Speeches* and various issues of *Economic Survey* published by the Government of Nepal as well as the various issues of *Quarterly Economic Bulletin* of Nepal Rastra Bank. The study follows the IMF's *Government Finance Statistics (GFS)* method to classify the tax revenue. "In this classification, tax revenues are classified with respect to their bases on which they are levied"(*Ibid*, p.80). The tax revenue can be classified on the basis of income, profit, consumption of goods and services, international trade, property etc. For example, income tax is levied on income of individuals and profits of business. In this study, for simplicity purpose, the non-agricultural income is taken as the proxy base for the income tax (as the agricultural income is not taxed in Nepal). The VAT and excise are levied on private consumption and import duties are levied on the imports of goods and services. The total tax is based on the GDP at current market price.

Table 1: Proxy Tax Bases

Tax Revenue	*Proxy Bases*
Income Tax	Nonagricultural income at time t-1
VAT and Excise Tax	Private consumption at time t
Import Tax	Imports of goods and services at time t
Total Tax	Nominal GDP at time t

Limitations

There are three limitations of the study. In the first, due to the unavailability of the actual data of tax revenue from discretionary changes, the budget estimates of such revenue through discretionary change are cleaned by applying the proportional adjustment method. Secondly, since VAT was launched in November 1997 in Nepal, no time series data prior to that time are available. For that reason, the aggregate data on sales tax, hotel tax, entertainment tax and contract tax are used in place of VAT prior to 1997. Finally, because of the difficulty to access data prior to 1975, only data for the period of 30 years are used for the elasticity and buoyancy estimation purpose.

The Adjustment Procedure

Tax revenue usually changes due to discretionary measures, for example, changes in tax rates, tax net expansion and so on. Therefore, a need to separate the changes in revenue emanating through the discretionary measures from that due to automatic measures arises to estimate the elasticity. This is the way to distinguish tax elasticity from tax buoyancy.

Tax revenue series can be adjusted in three ways: constant rate procedure, the proportional adjustment procedure and the dummy variable procedure. The selection of the appropriate adjustment method depends upon the availability of the data on tax changes and the type and frequency of such changes (*Ibid*, p.78). The constant rate structure method requires disaggregated data on tax rates and tax bases, which is not easily available in Nepal. Since the tax revenues change frequently through the discretionary changes, the dummy variable procedure is not applicable. So the proportional adjustment procedure, which requires calculation of the revenue implications of discretionary measures, is applied in the study to adjust the historical tax revenue data. In this method, to remove the estimated revenue impact through discretionary measures, the annual observed data are adjusted for discretionary changes. The resulting series are converted to the first year's basis by adjusting the year to year changes by the ratio of the tax yield on the basis of the first year rates to the actual tax yield.

The proportional adjustment method (Sahota, 1961) is as follows:

$$NR_t = \frac{AR_t - DR_t}{AR_{t_1}} \times NR_{t1}$$

where NRt = net or adjusted revenue series in year t; $AR_{t=}$ actual revenue collection in year t; $DR_{t=}$ proportional revenue collection through discretionary changes in year t; and $AR_{t-1=}$ net revenue series in preceding year.

Elasticity and Buoyancy Calculation

Elasticity is defined as the ratio of proportionate change in adjusted tax to the relative change in income in such a way as,

$$\text{Elasticity} = \frac{\Delta T^* / T^*}{\Delta \text{Base} / \text{Base}}$$

where ΔT^*= change in tax revenues adjusted for the estimated impact of changes in the tax system over the period.

$$\text{Buoyancy} = \frac{\Delta T / T}{\Delta \text{Base} / \text{Base}}$$

where ΔT = change in actual tax revenues over the period.
"If the changes in the tax system are revenue enhancing, then buoyancy will exceed elasticity" (IMF, 2006).

IV. METHODOLOGY

The study has applied time series regression approach for the empirical measurement of the elasticity as well as buoyancy for the different types of taxes stated earlier. Generally tax elasticity/buoyancy is calculated using the regression equation:

$$\log tr_t = a + b \log gdp_t + u_t \quad (1)$$

where tr_t = tax revenue at time t (adjusted in case of elasticity and actual in case of buoyancy); a=intercept; b=elasticity or buoyancy coefficient of respective tax; gdp_t = nominal GDP at time t; and u_t = error term .

As stated earlier, the partitioning approach has been applied to estimate the elasticity and buoyancy coefficients. That means, tax elasticity and buoyancy are estimated through two ways: tax to base and base to income. Tax to base elasticity measures the progressiveness of the tax structure, and/or a given trend in administrative efficiency, while the base to income elasticity measures the responsiveness of tax base to income. The product of these two coefficients gives the same result of traditional income elasticity approach (Mukul, 1977).

The functional form of the least square equation for computing tax to base elasticity is in log linear or double log specification such as :

$$\log tr_t = a + b \log tb_t + u_t \quad (2)$$

where tr_t = tax revenue at time t (adjusted in case of elasticity and actual in case of buoyancy); a= intercept; b=elasticity or buoyancy coefficient of respective tax; tb_t = tax base at time t; and u_t = error term

The regression used to estimate base to income elasticity/buoyancy is:

$$\log tb_t = a + b \log gdp_t + u_t \quad (3)$$

where tb_t = tax base at time t and gdp_t = GDP at market prices at time t

Unit Root Tests

The second step in seeking a methodology for modeling any economic relationship is to ascertain the stationarity of the variables under scrutiny, otherwise regression results would be spurious (nonsense). Table 2 shows the Augmented Dickey Fuller (ADF) test for all variables under the study. ADF has been calculated at first lag with intercept.

TABLE 2: ADF Test Results (Unit Root Tests)

Variables	*Level*	*First Difference*
$lngdp_t$	-0.833	-6.255
$lnexd_t$	-0.754	-6.4-645
$lnimd_t$	-2.078	-4.771
$lninct_t$	-0.013	-5.338
$lnnagdp_{t-1}$	-1.488	-2.692 (10%)
$lnpvtcon_t$	-0.947	-6.512
$lntimp_t$	-1.418	-4.570
$lntr_t$	-1.213	-5.006
$lnttr_t$	-1.227	-5.241
$lnvat_t$	-0.023	-4.175
$lnaexd_t$	-0.532	-5.792
$lnaimd_t$	-1.574	-6.263
$lnainct_t$	-1.449	-4.369
$lnatr_t$	-0.870	-5.729
$lnattr_t$	-0.920	-5.397
$lnavat_t$	-1.419	-4.855

Mackinnon critical values for rejection of null hypothesis of a unit root are : 1 % critical value = -3.689
5% critical value = -2.972
10% critical value = -2.625

The figures shown are 't' ratios for which a suggested significance value in the ADF test is -3.0 or below (Dickey and Fuller, 1979, 1981).

ADF statistics in the above table shows that all variables under scrutiny have unit roots. In other words, they are non-stationary in level but stationary in the first difference. In this case, the regression is run on the first difference. But the regression (first difference) provides the results in growth but not the elasticity estimates . Since the main purpose of this study is to examine the elasticity and buoyancy of tax, the primary tool for this would be to run the regression in the natural log linear form. Moreover, as the regressions on levels have very high-adjusted R^2 it is a positive indication to apply the regression on log levels (Special Study Division, 2004). The presence of auto correlation, observed in all estimated equations have been corrected by applying the Cochrane – Orcutt method [AR(1)] and / or moving average method [MA(1)] .

5. Analysis of Results

Import Duties

The elasticity of import tax is 0.54 (Appendix 2) implying that a 10 percent change in the nominal GDP results in a 5.4 percent change in import tax. The result is significant at 1 percent level with a satisfactory adjusted R^2 (0.93). DW statistics is 1.98 reflecting a very little auto correlation in the equation. The buoyancy coefficient, on the other hand is 1.05 (Appendix 1). It is higher by 0.51 (1.05-0.54) compared to the elasticity coefficient implying that a 5.1 percent change in import tax through discretionary measures was due to a 10 percent change in the nominal GDP. From this, it can be easily observed that import tax in Nepal is inelastic. In the period 1975-1994, the elasticity and buoyancy of import tax were 0.51 and 1.05 respectively (Adhikari, 1995). Clearly in that period, the role of discretionary measures to generate import tax was even higher than the review period. However, this was not so significant.

Also in the case of ' tax to base ' coefficients, buoyancy (0.83) as shown in Appendix 1 was higher by 0.40 over the elasticity (0.43) as illustrated in Appendix 2. It implies that although the 10 percent changes in the total value of imports results in an 8.3 percent change in the import tax, the 4.3 percent change is from discretionary measures. Also in this case, elasticity is about approximately half of the buoyancy. In the period 1975-1994 such tax to base (import duties to total imports) elasticity and buoyancy were 0.40 and 0.80 respectively (Adhikari, 1995). Thus, no additional changes have taken place in this period in the structure of elasticity and buoyancy.

One interesting finding of this study is that import tax is not much responsive to the changes in the value of imports. This conclusion is confirmed by the fact that despite a substantial increase in imports in the early and mid-1990s, the import duties did not increase in this proportion (Special Study Division, 2004). The decrease in tariff rates, composition of the imports (for example, majority of raw materials and capital goods which attract low duties), large informal trade between Nepal and India, removal of quantitative restrictions, as well as inefficiency of the customs administration to control revenue leakage are the main reasons for such a low responsiveness of import duties to the value of imports.

Another important finding is that both the traditional approach (tax to GDP) and the partitioning approach (tax to base and base to income) for calculating the elasticity provide very similar results. In the case of import tax, the traditional approach provides buoyancy (import duties to GDP) as 1.05. The product of the tax to base (import duties to total imports) and the base to income (total imports to GDP) under the partitioning approach is 1.03. Similarly, the traditional approach provides elasticity coefficient of import duties at 0.54. In the partitioning approach, such elasticity coefficient is 0.52. Therefore, the verification of the equation is also possible under the study.

Income Tax

The buoyancy of income tax is 1.37 and the elasticity coefficient is 0.41. The results are significant at 1 percent level with an adjusted R^2 (0.98) for buoyancy and 0.92 for elasticity . This clearly shows that there is very low natural growth of income tax during

the review period. The major portion of income tax is received through discretionary measures. During the period 1975-94, buoyancy and elasticity of income tax were 1.14 and 0.39 respectively (Adhikari, 1995). In the review period, the buoyancy coefficient of income tax has improved because several types of income are brought into the tax net . Many private limited companies, foreign airlines, joint venture banks and financial institutions were established and their income are brought into the tax net. Interest and dividend tax were introduced during this period. It can be observed that most of the sources of income, which were exempted earlier, are brought into the tax net today. Moreover, the income tax rates are frequently changed through the annual budget. These developments in tax structure may lead to the improvement in income tax buoyancy in the review period. However, the elasticity coefficient improved very slowly. The nominal increase (0.02) in the elasticity coefficient implies that there is very low scope of natural growth of income tax and that the discretionary measures have the vibrant role in generating income tax revenue.

The results obtained under both the traditional and partitioning approach are fairly close. For example, elasticity under the traditional approach is 0.41, which is fairly close to 0.43 under the partitioning approach.

Value Added Tax

Prior to 1997, the VAT was not existent. However sales tax, contract tax, and hotel tax were present. Therefore, the sum of these taxes is treated as VAT up to that time. The elasticity and buoyancy of VAT are calculated in two periods 1975-1996 and 1975-2005, as the sample period of VAT is very small, that is, eight years only.

From the empirical results, the elasticity and buoyancy coefficients of VAT are 0.55 and 1.15 respectively during the review period. In the period 1975-1996 (prior to the introduction of the VAT), such coefficients (the sum of sales tax, contract tax ,hotel tax and entertainment tax) were 0.82 and 1.04 respectively. This result demonstrates that after the introduction of the VAT, tax buoyancy increased but the tax elasticity declined. Though the VAT is introduced in Nepal with an expectation of broadening the tax base, eliminating tax cascading, creating an investment friendly tax system and increasing the revenue, it seems also inelastic. The results obtained under the traditional approach and the partitioning approach are fairly close in this case, too.

Excise Tax

This is only the tax, whose buoyancy is less than unity (0.98). Its elasticity coefficient is 0.49, which is exactly half of the buoyancy. It means that 10 percent change in nominal GDP results in a 9.8 percent change in excise tax, of which 4.9-percentage points falls in the discretionary measures. It clearly illustrates that there is low natural growth of excise tax during the review period. The elasticity results are significant at 1 percent level with an adjusted R^2 (0.96) and DW statistics (1.95) reflecting very low positive serial correlation. Also the buoyancy results are significant at 1 percent level with quite high-adjusted R^2 (0.99) and DW statistics (2.00) showing the optimum level of autocorrelation. The proxy base of excise under the partitioning approach is private sector consumption. The results obtained under both the traditional and the partitioning approaches are similar

in case of elasticity as well as buoyancy. The results confirm that excise duties in the review period are not much responsive to the GDP. Usually the adoption of specific excise duties rather than advalorem tax rate, exemption and the leakage may be the principal resources.

Total Tax and Total Revenue

Total tax revenue which occupies approximately 80 percent of the total revenue mobilization in Nepal has been assigned elasticity coefficient (0.51) which is less than half of the buoyancy (1.12). From these results, it can be easily observed that there is very low automatic growth of the tax revenue reflecting a very inelastic tax structure.

During the review period, total revenue has been assigned the elasticity coefficient of 0.59 (Appendix 2) implying that total revenue changes by 5.9 percent as a result of 10 percent change in the nominal GDP (removing the revenue from discretionary changes). On the other hand, buoyancy of the total revenue is more than unity (1.14) (Appendix 1). The difference between the elasticity and buoyancy of the total revenue is 0.55 which indicates that 10 percent change in nominal GDP results in 5.5 percent change in total revenue through discretionary changes. It denotes that even after many tax reforms in this period, revenue mobilization heavily depends upon the discretionary measures. During the period 1975-94 such revenue elasticity coefficient was 0.65 and buoyancy was 1.10 (Adhikari, 1995) . The difference was 0.45. It clearly shows that in the review period, the automatic response of the revenue to the nominal GDP was further discouraged implying that even in the later period revenue mobilization through discretionary changes has increased.

VI. CONCLUSION AND RECOMMENDATIONS

A time series analysis of tax elasticity and buoyancy reveals an inelastic tax structure in Nepal for the period 1975-2005. Taxes are not responsive to changes in income with most elasticity coefficients reporting below unity. The tax system is not progressive adequately also in the case of proxy bases. A progressive tax system needs to have at least greater than unitary value of the coefficient of elasticity, (Adhikari, 1995). And a higher degree of progressivity in the tax structure would result in an elasticity greater than 2 (Dahal, 1984). The low built in flexibility (elasticity) observed in Nepalese tax system is explained through a variety of factors such as exemptions, tax incentives, duty waivers, low compliance and the large sectors of the economy which are not subject to taxation. Therefore, the automatic response of tax to income is low. Compared to the period 1975-1994, the elasticity coefficients of tax during the review period did not reveal significant differences. However, the higher coefficients obtained through the sensitivity (buoyancy) analysis focus on the role of discretionary measures in maintaining a steady source of tax revenue throughout the review period.

The targeted average revenue growth mentioned in the Tenth Plan could be achieved only with the rigorous efforts of the fiscal authorities to improve the overall tax system as well as revenue administration. The major recommendations in this regard are as follows:

(a) As the study reveals that the import tax is not much responsive to the changes in the value of imports, the need for enhancing the efficiency of the customs administration

to control the revenue leakage is highly felt. Improvement in customs valuation, discouraging the over-invoicing and under-invoicing, penalizing the wrong declaration of imported goods and misutilization of pass book facility at customs points, checking the use of duplicate documents, minimizing LC related frauds, enhancing the ASYCUDA (Automated System for Customs' Data), and enhancing the activities of customs patrolling group are some of the major mechanisms of enhancing the customs reforms.
With regard to the VAT, developing a sound billing habit, increasing consumers' consciousness on demanding bills, easing the tax deduction and VAT refund process, discouraging the sellers' trend of demanding huge amount of 'tax credit', developing cooperative and positive thinking of VAT personnel to correct the mistakes of the sellers on maintaining the accounts, relevant training for the VAT personnel, right placement of the personnel as well as less frequent transfer policy are some of the important measures that need to be taken.

(b) With respect to excise duties, introducing new goods in the tax net, and thus broadening the tax net of excise duties, adoption of advalorem tax rates rather than specific tax rates are the major steps to be taken.

(c) In the context of income tax, agricultural income, which has been left outside the tax net due to non-economic issues, should be brought under the tax net. As agriculture contributes about 38 percent to the GDP, there is no reason to keep this sector outside the tax net. Additionally, deduction of unnecessary exemptions, introduction of income tax on new services which were not taxed earlier are the ways to generate more revenue from income tax.

(d) On the total tax revenue front, establishment of simple, equitable, fair and practical tax system with lower and less differentiated taxes and tariff rates, widened bases and enhanced voluntary tax compliance are very crucial to improve tax administration. Moreover, rationalizing the tax structure and rates, reducing discretionary exemptions and burdensome bureaucratic requirements are recommended to enhance the efficiency of the tax administration.

Only the discretionary measures cannot generate more revenue forever. Automatic measures for generating tax revenue is of the great essence in this regard. Improvement in tax administration to control the leakage and to broaden the tax bases in practice is important for enhancing the elasticity of the tax.

APPENDIX 1: Buoyancy of Major Taxes in Nepal – Sample Period (1975-2005)

Major Taxes	Equation Applied	a	b	Adj R^2	DW	P	AIC	SC	F- Statistics
1. Excise Duties									
Total Buoyancy	$lnexd_t$ c $lngdp_t$ MA(1) AR(1)	-4.50	0.98	0.99	2.00	0.44	-1.68	-1.49	1246.51
		(-8.69)	(22.60)						
Tax to Base	$lnexd_t$ c $lnpvtcon_t$ AR(1)	-4.29	0.99	0.99	1.66	0.71	-1.91	-1.77	2291.85
		(-6.54)	(17.97)						
Base to Income	$lnpvtcon_t$ c $lngdp_t$ AR(1)	-0.12	0.99	0.99	2.00	0.05	-3.55	-3.41	11384.37
		(-1.46)	(142.99)						
2. Import Duties									
Total Buoyancy	$lnimd_t$ c $lngdp_t$ AR(1) MA(1)	-4.36	1.05	0.99	2.07	0.52	-1.77	-1.58	1554.93
		(-7.60)	(21.75)						
Tax to Base	$lnimd_t$ c $lntimp_t$ AR(1) MA(1)	-0.56	0.83	0.99	2.01	0.47	-1.34	-1.14	1007.57
		(-1.45)	(22.43)						
Base to Income	$lntimp_t$ c $lngdp_t$ AR(1) MA(1)	-4.08	1.22	0.99	2.00	0.69	-1.70	-1.51	1979.76
		(-5.65)	(20.33)						
3. Income Tax									
Total Buoyancy	$lninct_t$ c $lngdp_t$ AR(1)	-8.91	1.37	0.98	1.28	0.66	-0.33	-0.19	895.00
		(-7.55)	(13.79)						
Tax to Base	$lninct_t$ c $lnnagdp_{t-1}$ AR(1) MA(1)	-6.70	1.25	0.99	1.81	0.61	-1.12	-0.94	1369.83
		(-6.32)	(13.28)						
Base to Income	$lnnagdp_{t-1}$ c $lngdp_t$ AR(1) MA(1)	-2.26	1.14	0.99	1.97	-0.04	-2.98	-2.79	5792.72
		(-20.80)	(122.19)						
4. VAT									
Total Buoyancy	$lnvat_t$ c $lngdp_t$ AR(1) MA(1)	-5.54	1.15	0.99	1.83	0.49	-1.93	-.174	2187.47
		(-9.95)	(24.73)						
Tax to Base	$lnvat_t$ c $lnpvtcon_t$ AR(1) MA(1)	-5.31	1.16	0.99	1.67	0.54	-1.83	-1.63	1974.04
		(-9.65)	(24.7)						
Base to Income	$lnpvtcon_t$ c $lngdp_t$ MA(1)	-0.12	0.99	0.99	2.00	0.05	-3.55	-3.41	11384.37
		(-1.46)	(142.99)						
5. Total Tax	$lnttr_t$ c $lngdp_t$ MA(1)	-3.94	1.12	0.99	1.91	0.17	-2.73	-2.54	7793.21
		(-14.87)	(49.54)						
6. Total Revenue	$lntr_t$ c $lngdp_t$ AR(1) MA(1)	-4.00	1.14	0.99	1.89	-0.10	-2.60	-2.41	4044.46
		(-20.49)	(68.50)						

(Figures in parentheses are t – statistics)

a = estimated intercept

b = estimated buoyancy coefficient

p= autocorrelation coefficient

All buoyancy coefficients are significant at 1 percent .

AIC=Akaike Info Criterion

SC= Schwarz Criterion

$lnexd_t$ = natural log of excise duties at time t

$lngdp_t$ = natural log of nominal GDP at time t

$lnpvtcon_t$ = natural log of private consumption at time t

$lnnagdp_{t-1}$ = natural log of non agricultural GDP at time t-1

$lnvat_t$ = natural log of Value Added Tax at time t

$lntr_t$ = natural log of total revenue at time t

$lninct_t$ = natural log of income tax at time t

$lnimd_t$ = natural log of import duties at time t

$lntimp_t$ = natural log of total value of import at time t

APPENDIX 2 : Elasticity of Major Taxes in Nepal – Sample Period (1975-2005)

Major Taxes	Equation Applied	a	b	Adj R^2	DW	P	AIC	SC	F- Statistics
1. Excise Duties									
Total Elasticity	$lnaexd_t$ c $lngdp_t$ AR(1)	-0.08	0.49	0.96	1.95	0.50	-1.68	-1.74	450.78
		(-0.19)	**(14.8)**						
Tax to Base	$lnaexd_t$ c $lnpvtcon_t$ AR(1)	-0.01	0.49	0.96	2.08	0.44	-1.71	-1.57	435.8
		(-0.03)	(16.38)						
Base to Income	$lnpvtcon_t$ c $lngdp_t$ AR(1)	-0.12	0.99	0.99	2.00	0.05	-3.55	-3.41	11384.37
		(-1.46)	(142.99)						
2. Import Duties									
Total Elasticity	$lnaimd_t$ c $lngdp_t$ AR(1)	0.45	0.54	0.93	1.98	0.46	-0.62	-0.48	196.59
		(0.71)	(9.97)						
Tax to Base	$lnaimd_t$ c $lntimp_t$ AR(1)	2.36	0.43	0.93	2.03	0.39	-0.61	-0.47	194.73
		(6.07)	(11.45)						
Base to Income	$lntimp_t$ c $lngdp_t$ AR(1) MA(1)	-4.08	1.22	0.99	2.00	0.69	-1.70	-1.51	1979.76
		(-5.65)	(20.33						
3. Income Tax									
Total Elasticity	$lnainct_t$ c $lngdp_t$ AR(1) MA(1)	0.45	0.41	0.92	2.03	0.52	-0.68	-0.49	107.37
		(0.40)	(4.37)						
Tax to Base	$lnainct_t$ c $lnnagdp_{t-1}$ AR(1) MA(1)	1.03	0.38	0.92	2.04	0.55	-0.73	-0.54	113.75
		(1.06)	(4.35)						
Base to Income	$lnnagdp_{t-1}$ c lngdpt AR(1) MA(1)	-2.26	1.14	0.99	1.97	-0.04	-0.54	-2.79	5792.72
		(-20.80	(122.19)						
4. VAT									
Total Elasticity	$lnavat_t$ c $lngdp_t$ AR(1)	0.35	0.55	0.96	1.85	0.79	-0.83	-0.69	344.73
		(0.19)	(3.76)						
Tax to Base	$lnavat_t$ c $lnpvtcon_t$ AR(1)	0.20	0.58	0.96	1.81	0.79	-0.85	-0.71	352.42
		(0.12)	(4.11)						
Base to Income	$lnpvtcon_t$ c $lngdp_t$ MA(1)	-0.12	0.99	0.99	2.00	0.05	-3.55	-3.41	11384.37
		(-1.46)	(142.99)						
5. Total Tax	$lnattr_t$ c $lngdp_t$ AR(1)	1.88	0.51	0.96	1.91	0.62	-1.50	-1.37	416.97
		(3.22)	(10.32)						
6. Total Revenue	$lnatr_t$ c $_{lngdpt}$ AR(1)	1.30	0.59	0.97	1.94	0.50	-1.59	-1.45	586.01
		(3.12)	(16.66)						

(Figures in parentheses are t – statistics)

a = estimated intercept

b = estimated elasticity coefficient

p= autocorrelation coefficient

All elasticity coefficients are significant at 1 percent .

AIC=Akaike Info Criterion
SC= Schwarz Criterion

$lnaexd_t$ = natural log of adjusted excise duties at time t

$lngdp_t$ = natural log of nominal GDP at time t

$lnpvtcon_t$ = natural log of private consumption at time t

$lnnagdp_{t-1}$ = natural log of non agricultural GDP at time t-1

$lnavat_t$ = natural log of adjusted Value Added Tax at time t

$lnattr_t$ = natural log of adjusted total tax revenue at time t

$lnatr_t$ = natural log of adjusted total revenue at time t

$lnainct_t$ = natural log of adjusted income tax at time t

$lnaimd_t$ = natural log of adjusted import duties at time t

$lntimp_t$ = natural log of total value of import at time t

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