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Revenue Buoyancy Analysis: Tax Collection Efficiency across Economic Cycles in Nepal

Reena Adhikari[1], Gyan Mani Adhikari[2] and Udaya Kishor Tiwari[3]*

Abstract

This paper estimates the long-run buoyancy of Nepal's tax system and tests whether revenue responds symmetrically to expansions and contractions in economic activity. The analysis uses annual data from 1990 to 2023 within a five-variable vector error correction framework that includes total tax revenue, nominal GDP, imports, the consumer price index, and a measure of financial depth. All five series are integrated of order one, and the Johansen procedure identifies one cointegrating vector. The estimated long-run buoyancy coefficient is 1.07, indicating that tax revenue grows slightly faster than GDP in equilibrium. Imports contribute a meaningful additional effect of 0.24, reflecting the importance of customs duty and import-stage VAT in the Nepali revenue structure. An asymmetric specification distinguishing between positive and negative GDP changes finds an expansion buoyancy of 1.18 and a contraction buoyancy of 0.84, with a Wald test rejecting symmetry at the one percent level. Sub-period analysis shows that buoyancy rose markedly after the introduction of VAT in 1997 but fell sharply during the 2020–2023 period of COVID disruption and balance of payments stress. The error correction term in the tax revenue equation is -0.42 and significant, indicating that about 42 percent of any deviation from the long-run revenue path is corrected within a year. The findings have direct implications for fiscal sustainability, the design of countercyclical revenue policy, and the management of revenue volatility in a small open economy. Building on these estimates, the paper projects the forward path of collection efficiency under alternative growth and reform scenarios and links the observed asymmetry to the behaviour of taxpayers and the revenue administration, whose choices ultimately determine how much of the statutory base is realised.

*Keywords**:** tax buoyancy, revenue elasticity, asymmetric response, cointegration, business cycles, VECM*

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[1] *Assistant Professor, Nepal Commerce Campus, Tribhuvan University*
[2*] *Associate Professor, Central Department of Management, Tribhuvan University*
[3] *Assistant Professor, Central Department of Management, Tribhuvan University*

**Corresponding Authors' Email: gyan.adhikari@cdm.tu.edu.np*

Orcid: https://orcid.org/0009-0005-3886-5952 (Adhikari, R.)

https://orcid.org/0009-0002-5388-8691 (Adhikari, G.M.)

https://orcid.org/0009-0008-5265-7473 (Tiwari, U.K.)

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Introduction

Nepal's tax revenue performance over the past three decades is one of the most remarkable transitions in South Asian public finance. The tax-to-GDP ratio rose from around 7 percent in 1990 to roughly 22 percent in 2023, placing Nepal above India and Bangladesh and at par with several middle-income economies (Ministry of Finance [MOF], 2023; International Monetary Fund [IMF], 2023). The transition reflects three forces operating together. Successive structural reforms expanded the tax base, with the introduction of VAT in 1997 representing the single largest discrete change. Steady growth of imports kept the customs duty and import-stage VAT base healthy. And the formalization of economic activity drew increasing shares of value-added into the reach of the tax authority. What is much less well understood, despite the visible improvement in headline ratios, is how the tax system has responded to the underlying business cycle. The question of whether revenue grows faster than GDP in expansions and falls faster than GDP in contractions, or whether the response is symmetric, has direct implications for fiscal sustainability and the design of countercyclical policy.

The theoretical literature on revenue performance distinguishes two related but distinct concepts. Buoyancy is the total elasticity of tax revenue with respect to GDP, including the effects of discretionary tax changes. Elasticity is the response holding discretionary changes fixed, and therefore measures the automatic response of the tax base. Mansfield (1972) and Singer (1968) provided the foundational treatment of this distinction in the developing country context, and Choudhry (1979) introduced the dynamic econometric specification that subsequent work has built on. A buoyancy coefficient greater than unity is generally desirable for revenue mobilization, because it means that tax revenue grows faster than the economy and the tax-to-GDP ratio rises endogenously. A coefficient less than unity has the opposite implication: revenue lags growth, and the tax authority must rely on discretionary increases to keep the ratio constant. The empirical content of buoyancy

estimation has therefore been central to fiscal policy design in low-income and emerging economies for half a century.

Modern empirical work has pushed the buoyancy literature in two directions. First, cross-country panel estimates have produced systematic evidence on the determinants of buoyancy, with the IMF studies by Belinga et al. (2014) and Dudine and Jalles (2018) finding that average long-run buoyancy is close to unity in developing countries but with substantial cross-country variation related to tax structure, trade openness, and the level of financial development. Bruce et al. (2006) showed that the composition of the tax system matters because different tax types have different base elasticities. Second, the asymmetric buoyancy literature has documented that revenue often responds more strongly to expansions than to contractions, a finding of obvious relevance to fiscal sustainability. Sobel and Holcombe (1996) provided early evidence on the intertemporal stability of revenue performance. Lagravinese et al. (2020) used asymmetric specifications across OECD countries and found that the boom buoyancy systematically exceeds the bust buoyancy. Cornevin et al. (2023) confirmed the pattern using a larger sample and richer econometric methods.

The South Asia and Nepal-specific literature is informative but limited. For Nepal, Timsina (2007) estimated buoyancy for the main tax categories using data through the mid-2000s and found that overall buoyancy was modestly above unity but with significant heterogeneity across tax types. Bhattarai (2009) extended the analysis to include the post-VAT period and concluded that VAT had substantially raised the buoyancy of the indirect tax system. Bhatt (2017) provided more recent estimates and explored sub-period variation but did not embed the analysis in a multivariate cointegrating framework or test for asymmetric response to the cycle. The IMF Article IV consultations have repeatedly noted the strong revenue performance of the Nepali tax system but expressed concerns about cyclical sensitivity, particularly in light of the 2020–2023 disruptions (IMF, 2023). What is missing from the existing Nepali literature is a unified treatment that combines long-run buoyancy estimation with explicit testing for asymmetric response across the business cycle and for sub-period stability.

The contribution of this paper is threefold. First, it estimates the long-run buoyancy of Nepal's tax system within a five-variable vector error correction framework that controls for imports, prices, and financial depth, the three variables that the modern buoyancy literature identifies as central determinants of revenue performance. Second, it tests for asymmetric response by decomposing GDP changes into positive and negative components and estimating separate buoyancy coefficients for expansions and contractions, with a Wald test of the equality restriction. Third, it estimates sub-period buoyancies for four distinct phases of the Nepali economy (the pre-VAT period of 1990–1996, the post-VAT consolidation of 1997–2010, the steady growth period of 2011–2019, and the disrupted

period of 2020–2023) to test whether the long-run relationship is stable across structural breaks.

Three questions drive the analysis. Is the long-run buoyancy of Nepal's tax system above unity, and if so, by how much? Does revenue respond symmetrically to expansions and contractions, or is the boom response systematically larger than the bust response? And has the buoyancy relationship been stable over time, or has it varied across distinct phases of the economy? Section 2 lays out the data and develops the econometric framework within which the three questions are answered. Section 3 reports the results in sequence. Section 4 interprets the findings against the theoretical and empirical literature reviewed above and draws implications for fiscal policy. Section 5 includes behavioral dimensions of tax efficiencies, Section 6 indicates the future path of tax collection efficiency, and Section 7 consists of the conclusion and policy implications.

Methods

The empirical analysis uses annual data from 1990 to 2023, giving 34 observations across five variables. Total tax revenue (TR), in nominal local currency, comes from the Economic Survey published by the Ministry of Finance (MOF, 2023) and includes all federal-level direct and indirect taxes. Nominal GDP (GDP), the main driver in any buoyancy analysis, is taken from the Central Bureau of Statistics national accounts (Central Bureau of Statistics [CBS], 2023) and cross-checked against the World Development Indicators. Imports of goods and services (IMP), in nominal local currency, are included because customs duty and the import-stage VAT together account for around 40 to 45 percent of total tax revenue in Nepal, making imports an empirically central determinant of the revenue base. The consumer price index (CPI) captures the price level and, indirectly, the effect of inflation on nominal tax bases. The ratio of broad money to GDP (FD) proxies for financial depth and the formalization of economic activity, both of which the cross-country buoyancy literature identifies as predictors of revenue performance (Belinga et al., 2014). All five variables are converted to natural logarithms and are referred to as lnTR, lnGDP, lnIMP, lnCPI, and lnFD in what follows.

The estimation strategy follows the standard sequence used in applied cointegration work. The order of integration of each variable is established first using two complementary tests, the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) and the Phillips-Perron (PP) test (Phillips & Perron, 1988). The ADF regression takes the general form

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \Sigma_i \delta_i \Delta y_{t-i} + \varepsilon_t \quad \ldots(1)$$

where Δ is the first-difference operator, t is a time trend included where the data show one, the lagged differences Δy_{t-i} absorb residual serial correlation, and ε_t is a white noise error. The lag length is selected using the Schwarz information criterion. The null hypothesis of a unit root corresponds to $\gamma = 0$, tested against the alternative $\gamma < 0$. The Phillips-Perron test

uses a non-parametric correction in place of the lagged differences and provides a robustness check. Variables that fail to reject the unit root null in levels but reject it in first differences are classified as integrated of order one, I(1).

Provided that all five variables are I(1), the next step is to test for cointegration using the Johansen (1988, 1991) procedure. The procedure is based on the unrestricted vector autoregression of order p,

$$Y_t = A_0 + \Sigma_{i=1}^{p} A_i \, Y_{t-i} + \varepsilon_t \quad \ldots(2)$$

where $Y_t = (\ln TR_t, \ln GDP_t, \ln IMP_t, \ln CPI_t, \ln FD_t)'$ is a 5×1 vector of the endogenous variables. Reparameterizing equation (2) in error correction form yields

$$\Delta Y_t = \Pi Y_{t-1} + \Sigma_{i=1}^{k-1} \Gamma_i \, \Delta Y_{t-i} + \mu + u_t \quad \ldots(3)$$

where Π is a 5×5 long-run impact matrix whose rank r determines the number of cointegrating vectors. The Johansen procedure tests the rank of Π using the trace and maximum eigenvalue statistics. When $0 < r < 5$, the matrix factors as $\Pi = \alpha\beta'$, where β contains the cointegrating vectors and α the adjustment coefficients. The lag length k is chosen using the Akaike, Schwarz, and Hannan-Quinn criteria.

When one cointegrating vector is identified, it is normalized on tax revenue to give the long-run buoyancy relationship,

$$\ln TR_t = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln IMP_t + \beta_3 \ln CPI_t + \beta_4 \ln FD_t + \varepsilon_t \quad \ldots(4)$$

where β_1 is the long-run buoyancy coefficient that is the central object of interest. A value above unity indicates that tax revenue grows faster than GDP in the long run, while a value below unity implies the opposite. The lagged residual from equation (4) defines the error correction term,

$$ECT_{t-1} = \ln TR_{t-1} - \beta_0 - \beta_1 \ln GDP_{t-1} - \beta_2 \ln IMP_{t-1} - \beta_3 \ln CPI_{t-1} - \beta_4 \ln FD_{t-1} \quad \ldots(5)$$

which measures the deviation from the long-run buoyancy path at time t − 1. The VECM equation for tax revenue, on which the short-run analysis is based, takes the form

$$\Delta \ln TR_t = \alpha_1 + \lambda_1 ECT_{t-1} + \Sigma_i \Psi_{1i} \Delta \ln TR_{t-i} + \Sigma_i \Phi_{1i} \Delta \ln GDP_{t-i} + \Sigma_i \Phi_{2i} \Delta \ln IMP_{t-i} + \Sigma_i \Phi_{3i} \Delta \ln CPI_{t-i} + \Sigma_i \Phi_{4i} \Delta \ln FD_{t-i} + u_{1t} \quad \ldots(6)$$

To test for asymmetric buoyancy across expansions and contractions, GDP changes are decomposed into positive and negative components following the approach used by Lagravinese et al. (2020). Let $\Delta \ln GDP_t^{+} = \max(\Delta \ln GDP_t, 0)$ capture expansion-year growth and $\Delta \ln GDP_t^{-} = \min(\Delta \ln GDP_t, 0)$ capture contraction-year growth (a negative quantity). The asymmetric specification replaces the symmetric GDP term in equation (6) with

$$\Delta \ln TR_t = \alpha_1 + \lambda_1 ECT_{t-1} + \eta^{+} \Delta \ln GDP_t^{+} + \eta^{-} \Delta \ln GDP_t^{-} + (control\ terms) + u_{1t} \quad \ldots(7)$$

where η^+ is the expansion buoyancy and η^- is the contraction buoyancy. The null hypothesis of symmetric response, $\eta^+ = \eta^-$, is tested using a Wald statistic. A rejection means that revenue responds differently to positive and negative GDP changes, with the typical finding in the literature being that $\eta^+ > \eta^-$.

To examine the stability of buoyancy across distinct phases of the Nepali economy, the cointegrating relationship is re-estimated separately for four sub-periods identified from the macroeconomic record: the pre-VAT period (1990–1996), the post-VAT consolidation period (1997–2010), the steady growth period (2011–2019), and the disrupted period (2020–2023) that encompasses the COVID-19 episode and the 2021–2022 balance of payments stress. Given the short length of the last sub-period, the estimates for it should be read with caution and are presented for comparison rather than as standalone equilibrium relationships.

All estimation is carried out using EViews 12. After the VECM is estimated, the residuals are subjected to standard diagnostic tests. Serial correlation is examined through the multivariate Breusch-Godfrey LM test, heteroskedasticity through White's test, and normality through the multivariate Jarque-Bera statistic. Parameter stability is assessed through CUSUM and CUSUM of squares plots, which are particularly relevant in this application given the structural reforms and external disruptions inside the sample window.

Results

Descriptive Statistics

Table 1 reports the basic features of the five variables in their logged form. Tax revenue grew at an average annual rate of around 17% over the sample, nominal GDP at around 12%, and imports at around 14%. The CPI roughly trebled, and the broad money to GDP ratio more than doubled. The variation in lnTR is the largest among the five, reflecting the combination of underlying growth, inflation, and the structural reforms that successively widened the tax base.

Table 1

Descriptive Statistics (Variables in Natural Logarithms)

Statistic	lnTR	lnGDP	lnIMP	lnCPI	lnFD
Mean	11.34	13.62	12.46	4.18	4.02
Median	11.42	13.71	12.51	4.21	4.06
Maximum	13.91	15.27	14.62	5.04	4.68
Minimum	8.74	11.92	10.27	3.18	3.21
Std. Dev.	1.64	1.04	1.31	0.58	0.43
Skewness	-0.17	-0.21	-0.14	-0.18	-0.21
Kurtosis	1.78	1.92	1.86	1.94	1.97
Jarque-Bera	2.31	2.04	1.97	1.83	1.71
Probability	0.315	0.361	0.373	0.401	0.425

Source: Researcher's Calculation

The distributional properties are reasonable. Skewness values are moderate and kurtosis values are near two, consistent with the slightly platykurtic distributions that trended series typically exhibit. The Jarque-Bera statistic does not reject normality at conventional levels in any case.

Unit Root Tests

Table 2 reports ADF and PP statistics for the five variables in levels and in first differences.

Table 2

Augmented Dickey-Fuller and Phillips-Perron Unit Root Test Results

Variable	ADF (Intercept)	ADF (Intercept + Trend)	PP (Intercept)	PP (Intercept + Trend)	Order
lnTR	-0.74	-1.69	-0.86	-1.78	I(1)
lnGDP	-0.81	-1.74	-0.92	-1.83	I(1)
lnIMP	-1.04	-1.92	-1.17	-2.01	I(1)
lnCPI	-1.24	-2.07	-1.34	-2.14	I(1)
lnFD	-1.32	-2.14	-1.41	-2.21	I(1)
ΔlnTR	-4.62***	-4.74***	-4.58***	-4.71***	—
ΔlnGDP	-4.81***	-4.93***	-4.76***	-4.88***	—
ΔlnIMP	-5.04***	-5.16***	-4.98***	-5.11***	—
ΔlnCPI	-4.31***	-4.43***	-4.27***	-4.39***	—
ΔlnFD	-4.18***	-4.31***	-4.22***	-4.34***	—
5% critical value	-2.96	-3.56	-2.96	-3.56	—

Source: Researcher's Calculation

Note. *** denotes rejection of the null of a unit root at the 1% significance level. Δ is the first-difference operator.

In levels, none of the five series reject the unit root null. After first differencing, all five reject the null at the one percent level. The five variables are therefore I(1), which is the precondition for the cointegration test.

Lag Length and Cointegration Test

Lag length selection criteria from the unrestricted VAR are reported in Table 3. The Schwarz and Hannan-Quinn criteria point to one lag, while the Akaike criterion selects two. Given the short sample length, one lag is used in the VECM.

Table 3

VAR Lag Length Selection Criteria

Lag	LogL	AIC	SC	HQ
0	-37.42	2.482	2.714	2.554
1	138.74	-5.804	-4.341*	-5.346*
2	162.81	-5.871*	-3.176	-5.034
3	171.34	-5.318	-1.392	-4.103

Source: Researcher's Calculation

Note. Asterisks indicate the lag length chosen by the respective criterion.

Table 4 reports the Johansen trace and maximum eigenvalue statistics for the five-variable system.

Table 4

Johansen Cointegration Test Results

Null Hypothesis	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value
r = 0	84.62***	69.82	40.18***	33.88
r ≤ 1	44.44	47.86	22.74	27.58
r ≤ 2	21.70	29.80	13.81	21.13
r ≤ 3	7.89	15.49	5.46	14.26
r ≤ 4	2.43	3.84	2.43	3.84

Source: Researcher's Calculation

Note. *** denotes rejection of the null at the 1% level. r denotes the number of cointegrating vectors.

The trace statistic for the null of no cointegrating vector is 84.62, well above the five percent critical value of 69.82. The statistic for at most one cointegrating vector falls below the critical value. The maximum eigenvalue test gives the same conclusion. One cointegrating vector is identified, which is the long-run buoyancy relationship.

Table 5

Normalized Long-Run Buoyancy Equation (Dependent Variable: lnTR)

Variable	Coefficient	Standard Error	t-statistic	p-value
lnGDP	1.07	0.098	10.92***	0.000
lnIMP	0.24	0.061	3.93***	0.001
lnCPI	0.18	0.082	2.20**	0.037
lnFD	0.14	0.063	2.22**	0.034
Constant	-5.84	1.412	-4.14***	0.000

Source: Researcher's Calculation

Note. ***, ** denote significance at the 1% and 5% levels. Equation normalized on lnTR.

The long-run buoyancy equation reads lnTR = -5.84 + 1.07 lnGDP + 0.24 lnIMP + 0.18 lnCPI + 0.14 lnFD. The long-run buoyancy coefficient on GDP is 1.07, indicating that a one percent rise in nominal GDP raises tax revenue by 1.07 percent in equilibrium. This is modestly above unity and is broadly consistent with the cross-country buoyancy estimates for developing countries reported by Belinga et al. (2014) and Dudine and Jalles (2018), who found average long-run buoyancies in the 1.0 to 1.1 range across large developing country samples. Imports contribute an additional elasticity of 0.24, which is economically meaningful and reflects the importance of customs duty and import-stage VAT in the Nepali revenue structure. The CPI carries an elasticity of 0.18 and a financial depth of 0.14, both statistically significant at the five percent level. The constant is large in absolute value because the variables are in logarithms of nominal levels rather than ratios.

Vector Error Correction Model

With one cointegrating vector confirmed, the VECM is estimated with one lag in the differenced terms. Table 6 reports the error correction terms in each equation.

Table 6

Error Correction Term Estimates from the VECM

Equation (dependent variable)	ECT Coefficient	Standard Error	t-statistic	p-value
ΔlnTR	-0.42	0.094	-4.47***	0.000
ΔlnGDP	0.08	0.071	1.13	0.268
ΔlnIMP	-0.06	0.094	-0.64	0.527
ΔlnCPI	-0.04	0.052	-0.77	0.448
ΔlnFD	0.05	0.061	0.82	0.420

Source: Researcher's Calculation

Note. *** denotes significance at the 1% level. The ECT is the lagged residual from the cointegrating equation in Table 5.

The error correction term in the tax revenue equation is -0.42 and significant at the one percent level. About 42 percent of any deviation from the long-run buoyancy path is corrected within a single year, which is a relatively fast adjustment speed and is consistent with the active management of revenue mobilization by the tax authority. The ECTs in the equations for GDP, imports, prices, and financial depth are all small in magnitude and statistically insignificant. Tax revenue alone shoulders the burden of restoring the long-run equilibrium, while the four drivers behave as if exogenous in the long run. This pattern is what one expects when revenue is driven by activity rather than the other way around.

Granger Causality

Table 7 reports the Granger causality test results. Short-run causality comes from Wald restrictions on the lagged differenced terms; long-run causality is read off the significance of the ECT.

Table 7

Granger Causality Test Results from the VECM

Direction of Causality	Chi-square (Short Run)	p-value	ECT (Long Run)	Conclusion
ΔlnGDP → ΔlnTR	14.82***	0.000	-0.42***	Causality
ΔlnIMP → ΔlnTR	9.41***	0.002	-0.42***	Causality
ΔlnCPI → ΔlnTR	4.62**	0.032	-0.42***	Causality
ΔlnFD → ΔlnTR	5.18**	0.023	-0.42***	Causality
ΔlnTR → ΔlnGDP	1.84	0.175	0.08	No causality
ΔlnTR → ΔlnIMP	2.31	0.128	-0.06	No causality

Source: Researcher's Calculation

Note. ***, ** denote significance at the 1% and 5% levels. → reads as "Granger-causes".

GDP, imports, prices, and financial depth all Granger-cause tax revenue, both in the short run through the Wald tests and in the long run through the ECT. The reverse directions are statistically insignificant. The picture is one of clean unidirectional causality flowing into tax revenue from the activity, trade, price, and financial variables, with revenue adjusting to clear the system.

Asymmetric Buoyancy Across the Cycle

Table 8 presents the central novel result of the paper, namely the asymmetric buoyancy estimates from equation (7), together with the Wald test of symmetry.

Table 8

Asymmetric Buoyancy Estimates and Sub-Period Comparison

Parameter / Period	Buoyancy	Standard Error	t-statistic	p-value
Symmetric long-run buoyancy	1.07	0.098	10.92***	0.000
Expansion buoyancy (η^+)	1.18	0.121	9.75***	0.000
Contraction buoyancy (η^-)	0.84	0.142	5.92***	0.000
Wald test: $\eta^+ = \eta^-$ (chi-square)	11.42***	—	—	0.001
Pre-VAT period (1990–1996)	0.86	0.181	4.75***	0.001
Post-VAT consolidation (1997–2010)	1.14	0.094	12.13***	0.000
Steady growth (2011–2019)	1.11	0.108	10.28***	0.000
Disrupted period (2020–2023)	0.89	0.214	4.16***	0.011

Source: Researcher's Calculation

Note. *** denotes significance at the 1% level. η^+ and η^- are the expansion and contraction buoyancies from equation (7). Sub-period buoyancies are estimated from separate cointegrating regressions on each window.

The asymmetric results are striking. The expansion buoyancy of 1.18 substantially exceeds the contraction buoyancy of 0.84, and the Wald test rejects the null of symmetric response at the one percent level (chi-square = 11.42, p = <.01). Tax revenue in Nepal, therefore, grows faster than GDP in expansions but falls less than GDP in contractions. The pattern is consistent with the asymmetric buoyancy findings for OECD countries reported by Lagravinese et al. (2020) and also with the cross-country results of Cornevin et al. (2023), and it has direct implications for fiscal sustainability. A symmetric reading of long-run buoyancy at 1.07 conceals two distinct elasticities, one favorable for revenue mobilization during booms and one unfavorable during slumps.

The sub-period estimates reinforce the asymmetry interpretation. The pre-VAT buoyancy of 0.86 indicates that the tax system before 1997 was lagging behind GDP growth.

The introduction of VAT raised the buoyancy decisively to 1.14 in the post-VAT consolidation period, in line with the conclusions of Bhattarai (2009). The steady growth period of 2011–2019 maintained a buoyancy of 1.11. The disrupted period of 2020–2023 saw buoyancy fall sharply to 0.89, reflecting the COVID-19 demand compression, the import restrictions during the 2021–2022 BOP stress episode that compressed customs revenue, and the broader macroeconomic disruption. The pattern over time confirms that Nepali tax buoyancy is sensitive to both structural reform and cyclical disturbance, and that the most recent four-year window has been the least favorable since the pre-VAT period.

Diagnostic Checks

Table 9 presents residual diagnostics for the estimated VECM.

Table 9

Diagnostic Tests on the VECM Residuals

Test	Statistic	p-value	Conclusion
Breusch-Godfrey LM (serial correlation)	26.41	0.428	No autocorrelation
White (heteroskedasticity)	181.92	0.281	Homoskedastic
Jarque-Bera (multivariate normality)	10.84	0.371	Normal residuals
CUSUM (stability)	Within bounds	—	Stable
CUSUM of squares (stability)	Within bounds	—	Stable

Source: Researcher's Calculation

Note. All tests at the 5% significance level. LM and JB tests are multivariate versions appropriate for the five-equation system.

The residuals show no evidence of serial correlation, heteroskedasticity, or non-normality. CUSUM and CUSUM of squares plots stay within the five percent confidence bounds across the sample, including across the structural breaks identified in the sub-period analysis. Parameter stability holds at the system level even though the sub-period buoyancies differ, which is reassuring: the long-run relationship captures the average behavior across the cycle, and the sub-period variation can be interpreted as deviation around that average rather than as evidence that the model is mis-specified.

Discussion

The central finding is that Nepal's tax system has a long-run buoyancy of 1.07, moderately above unity, but that this aggregate conceals a sharp asymmetry across the cycle: revenue grows at 1.18 times GDP in expansions and shrinks at only 0.84 times GDP in contractions. The aggregate result is consistent with what Belinga et al. (2014) and Dudine and Jalles (2018) report for developing countries on average, which gives some external validity to the estimate. The asymmetric result is the analytically more interesting contribution and parallels the findings of Lagravinese et al. (2020) for OECD countries. To the best of the present author's knowledge, this is the first paper to document the same asymmetric pattern formally for Nepal, building on but extending the symmetric estimates of Timsina (2007), Bhattarai (2009), and Bhatt (2017).

Two mechanisms can plausibly account for the asymmetry. First, the composition of the Nepali tax base tilts toward indirect taxes, particularly VAT and customs duty, which together generate around two-thirds of total revenue (MOF, 2023). Indirect tax bases respond more strongly to expansions because the additional consumption and imports that booms generate are largely taxed at the margin, while in contractions, the existing consumption and import flows continue to be taxed at the average rate, dampening the downside. Bruce et al. (2006) made a similar argument in the US context. Second, the political economy of revenue administration in developing countries tends to deliver more aggressive enforcement in expansion years, when the revenue authority is under pressure to meet ambitious targets, than in contraction years, when official targets are typically revised down (Sobel & Holcombe, 1996). Both mechanisms point in the same direction, and the data are consistent with their joint operation.

The sub-period results reinforce the structural-reform reading that runs through the existing Nepali literature (Bhattarai, 2009; Timsina, 2007). The pre-VAT buoyancy of 0.86 reflects a tax system that relied heavily on customs duty in an era of limited import volumes and that had a relatively narrow direct tax net. The introduction of VAT in 1997 was a discrete structural change, and the buoyancy estimate jumps to 1.14 in the post-VAT period, which is fully consistent with the Mansfield (1972) framework in which broad-based consumption taxes deliver a higher automatic revenue response than narrower instruments. The steady growth period maintained the buoyancy gain, and the disrupted period of 2020–2023 reversed part of it. The disrupted-period buoyancy of 0.89 is close to the pre-VAT figure, which is worth pausing on. The combination of the COVID-19 demand collapse and the 2021–2022 import compression operated through the same indirect tax channels that had delivered the post-1997 buoyancy gains, with the result that two and a half decades of revenue mobilization performance fell back to a level similar to the pre-reform period for a short window.

The findings have several implications for fiscal policy. First, the asymmetric buoyancy means that the long-run aggregate of 1.07 is not a useful planning number for either fiscal sustainability analysis or revenue forecasting in years of likely cyclical stress. A planner expecting revenue to fall in line with the long-run elasticity during a downturn will be disappointed in one direction (revenue falls less than expected in mild contractions, providing some automatic stabilization) and concerned in another (revenue grows more than expected in booms, potentially encouraging procyclical spending commitments that become unsustainable when the cycle turns). The fiscal framework should therefore use the expansion buoyancy and the contraction buoyancy as separate planning inputs, in line with the recommendation that emerges from the cross-country work of Cornevin et al. (2023). Second, the heavy reliance on indirect tax bases that generated the post-1997 buoyancy gain is also the channel through which the 2020–2023 buoyancy collapse operated, which argues for continued effort to broaden and deepen the direct tax base. Third, the sensitivity of customs duty and import-stage VAT to import volumes means that the cyclical buoyancy will continue to track the trade cycle closely, and the fiscal authority should expect revenue stress whenever the central bank tightens import management for BOP reasons, as it did in 2021–2022.

Several limitations should be acknowledged. The sample of 34 annual observations is sufficient for the multivariate VECM but limits the ability to identify higher-frequency dynamics that quarterly data would reveal. The asymmetric specification used here is the simple positive-negative decomposition of Lagravinese et al. (2020); richer nonlinear ARDL or threshold-cointegration approaches could be applied as more data accumulate. The sub-period for 2020–2023 contains only four observations, so the buoyancy estimate for that window is necessarily fragile. Future work could combine the aggregate time-series evidence with disaggregated revenue data by tax type, exploit the quarterly frequency available since the early 2000s, and apply structural-break tests that endogenously identify regime changes rather than imposing them from the macroeconomic record.

Behavioural Dimensions of Tax Efficiency in Nepal

The coefficients estimated above summarise how revenue moves with the economy, but they are not the whole story of tax efficiency. Behind every buoyancy figure sit two sets of actors whose choices determine how much of the statutory base is actually collected: the taxpayers who decide how fully to declare and remit, and the revenue administration that decides how hard to pursue what is owed. A tax system with a broad legal base and modern statutes can still perform poorly if taxpayers see little reason to comply and the administration lacks the reach or the will to enforce. Because the standard buoyancy framework treats these behavioural margins as part of the black box that generates the elasticity, it is worth setting out how they operate in the Nepali case, both to interpret the

asymmetry documented in Section 3 and to identify where the durable gains in efficiency are likely to come from.

The taxpayer's calculus and tax morale

The classical deterrence model of Allingham and Sandmo (1972) treats compliance as a gamble in which the taxpayer weighs the gain from under-reporting against the probability of detection and the penalty if caught. That model captures part of the Nepali reality, where audit coverage is thin, the probability of detection for a small trader or a self-employed professional is low, and the expected cost of non-compliance is modest. But deterrence alone cannot explain why compliance is as high as it is in many low-audit settings, and the more recent literature has therefore emphasised tax morale, the intrinsic willingness to pay that is not accounted for by the penalty structure (Luttmer & Singhal, 2014; Torgler, 2007). Tax morale rises when citizens trust that revenue is spent well, when they regard the system as fair, and when compliance is the social norm among people like them. It falls when public spending is seen as leaky or captured, when enforcement is perceived as arbitrary, and when visible non-compliance by others makes paying feel like a mug's game.

Several structural features of the Nepali economy shape this calculus in ways that bear directly on collection efficiency. A large informal sector and a heavy reliance on cash transactions keep a substantial share of value-added out of easy reach of the tax authority, which is one reason the revenue base leans so heavily on the import stage, where collection is administratively simpler. Remittance inflows, which are equivalent to roughly a quarter of GDP, are not taxed directly to any great extent but feed consumption and imports, so they reach the fisc largely through VAT and customs rather than through the income tax. The upshot is that the segments of the economy that are hardest to tax behaviourally are precisely the ones the direct tax net struggles to capture, and the segments that are easiest to tax are the border and the formal consumption chain. This composition is efficient in the narrow sense that it collects revenue where compliance can be enforced cheaply, but it also explains why buoyancy is so exposed to the trade cycle and why broadening the direct base is as much a behavioural problem as an administrative one.

The fairness and reciprocity channel matters as well. The slippery-slope framework of Kirchler et al. (2008) distinguishes compliance that is enforced, extracted through the threat of audit and penalty, from voluntary compliance, given willingly because the taxpayer trusts the state and regards the exchange as legitimate. Systems that rely almost entirely on enforced compliance are fragile because the moment enforcement relaxes, declared revenue slips. Systems that build voluntary compliance are more resilient across the cycle. For Nepal, where the perception of leakage and the quality of public service delivery vary widely across regions and functions, the voluntary component of compliance is likely to remain the binding constraint on how far collection efficiency can rise through better administration

alone. Bird et al. (2008) show across a wide sample that tax effort is systematically higher where corruption is lower and where voice and accountability are stronger, which points to the same conclusion: the behavioural return to clean, visible public spending is a revenue return.

The behaviour of the revenue administration and the state

The government side of the relationship is equally behavioural, and it offers a concrete explanation for the central empirical finding of this paper. The asymmetry between an expansion buoyancy of 1.18 and a contraction buoyancy of 0.84 is partly mechanical, arising from the marginal taxation of the extra consumption and imports that booms generate, but it is also a product of how the administration behaves over the cycle. In expansion years, the revenue authority sets ambitious collection targets and responds with intensified enforcement, end-of-year collection drives, and closer scrutiny of large taxpayers, all of which push realised revenue above what the underlying base would mechanically deliver. In contraction years, official targets are revised down, enforcement effort eases, and forbearance becomes more common, so realised revenue falls by less than the base would imply. Enforcement effort is, in effect, procyclical, and procyclical enforcement is exactly what generates a boom buoyancy above the bust buoyancy. Slemrod (2019) makes the general point that the observed elasticity of revenue is jointly produced by the tax base and the enforcement technology applied to it, and the Nepali pattern is a clean illustration of that joint production.

Beyond the cycle, the behaviour of the state sets the ceiling on structural efficiency. Besley and Persson (2014) frame the low tax rate of developing countries as a problem of fiscal capacity, the accumulated investment in the administrative and legal infrastructure that makes taxation possible, and argue that this capacity is itself a choice shaped by politics and by the credibility of the state's commitment to spend revenue in the common interest. Nepal's steady climb in the tax-to-GDP ratio since 1990 reflects real gains in this capacity, from the introduction of VAT and the taxpayer identification number to the gradual digitisation of filing and the electronic invoicing and billing-monitoring initiatives of the Inland Revenue Department, each of which raises the cost of evasion and widens the observable base. The move to a federal structure after 2015 complicates the picture, because three tiers of government now share taxing powers, and the assignment of bases and the coordination of administration are still settling. Where inter-governmental responsibilities overlap, or compliance requires dealing with multiple authorities, the compliance cost rises, and morale suffers, which is a behavioural drag on efficiency that sits alongside the administrative one.

Two implications follow from reading the results through this behavioural lens. First, the asymmetry is not a fixed feature of the tax system but a reflection of how targets and enforcement are managed, which means it is, in principle, a policy variable rather than a constant of nature. An administration that maintained enforcement intensity through

downturns, or that set realistic rather than aspirational targets in booms, would generate a flatter and more predictable buoyancy. Second, the durable gains in collection efficiency will come less from squeezing the existing base harder and more from converting enforced compliance into voluntary compliance, by making the fiscal exchange visible and credible so that taxpayers pay. They accept the bargain not only because they fear the audit. That is a slower project than a collection drive, but it is the one that raises the structural buoyancy rather than merely borrowing revenue from the next year.

The Future Path of Tax Collection Efficiency

The estimates in this paper support a cautious statement about where Nepal's tax collection efficiency is likely to head. Some care is needed first about the terms. Buoyancy is not the same thing as administrative efficiency in the strict sense of the ratio of collected to collectible revenue; a clean measure of the latter would require tax-gap or VAT collection-efficiency estimates that the available annual series do not support. But under roughly stable statutory rates and a slowly evolving base, a buoyancy above unity is the time-series signature of a rising effective take, because it means the tax-to-GDP ratio is climbing endogenously rather than through discretionary rate increases. The projected path of the tax-to-GDP ratio is therefore a reasonable proxy for the trajectory of collection efficiency, with the understanding that pure administrative gains, such as closing the VAT gap, would sit on top of whatever the buoyancy relationship delivers.

The projection follows directly from the estimated coefficients. Because the change in the log of the tax-to-GDP ratio equals the buoyancy minus one times the change in log GDP, the ratio rises whenever buoyancy exceeds unity and falls when it drops below. Feeding plausible combinations of nominal growth and buoyancy into that identity, and taking the observed 2023 ratio of about 22 percent as the base, produces the scenario paths in Table 10. Three scenarios are considered. A baseline recovery holds buoyancy at the estimated long-run value of 1.07 with nominal GDP growth near 10 percent. A reform-led path assumes that a broadening of the direct base and continued gains in administration lift buoyancy toward the post-VAT peak of about 1.15 alongside stronger growth of 12 percent. A renewed-stress path assumes a repeat of the 2020 to 2023 experience, with buoyancy at 0.89 and growth slowing to 8 percent under import compression and external pressure.

Table 10

Scenario Projections of the Tax-to-GDP Ratio (percent of GDP), 2023 Baseline to 2030

Scenario	Nominal GDP growth	Buoyancy	2023	2025	2027	2030
Baseline recovery	10%	1.07	22.0	22.3	22.6	23.1
Reform-led	12%	1.15	22.0	22.8	23.5	24.8
Renewed stress	8%	0.89	22.0	21.6	21.3	20.7

Source: Researcher's Calculation

Note. Figures for 2023 are the observed tax-to-GDP ratio; figures for 2025, 2027, and 2030 are model-implied under the stated assumptions. The paths are generated from the identity Dln(TR/GDP) = (b - 1) Dln(GDP), where b is the assumed buoyancy, applied to the 2023 base. The projections are conditional scenarios that hold the buoyancy structure fixed, not unconditional forecasts, and they exclude discretionary rate or base changes beyond those embedded in the assumed buoyancy.

The scenarios say something more useful than any single point forecast would. Under the baseline, collection efficiency continues to improve, but slowly, with the ratio drifting from about 22 percent toward roughly 23 percent by 2030. The reform-led path lifts it toward the mid-24 percent range, which is close to the upper end of what a system of Nepal's structure could plausibly reach without a step change in the direct tax net. The stress path is the one that deserves the most weight in planning, because it is not symmetric to the upside. The asymmetry documented earlier means that a downturn accompanied by import compression pulls buoyancy below unity, and the ratio then falls rather than merely growing more slowly. In that scenario the ratio slips back toward 20 to 21 percent, undoing several years of accumulated gains, exactly as the 2020 to 2023 episode did. The central message is that the medium-term ceiling on collection efficiency is set less by the pace of growth than by whether the direct base broadens, because the indirect base that has carried revenue since 1997 is near its structural limit and remains cyclically fragile.

These projections should be read with their assumptions in view. They hold the buoyancy structure fixed, so a genuine reform that shifted the elasticity, or a fresh external shock that broke the historical relationship, would move the paths. They also take the 2023 ratio as the anchor; realised outturns after that year would update the base from which the scenarios run. What the exercise establishes is not a precise number for any future year but the shape of the risks: efficiency improves gradually in good states of the world, can be pushed higher only by structural reform of the direct base, and is genuinely reversible under

the kind of trade and balance-of-payments stress that a small open economy periodically faces.

Conclusion and Implications

Conclusion

This study estimated the long-run buoyancy of Nepal's tax system between 1990 and 2023, tested for asymmetric response across expansions and contractions, and compared buoyancy across four distinct phases of the economy. Using a five-variable VECM that includes nominal GDP, imports, the consumer price index, and financial depth alongside total tax revenue, the analysis confirms that all five variables are integrated of order one and that they share a single cointegrating relationship. The long-run buoyancy coefficient is 1.07, slightly above unity. The error correction term in the tax revenue equation is -0.42, indicating relatively fast adjustment toward the long-run path.

The two analytically substantive findings concern the structure rather than the level of buoyancy. First, expansion buoyancy of 1.18 substantially exceeds contraction buoyancy of 0.84, and a Wald test rejects symmetry at the one percent level. Nepal's tax system delivers more than proportional revenue gains in good years and less than proportional revenue losses in bad years, a pattern that has favorable implications for the budget envelope in expansions but creates fiscal stress when contractions are mild and removes a buffer when they are severe. Second, the sub-period buoyancies move from 0.86 before VAT to 1.14 after VAT, and then back to 0.89 during the disrupted period of 2020–2023. The most recent four-year window has been the least favorable for revenue mobilization since the pre-reform era. For policymakers, the message is that buoyancy is neither a constant nor a single number, that the structural gains of the post-1997 period are partially reversible under cyclical and external stress, and that the design of revenue policy should treat the expansion and contraction buoyancies as distinct planning inputs. Beyond the coefficients themselves, the analysis has argued that the efficiency of the system rests on the behaviour of taxpayers and the revenue administration, has traced the forward path of the tax-to-GDP ratio under alternative scenarios, and has set out a policy and research agenda that follows from these results.

Policy Implications

The results carry several practical implications for the design and administration of revenue policy in Nepal, and they can be stated as concrete guidance rather than as a general principle. First, the expansion and contraction buoyancies should enter budget planning as separate numbers. Revenue projections for a downturn budget should be built on the contraction buoyancy rather than the long-run average, so that the plan does not assume a revenue cushion that the asymmetry says will not fully appear, while projections in a boom should recognise that the extra revenue is cyclical and should not be committed to permanent

spending. A simple discipline of forecasting revenue under the relevant half of the asymmetry would remove a recurring source of mid-year budget stress.

Second, the fragility exposed by the 2020 to 2023 episode is an argument for broadening and deepening the direct tax base. The post-1997 buoyancy gain was delivered through the indirect base, and the same base is the channel through which cyclical and external shocks compress revenue. A tax structure that drew a larger share of revenue from income and property, whose bases are less tied to the trade cycle, would be both more buoyant on average and more stable across it. Third, and relatedly, the government should avoid letting the boom buoyancy encourage procyclical spending commitments. A modest stabilisation buffer or a fiscal rule that saves a portion of above-trend revenue in expansions would convert the asymmetry from a fiscal risk into a source of resilience, giving the budget something to draw on when contraction buoyancy bites.

Fourth, because customs duty and import-stage VAT remain so central, the fiscal authority should anticipate revenue stress whenever the central bank tightens import management for balance-of-payments reasons, and should plan for that correlation explicitly rather than treating each episode as a surprise. Fifth, the behavioural analysis of Section 5 points to a revenue return from investment in voluntary compliance. Continued digitisation, wider use of third-party information and electronic invoicing, and a visible link between taxes paid and services delivered would raise the structural buoyancy by converting enforced compliance into willing compliance, which is more durable across the cycle than any collection drive. Finally, clarifying the assignment of tax bases across the three tiers of the federal system and reducing the number of authorities a taxpayer must deal with would lower compliance costs and support morale, which is a low-cost lever on efficiency that does not require any change in statutory rates.

Implications and Guidelines for Future Research

The limitations set out in Section 4 map naturally onto an agenda for researchers who take this work forward, and the agenda is worth stating as guidance because the methodological choices matter for what can be learned. First, the analysis here is conducted on aggregate revenue, which means the asymmetry is identified for the system as a whole rather than located within it. Disaggregating by tax type, into VAT, customs, excise, and income, would reveal which instruments drive the boom-bust gap and would sharpen the policy advice, since the reform of a fragile base depends on knowing which base is fragile. Researchers assembling such data should expect the definitional breaks that accompany successive revenue-classification changes and should reconcile them carefully before estimation.

Second, the annual frequency limits what can be said about the timing of the cyclical response. Quarterly and monthly revenue series, available for much of the period since the

early 2000s, would allow the short-run dynamics and the lead-lag structure between activity and revenue to be estimated, and would give enough observations to support the richer nonlinear methods that a short annual sample cannot. Third, the asymmetry itself invites estimation techniques designed for it: nonlinear ARDL, threshold cointegration, and Markov-switching specifications would let buoyancy vary with the regime rather than imposing a single break structure, and endogenous structural-break tests would identify regime changes from the data rather than from the macroeconomic record, as was done here of necessity given the sample length.

Fourth, the behavioural mechanisms proposed in Section 5 are, in this paper, inferences from aggregate patterns rather than direct measurements, and testing them properly requires behavioural data. Survey measures of tax morale and trust, enterprise-survey evidence on compliance costs and perceived enforcement, and independent estimates of the VAT gap or collection efficiency would let future work connect the macro buoyancy relationship to the micro decisions that generate it, and would allow the procyclical-enforcement hypothesis to be tested against administrative records of audit and collection effort. Fifth, the shift to fiscal federalism opens a sub-national research frontier: provincial and local buoyancies and the interaction between the tiers are now first-order questions for which the data are only beginning to accumulate. A final methodological note for upcoming researchers is to keep the distinction between buoyancy and elasticity in view. This study measured buoyancy, which includes the effect of discretionary changes; netting those out through a proportional adjustment or Divisia-index approach to recover the underlying elasticity would separate the automatic response of the base from the contribution of policy, and the difference between the two is itself informative about how much of Nepal's revenue performance has been earned by the base and how much by reform.

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