

Tuition Fee Regulation, Unit Cost, Cost Recovery, and Financial Performance in Public Higher Education: A Comparative Study of Nigeria, the UK, and the USA

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ABSTRACT

Backgrounds: Regulated tuition fees fall below economic costs, widening the gap between revenue and unit cost. This deepens reliance on state subsidies and threatens the financial sustainability of public universities.

Objectives: This study compares financial sustainability in public universities across Nigeria, the UK, and the USA using financial performance indicators. It tests five hypotheses on cost absorption, covering unit cost, tuition revenue, cost recovery, funding subsidies, and efficiency across 12 institutions.

Methodology: This study compares financial sustainability across 12 public universities in Nigeria, the UK, and the USA using performance indicators. It tests five hypotheses on cost absorption: unit cost, tuition revenue, cost recovery, subsidies, and efficiency.

Findings: Result show statistically significant differences in unit cost, tuition revenue, subsidy, and sustainability ratios across countries. Cost recovery ratios range from 16% for Nigeria, 28% for the UK and 39% in USA, indicating substantial subsidies. It identified emerging proximity in Nigeria and UK's public universities' operating margins and net asset returns despite different cost/tuition levels which has been underexplored and reported in the existing HEIs financial evaluation studies. Similarly, it established that Nigeria's public sector HEIs do not fully capture cost-of-service delivery and make supplementary disclosure(s) cost under-recovery in their financial statements as expected in low-cost, high subvention cluster(s).

Conclusions: These results provide cross-national metrics for higher education finance and show how revenue constraints affect accounting. They reveal similar operating margins and net asset returns between Nigeria and the UK. Nigerian public universities should disclose cost under-recovery in financial statements.

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1. INTRODUCTION

Financing of public higher education has become a contested policy issue as governments balance access, affordability, and fiscal sustainability. In many jurisdictions, tuition fees are regulated to protect students from price shocks, yet such regulation often fixes fees below economic cost of provision (House of Commons Business Innovation and Skills Committee, 2011). The resulting under-recovery creates a dependency on government subvention and raises questions about long-term viability of public universities.

Tuition fees policy, pricing of higher education, financial assistance with accompanying policies is critical for the considerable funding in universities (Salmi & D'Addio, 2021). These factors impact on accessibility, quality, and prestige of higher education systems. Public taxation is

a major source of government revenue utilised in providing public goods and services including education and education subsidies to the citizenry. Therefore, there is implicit connectivity and trade-offs between government tax income and social services from the State, taxpayers' sacrifice for funding general and higher education. Economic regulation in higher education through tuition-fee policy and related students support schemes are largely funded from government's taxes imposed on constituents (Yusuf et al., 2023). Participants out-of-pocket and institutional expenditures on university degree-level education have been increasing steadily over time in selected countries.

This study on effects of tuition fee regulation on unit cost of education and financial performance of public universities in Nigeria, the United Kingdom, and USA is anchored on three reasons. The three countries provide a comparative lens due to shared historical linkages and mixed financing models. First, Nigeria inherited its higher education structure from the UK, while both have adopted elements of USA' cost-sharing model that combines tuition revenue, state funding, and private contributions (National Universities Commission, 2022). These similarities ranging from cost sharing of institutional expenditure(s) commitment in producing graduates of higher education institutions, differentiated tuition-charges for foreign students (outside its scope), fiscal dependence on governments / contributory funding, cross-subsidisation, and recurring trends of recording financial operating deficits regularly. These institutions have been in an uninterrupted operation for the four academic sessions and published financial statements for the entire financial period were selected to avoid data gaps. Despite these similarities, the degree of cost under-recovery and reliance on public subsidies varies substantially across sovereigns' systems. Flowing from these shared structural and financing characteristics, a comparative analysis of regulated tuition-fees is methodologically appropriate. It also allows for an assessment of effects of fees on cost of education, higher education subsidy expenditure, and financial performance measured through operating results on expenditure and assets. This provides a useful basis for understanding financial operating efficiency in public universities for both policymakers and practitioners.

The central problem is establishing the gap(s) between unit cost of education and unit tuition revenue. When tuition is regulated and fixed, universities cannot price at cost, which strains operating budgets and limits investment in research, infrastructure, and staff development. While the literature documents tuition policy effects on access and equity, few studies quantify unit cost absorption or compare cost recovery ratios across countries using standardised metrics.

The main objective of this study is to assess tuition fees regulation effects on unit cost, cost recovery and financial sustainability in public higher education institutions. Specifically, the study (a) develop and apply harmonised measurement framework for unit cost, per-student tuition revenue, unit subsidy, operating surplus or deficit to expenditure, and operating return on net assets as sustainability ratios, (b) tests for statistically significant differences in these five metrics across Nigeria, the UK, and US; and (c) interprets the findings using education as cost sharing with education as public goods, resource dependence (government funding reliance) and Baumol's cost disease theories.

To guide the analysis, the study addresses the following research questions: how does unit cost of education per higher education student differ across countries; how does unit tuition revenue differ across the three countries; how does per-graduate education subsidy differ across the three countries; are there statistically significant differences in operating return to spending and assets across institutions in Nigeria, UK, and USA alongside across the sample; and are there significant differences in operating returns on net assets across institutions in Nigeria, the UK, and USA, and do empirical results align with cost sharing, resource dependence and Baumol's cost disease explanations.

This research's contribution to knowledge in three ways. First, it provides a harmonised measurement framework for comparing unit cost and cost recovery and higher education funding across jurisdictions. The study provides empirical evidence on cost recovery and efficiency, using institutional-level data and on whether increased public subvention to maintain financial stability or gradual fee adjustment is necessary (IPSASB, 2006; Treasury Board of Canada Secretariat, 2019). The results provide policy insights in education as public goods and cost-sharing model, and resource dependence theories. Its findings also contribute to policy debates on sustainable financing of public universities.

The rest of the paper proceeds as follows: Section 2 reviews the conceptual framework, and theoretical foundation of cost of education and financial performance metrics with empirical evidence and develops the hypotheses. Section 3 presents the methodology. Section 4 reports the results, and Section 5 discusses findings, and Section 6 concludes.

2. LITERATURE REVIEW

2.1. Cost of Education, Tuition Revenue and Financial Sustainability

Higher education is a global common good, occupies intermediate position between pure public and private goods (Marginson, 2011; Tilak, 2008; UNESCO, 2015, 2022, 2023). As a quasi-public good, it generates positive externalities as more skilled workforce, civic participation, and knowledge spillovers that benefit society beyond individual graduate, thereby justifying government subvention funding and subsidies (Johnstone, 2004; Tilak, 2008). It is excludable through admission and tuition-fee requirements and yields substantial private returns in earnings and social mobility. Callender and Davis (2023) provide evidence supporting this duality; indicating that cost-sharing normalise cost of participation but carries behavioural and welfare implications.

Higher education literature emphasises the importance of unit cost measurement for resource allocation and performance evaluation as core metric for assessing operational efficiency and financial sustainability (Becker, 2009; IPSASB, 2021). When unit cost exceeds unit tuition fee revenue, the difference constitutes under-recovery or producer's subsidy, typically financed by government. Activity-based costing (ABC) frameworks follows approaches used in higher education finance (Bowen, 1980; Căpușneanu et al., 2025; Joint Funding Councils (JFC), 1997). ABC method allocates institutional expenditure to students on a per-graduate basis in producing a unit cost metric that is comparable across institutions. Available information state that requisite cost recovery ratio for higher education institutions is 60% and 50% for government subvention reliance ratio (OECD, 2025a). Financial sustainability is commonly measured by two ratios: operating surplus to expenditure and operating return on net assets. A 4% operating revenue surplus to expenditure ratio and 5% return to net assets is widely regarded as the minimum threshold for reinvestment capacity and resilience against financial shocks in HEIs (IPSASB, 2024b; Treasury Board of Canada Secretariat, 2019). Prior empirical evidence has shown that most HEIs in developing countries operate below 4-5% threshold due to rigid tuition policies and inadequate funding.

The three distinct higher education cost, tuition-fee and funding clusters followed in economics of education, accounting-finance, and institutional management literature are low cost, high subvention funding, high cost, high tuition with fee-indexing, and hybrid high cost, high tuition-fees with middle-fee, declining subvention models. In low-cost and high subvention system, government is responsible for financing education augmented with low tuition-fees as beneficiaries' private contribution to share of costs. High-cost and high tuition system relates structure financing of education where burden of high-cost transferred from government to participants via high tuition-fees. High cost and high-tuition systems exhibit inelastic, and labour-intensive costs that drives tuition-fees up and in this context, tuition-fees regulation is applied to moderate its impacts. The middle-fee and declining systems is an intermediary model, blending low-cost, high subvention and high-cost, high-tuition with middle-fee, declining subvention systems apparently exist in USA where some institutions charge different fixed regulated tuition-fees.

Several empirical evidence on low-cost, high subvention have shown that it is difficult for HEIs to generate sufficient revenue through tuition-fee and other internally generated sources to meet operational requirements, therefore, HEIs are compelled to expect state subvention funding (Marginson, 2011). Similarly, evidence from Uzbekistan showing that as HEIs became more tuition-dependent, expenditure on faculty increased, consistent with RDT predictions (Kholmuminov et al., 2019). Callender and Davis (2023) confirmed that the middle-fee model shifts certain proportion of tuition-fees to participants, when fiscal subvention declines, reducing government funding dependency.

2.2. Theoretical Foundations

2.2.1. Cost-Sharing and Public Goods Theory

Higher education system is framed as a public good with positive externalities for society and economic development, thus, state traditionally bears most costs through subventions in keeping tuition-fees low. Common characteristics of higher education as public “goods” is that the institutions are moderately dependent on tuition-fee income but their responsiveness to market dynamics is weak, because HEIs behaviours are not necessarily affected by availability of tuition-fees revenue. This sub-theme’s framework is guided by two complementary theories: public goods and cost-sharing. “Public goods theory” frames higher education as a global common good and explains that education produces societal benefits such as skilled workforce, innovation, civic participation, social cohesion that cannot be captured or priced by markets, and therefore requires government and collective responsibility (Marginson, 2011; Tilak, 2008; UNESCO, 2015, 2022, 2023). Tilak (2008) emphasises that non-excludable, collective benefits of higher education, contending that treat it solely as a private investment undermines public outcomes/benefits and provides justification for baseline subsidy where education yields externalities that would not privately fund fully in low-cost, high subvention systems.

Johnstone (2004) cost-sharing theory provides the rationale for regulated tuition-fees by arguing that where graduates capture substantial private returns in earnings and mobility, part of the institutional cost burden be borne by beneficiaries rather than taxpayers’ alone. Cost-sharing framework states further that higher education costs should be distributed among government, students, parents, and institutions (Callender & Davis, 2023; Johnstone, 2004). Under regulated tuition regimes, student(s)’ share is capped, increasing government’s fiscal burden, but Callender et al argued that consequences in cost-sharing and shift in moving higher education spending onto graduates via loans changes behaviour even if repayments are deferred. This theory according to Callender et al supports the argument that regulated fees plus loan systems are not free, but bridge these frameworks empirically, showing that income-contingent, cost-sharing are largely accepted by graduates but carry “anxiety attached” and behavioural constraints.

As HEIs operate as non-profit quasi-market where tuition-fee revenue functions as a partial price supplemented by public funding, without regulation, market pricing would exclude low-income students and undermine social mobility. This hybrid model requires government subvention to compensate for regulated prices and sustain operations, aligns with public goods and cost-sharing model. The risk associated with public goods theory and cost-sharing is that fiscal sustainability depends entirely on government’s budget appropriations (Callender & Davis, 2023). When subvention declines, this funding model cannot adjust or adopt quickly to changing conditions because cost structures are built on high subsidy schemes. These frameworks position regulated tuition-fees as a policy balance between fiscal sustainability, equitable access, and dual public-private nature of higher education across Nigeria, the UK, and USA during 2019-2022.

2.2.2. Resource Dependence Theory

Resource dependence theory (RDT) posits that organisations depend on external actors for critical resources and must adapt their strategies to secure those resources (Pfeffer & Salancik, 2003). Under regulated tuition, universities are dependent on government subvention, which influences their strategic decisions and financial autonomy because it reduces HEIs ability to generate revenue internally, increasing dependence on government funding, constrains strategic autonomy and financial planning. RDT links both low-cost and middle tuition-fee and declining subvention funding due to HEIs are dependent on two sources: government appropriations and tuition-fee payments. These funding systems behaviours presuppose that as government funding falls; institutions shift revenue mix towards tuition to reduce fiscal appropriations dependency. This theory supports using cost recovery ratio as an indicator of institutional self-reliance, since it’s the most volatile model, because balance between state subvention and tuition-fee revenue directly impacts institutional autonomy, strategy, and resilience (Kholmuminov et al., 2019). These systems and trends exist in USA, UK, and European Union member countries where declining fiscal appropriations drive tuition growth.

2.2.3. Baumol's Cost Disease Theory and Course Costing

Baumol's cost disease theory explains the structural rise in education production costs for labour-intensive services with limited resources; rise faster because productivity gains in manufacturing compared to teaching, where wages must rise to compete with other sectors, leading to cost escalation that outpaces general inflation (Baumol, 1967). Faculty salaries must rise with other sectors, while instructional hours remain relatively fixed, driving up unit costs without a proportional increase in output. Baumol's cost disease aligns with high cost and high tuition pricing system's cost behaviour because production cannot easily increase even with adoption of technology (Martin & Hill, 2012). However, where tuition-fee is regulated, universities cannot pass such costs to students, resulting in under-recovery. ABC's course costing provides a method for apportioning institutional expenditure to students on a per-graduate basis (Borges et al., 2024; Joint Funding Councils (JFC), 1997); allows for standardised comparison of unit cost across institutions and countries, adjusting for programme duration and student enrollment.

These theoretical frameworks represent different equilibria between public responsibility, resource dependence and structural cost characteristics. The low cost, high subvention funding; high cost, high tuition with fee-indexing, hybrid high-cost, high tuition-fees and middle-fee, declining subvention models are not random, therefore suitably test which institutional features among tuition regulation, cost recovery, subsidies diversification and best stabilise "low", "middle" and "high" models.

2.3. Empirical Evidence and Hypotheses

In California, USA, Murphy et al found that the institutional cost per degree at California public universities was \$71,000 for UC and \$45,000 for CSU in 2013. The study reported that average institutional subsidy per student in the US declined from \$3,517 in 2004 to \$1,631 in 2016, driven by rising sticker prices rather than cost reductions while tuition revenue covered only around 28% of costs, showing tuition-fee dependence after subvention reductions. Shamekhi (2020) analyzed the magnitude and distribution of higher education subsidies in the United States, and its changes between 2004 and 2016, found that overall magnitude of higher education subsidies had not significantly changed. Average student received \$6552 from all sources between 2004 to 2015, increased to \$6744 in 2016. The trend was driven by substantial increase in tuition sticker prices from \$5674 to \$8431 per academic session due to coincidence of increase in student aid with almost equally proportionate decrease in institutional subsidies. USA represents mixture of high-cost, high-fee to mid-fee and declining subvention systems alongside its implication on operating margin (deficit) and negative return on assets.

Prior studies in the UK reported was cost recovery rates of 28% under £3,290 fees; 37% at £7,500, and 39.40% at £9,000, indicating that 28-39% of cost and unrepaid loan value to government (Barr, 2011; Bolton & Lewis, 2025). Sibieta et al. (2025) also reported that the UK's cost recovery ratios fall within 38-39% and these findings attest to prevalence of high tuition-fee with high-subsidy prevails in the UK.

Two studies provide evidence on characteristics of Nigeria's public universities unit cost of education, unit tuition revenue, cost recovery, subsidies, and funding model, confirm that Nigeria operate low-cost, low-fee, high subvention system. Oni reported that unit cost of higher education in federal institution was N119,421; state at N45,845 and private cost of N248,849 with price elasticity to cost [$\epsilon = 0.82$] but no subsidy [$\epsilon = -0.36$] (Osanosa, 2012). This study attests that subsidy size determines price, but cost is stronger driver, and federal universities receive highest subvention, record low-cost recovery which aligns with subvention without efficiency. Another Oni found recurrent cost was -95% of total institutional expenditure at Ekiti State University, with unit cost driven by student-teacher ratio (Oni, 2013). It shows that efficiency gains are more feasible at academic unit level without raising fees and lends supports on efficiency under funding gaps. However, Osanosa (2012) and Oni (2013) utilised pre-2015-unit cost of education and tuition revenue data which did not reflect cost structure and tuition revenue trends between 2019 to 2022. This temporal gap reflects paucity of comparative empirical studies on unit cost of education, tuition revenue generation, matching / mismatching, financing system and operating performance of HEIs in Nigeria, African and other low-income countries.

Studies in OECD member countries including European Union support evidence of public HEIs operating low-cost and low-fee, government-dependent systems (OECD, 2021). OECD reports indicated that government block-funding (government funding reliance) cover 94–96%% of costs in Netherlands, Finland, and Austria; less than 10% in France and 1% in Denmark with remainder borne by government respectively with high government subvention funding system (OECD, 2019). Studies in Iraq by Almagtome et al. (2019) from 2015-2017 found that the evaluated HEIs recorded persistent operating deficits because they operate under low-fee, government-dependent funding systems, alongside excessive staff spending and lack of authority to set fees above regulated levels (Almagtome et al., 2019). This illustrates consequences of non-fee indexing or alternative revenue which supports slim operating margin or operating deficit trend in public universities financial performance under fiscal shocks.

These empirical studies affirm that the three separate funding models are adopted in different Africa, Europe Union/OECD countries and North American countries, as duly represented by Nigeria, UK, and USA. First, among them is the high-cost, high-fee, and high subsidy systems in the UK where 28-39% is unrecovered; middle-fee, declining subvention system as in UC/CSU in USA where tuition filled is greater than 50% cut in government support. Then, in Nigeria with low tuition-fee, government dependent systems with high unit-cost pressure and weak cost recovery, juxtaposed with Iraq in Asia. Collectively, the evidence shows that none of these three higher education funding models achieve sustainability on fees or subventions alone, which motivates the hypotheses H01-H05 on tuition regulation, cost recovery and financial performance.

Based on this evidence, we formulate the following hypotheses:

H1: There is a significant difference in unit cost of education across Nigeria, the UK, and USA.

H2: There is a significant difference in unit tuition fee revenue across the three countries.

H3: There is a significant difference in unit higher education subsidy across the three countries.

H4: There is a significant difference in operating surplus to expenditure ratio across countries.

H5: There is a significant difference in operating return on net assets across the three countries.

While economics literature establishes link between tuition regulation and financial pressure, comparative empirical analysis using standardised unit cost metrics remains limited, particularly for Nigeria. This study narrows extant gaps by providing a cross-country comparison of unit cost, tuition revenue, subsidy, and financial sustainability ratios for Nigeria, the UK, and USA.

3. METHOD

A comparative quantitative design, anchored on activity-based course costing model is employed to examine how regulated tuition fees, cost of education and financial performance in public HEIs across the three countries during the period 2019-2022. The comparative approach was adopted to enable cross-country measurement of unit cost of education, unit tuition-fee revenue, cost recovery, unit higher education subsidy spending and associated financial performance indicators using standardised data.

3.1. Sovereign Entities, Sample Institutions, Data Sources and Collection Method

The sample comprises 12 public universities: purposively selected from the countries, with four each, from 2019 to 2022, yielding 48 observations. These institutions are Nigeria – Universities of Nigeria, Nsukka (UNN), Lagos (Unilag), Obafemi Awolowo University (OAU), and University of Abuja (UniAbuja). Universities of Manchester (UniManc), Liverpool, Warwick, and Bath from the UK. Then, Universities of `Texas Systems (UNITEXAS), Pennsylvania State, Wisconsin, and State University of New York (SUNY) from USA. Secondary materials (datasets) were extracted from audited financial statements of selected universities and national higher education statistics. All monetary values were converted to USD using average the annual exchange rates to ensure comparability.

The comparative scope of this study is limited to Nigeria, the United Kingdom, and USA for theoretical, historical, and empirical reasons as earlier. The sample adopted is illustrative rather than exhaustive but designed to represent the range of financing models existing in each of sovereign's system notably the high subvention in the UK, declining subvention in USA, and state dependent

subvention in Nigeria. The expectation is that findings are generalisable to similarly regulated public universities, not to private institutions which exhibit different cost structure(s) and pricing or operating outside fixed-fee regimes.

The selected countries financial data are reported in their domestic currencies, Naira, Pound Sterling and US dollars. To bring national currencies in parsimony, all monetary variables were converted to US\$ as common currency unit to facilitate cross-country comparison. Pre-data analysis diagnostic checks were conducted to assess whether exchange rate translations would significantly influence the results. Pre-data testing yields less than 1% and 1.5% cross-comparability effects for UK and Nigeria; an indication that exchange rate volatility and cross-comparability would have negligible impact on results, when financial aggregates were converted in US-dollars across board. Sensitivity to exchange rate fluctuations was addressed, using annual average exchange rates of relevant fiscal years and reporting results in both local currency and constant US\$ terms, isolates real changes in costs from nominal currency effects.

3.2. Variable Definition, Construction and Measurement

Five financial performance indicators were constructed as specified in the conceptual framework, covering unit cost of education, tuition revenue, and financial sustainability. Unit cost of education is total institutional expenditure divided by number of graduates over a standard 4-year cycle. Unit tuition fee revenue is total tuition revenue divided by the carrying number of students and or actual graduate output. Cost recovery ratio is unit tuition revenue divided by unit cost. Unit higher education subsidy is the difference between unit cost and unit tuition revenue. Operating surplus ratio is operating surplus divided by total expenditure, while operating return on net assets is operating surplus divided by net assets.

Table 1. Variables Definition, Identifier, Formulae, Metric-Benchmark

Variables	Tag-Code	Formula	Benchmark
Unit Cost of Education	UCOE	Total Expense ÷ No. of Students X 4 Years or graduate out-turn	Not Specified Open-Ended
Unit Tuition Revenue	UFTR	Total Tuition-fee ÷ No. of Students in 4 Years	Not Specified Open-Ended
Cost Recovery Rate	CRR	UCOE minus UFTR is n = X%	-do-
Unit Subsidy Ratio	UHES	UCOE minus UFTR 0% = 60%	(OECD, 2025a)
Govt Reliance Ratio	GFRR	= 50%	(OECD, 2019)
Operating Surplus Ratio	POSR	POSR/Expense = 4%	(Canada Treasury)
Return on Net Assets	NOIA	POSR/Net Asset = 5%	(IPSASB, 2024)

3.3. Model Specification and Development

Model development proceeds in two dimensions; operating financial efficiency and financial sustainability measurement models, enables us to establish unit costs, unit tuition-fee revenue, cost recovery rate, unit subsidy etcetera and measure institutions financial performance / financial sustainability and country-wise.

3.3.1. Operating Financial Efficiency Models

First, this model provides measure of unit cost as the building block to determine the relationship between cost and tuition revenue and cost recovery rate in subsequent models.

A. UCOE – ABC Approach:

$$UCOE = \sum_{ij}^{2019-2022} [(Total\ Institution's\ Expenses / Total\ Number\ of\ Degree-level\ Students\ for\ the\ 4\ Academic\ Sessions)] \dots\dots\dots(1)$$

Where: Total Institution's Expenditure divided with the total number of degree-level students (Full Time Equivalent) yield unit absorption rate vis-à-vis per-student share of cost of education from Year 1 (2019); Year 2, up to the 4th and Final Year, irrespective of whether everyone of such

students graduated or otherwise. The education expenditure absorption rate deals with FTE, and it is based on the standard duration of course programmes (prorated on four-year basis), and reference to it, is given in this subsect.

B. Unit Tuition Revenue–Revenue Collection Approach:

$$\text{UTFR} = \sum_{ij}^{2019-2022} [(\text{Total Institution's Tuition-Fee Revenue} / \text{Total Number of Degree-Level Students for the 4 Academic Sessions})] \dots\dots\dots(2)$$

Where: Total institution's tuition-fee revenue received, divided with total number of degree-level students (Full Time Equivalent) is the unit absorption rate, gives unit tuition revenue per-student from Year 1 (2019); Year 2, up to the 4th and final Year as cost sharing contribution by participants to cost of education whether actual graduation is recorded or otherwise. (Adjustments are made where students are granted free tuition scholarship by institutions where necessary, supported with data).

C. Cost Recovery Rate or Ratio:

$$\text{CRR} = \sum_{ij}^{2019-2022} [(\text{UCOE} - \text{UTFR}) \dots\dots\dots = 1, 2, 3 \dots\dots n \dots\dots\dots(3)$$

Where: UCOE is defined is unit cost and UTFR is the actual per-student tuition-fee revenue received, on Full Time Equivalent) basis for the standard academic course programme horizon. Treatment of unit cost and tuition-fee revenue for students who did not complete course of study within the standard timeframe including “carry-overs” are expected to be treated under suspense accounting records, thus such issues fall outside the scope and consideration of this study.

The CRR is cost recovery ratio; a vital control variable model function for the first model, and UCOE / UTFR in the second model respectively, is the metric used in determining whether cost of education is fully recovered, cost under-recovered or over recovery. It is linked directly to education subsidies, government funding reliance, financial autonomy, and sustainability. This constitutes one of the primary contributions of this empirical study to literature.

D. Unit Higher Education Subsidy / Government Reliance Ratio:

$$\text{UHES} = \sum_{ij}^{2019-2022} [(\text{UCOE} - \text{UTFR} / \text{UCOE}) \dots\dots\dots(4)$$

Where: UCOE as defined is unit cost and UTFR is the actual per-student tuition-fee revenue received, on Full Time Equivalent) basis for the standard academic course programme horizon. Treatment of unit cost and tuition-fee revenue for students who did not complete course of study within standard timeframe including “carry-overs” are expected to be treated under suspense accounting records, such issues fall outside the study's scope and considerations.

3.3.2. Financial Sustainability Performance-Operating Gain to Expense:

$$\text{POSR} = \sum_{ij}^{2019-2022} [(\text{Institution's Operating Surplus} / \text{Institution's Expenses in 4-Academic session's for graduate out-turn})] \dots\dots\dots(5)$$

Where: POSR is Institution's operating margin to expenditure ratio.

A. Financial Sustainability – Return on Net Assets:

$$\text{ROIA} = \sum_{ij}^{2019-2022} [(\text{Institution's Return} / \text{Net Assets for Yr 1, ,,,, Yr 4} \dots\dots\dots(6)$$

Where: ROIA is return to net assets.

3.4. Analytical Approach / Estimation Strategy

The analysis proceeds in three stages. First, descriptive analysis computes mean values for each indicator by country for all variables alongside cost recovery analysis calculates ratios for each university and compares across countries with country as grouping variable. Second, hypothesis testing uses one-way ANOVA to test for significant differences in country-level means for each

indicator at the significance level. For one-way ANOVA at 1% $\alpha = 0.01$, decision rule is: Reject H_0 if $p < 0.01$. Fail to reject H_0 if $p \geq 0.01$; meaning “all country means are equal”. Post-hoc Tukey tests identify pairwise differences. With only four time periods, unit root tests have low power, so stationarity is not assumed for inference. Panel unit root tests are not relied upon for inference, and this limitation noted in conclusions.

4. RESULTS AND DISCUSSION

4.1. Research Results

4.1.1. Descriptive Analysis

The outcome of these descriptive statistics given in table 2.

Table 2. 4-Years Mean Unit Cost, Unit Tuition, Cost Recovery, Subsidy, Operating Margin and Return on Net Assets (2019-2022)

Variables Metric	Nigeria	United Kingdom	USA	Overall
Unit cost of Education (\$)	4,807	121,712	149,765	92,095
Unit Tuition Revenue (\$)	752	48,222	42,508	30,494
Unit Education Subsidy (\$)	4,055	73,490	107,257	61,601
Cost Recovery Ratio	16.00%	39.00%	28.00%	28.00%
Govt Fund Reliance Ratio	84.00%	61.00%	72.00%	72.00%
Operating Surplus/Deficit	-0.92%	-1.76%	-21.95%	-24.63%
Return on Net Assets	-0.45%	-1.43%	-11.94%	-13.82%

The 12 Universities Country-Level Students Enrolment Data Schedule for the relevant academic years:

Table 3. Student Enrolment Schedule for Sampled Public Universities by Country

Year	Nigeria	UK	USA
2019	2,159,461	2,383,970	19,650,000
2020	2,335,467	3,475,340	18,640,000
2021	2,200,000	2,656,528	19,040,000
2022	2,348,000	2,862,620	18,668,000
Total	9,042,928	10,378,455	75,998,000
Mean	2,260,732	2,594,614	18,999,500

Descriptive analysis result reveals substantial cross-country divergence in cost and financing structure. Unit cost per-student ranges from \$4,807 in Nigeria to \$121,712 in the UK and \$149,765 in USA. Country-wise unit cost recovery to tuition-fee revenue ratios ranges from 16% in Nigeria to 28% in USA and the highest rate of 39% for the UK institutions. The three countries group average is 28% and falls within with OECD prior findings (OECD, 2025). Cost recovery rate in the Nigerian situation, is a 31-fold difference that reflects underlying disparity in tuition-fee policy, public subvention, and cost recovery models. These three patterns stand out; first, high-income systems as in USA, UK and Australia rely predominantly on tuition revenue, with limited government funding (Eurydice, 2025; OECD, 2025a). Overall cost recovery ratio / GFRR group mean of 28% and 72% falls in the same level as the USA (OECD, 2025). These operating models result(s) supports higher costs but increase HEIs exposure to market fluctuations in enrollment(s). There is significant under-recovery of the cost of education in all 12 institutions and across countries. Second, Nigeria belongs to low-income systems, exhibit low-costs of 16% paired with high fiscal reliance ratios of 84%, exceeds 60%, UK institutions are 39% and USA, 28.00%, representing high-cost, high-income, high-fee with declining subvention systems. UK and USA show 61% and 72% GFRR exceed 50% threshold (OECD, 2019). No institution and country achieved 50% GFRR confirms over reliance on subvention in meeting operational requirements.

Financial sustainability results show that the majority (institutions) recorded below 4% operating margin/expenditure and less than 5% return on net assets benchmarks considered necessary for reinvestment and financial resilience. At institutional level, University of Lagos; University of

Warwick and Pennsylvania State University achieved 4% operating margin/expenditure ratio. None 5% return to net assets—or even 2.5% annually with many assessed universities posted significant operating losses, from -13% for Uni-Abuja; -21% (Liverpool) and above -21% in USA.

4.1.2. ANOVA Results

One-way ANOVA was conducted to test whether the financial performance indicators differ significantly across the three country groups: Nigeria, UK, and USA. Table 4 presents ANOVA results.

Table 4. One-Way ANOVA's Result for Cross-Country Differences

Variables	F (2,45)	P-Value	η^2	Effect size	Decision (1%)
Unit Cost of Education	110.47	< .01	.83	Large	Reject Ho, Large practical effect
Unit Tuition Revenue	1,847.37	< .01	.99	Large	Reject Ho, -do-
Unit Subsidy/Reliance	32.82	< .01	.60	Large	Reject Ho, -do-
Operating Margin (POSR)	14.63	< .01	.39	Large	Reject Ho, -do-
Return Net Asset (NOIA)	9.41	< .01	.29	Large	Reject Ho, -do-

Note: N = 4 X 4 years per-country and 16 for each country group; POSR is Operating Surplus-(Deficit) (POSR) / Expenditure Ratio and Return on Net Assets is ROIA) Ratio. η^2 = eta squared.

One-way ANOVA at $\alpha = .01$ revealed significant differences across countries for unit cost, F (2,45) = 110.47, $p < .01$, $\eta^2 = .83$. For unit tuition-fee revenue and unit cost under-recovery, the analysis also revealed significant differences across countries for cost, F (2,45) = 1,847.32, $p < .01$, $\eta^2 = .99$ and F (2,45) = 32.82, $p < .01$, $\eta^2 = .60$, respectively. Furthermore, the Operating Revenue Surplus/Deficit (POSR) to Expenditure and Return on Net Assets Ratios yield F (2,45), $p < .01$, $\eta^2 = .39$, and F (2,45), $p < .01$, $\eta^2 = .29$, indicating significant differences in operating margin to expenditure and return to net asset ratios across countries. There are statistically significant differences in means across Nigeria, UK, and USA at the 1% level. Practical significance using η^2 shows a large effect, with $\eta^2 > .14$.

All the five hypotheses are rejected at the 1% level, indicating significant cross-country differences in public universities' financial performance. The five financial indicators, unit cost, tuition revenue per student, government fund reliance ratio, operating surplus and return on assets, are significant at $p < 0.001$, and effect sizes are large, with η^2 ranging from 0.83, 0.99, 0.60, 0.39, and 0.29, respectively.

These outcomes mean that country context accounts for or explains 29% to 99% of variations in financial performance indicators. Therefore, 1% for unit tuition-fee revenue and the other four variables ranging from 17% to 71% is due to everything else, differences between the 4 universities within each country, differences across the 4 years, random variation, measurement error, and so on.

4.1.3. Robustness-Post-hoc Pairwise Comparisons

To identify where the significance differences residue, we conduct Tukey HSD post-hoc tests for each of the metrics is presented in table 5, reports the mean difference and adjusted p-values.

Table 5. Tukey HSD Pairwise Comparison

Variables Metric (USD \$)	Nigeria vs UK	Nigeria vs USA	UK vs USA
Unit cost of Education	-29,226.38***	-36,239.25***	-7,012.88
Unit Tuition Revenue	-11,867.62***	-10,439.12***	1,428.50***
Cost Recovery Ratio	-17,383.50***	-23,466.75***	-6,083.25
POSR/Expenditure Ratio (%)	0.0006	0.1703***	0.1697***
Operating Return/NA Ratio	-0.0001	0.1388**	0.1389**

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Post-hoc Tukey tests attest existence of three distinct clusters, a low cost, high subvention clusters involving Nigeria and the UK, USA with probably Canada and Australia forming a high-cost, high-tuition cluster mixed with high-cost, middle-fee, and declining subvention system. This test confirms that Nigeria is a low cost, high subvention cluster differs significantly from the UK, a high cost, high subvention cluster; and USA operate mixed high cost, high subvention and high-cost, middle-fee on unit cost, with declining subvention system exhibit cost under-recovery at the 1% level. The emerging proximity in Nigeria and UK's public universities' operating margins and net asset returns despite very different cost/tuition levels is thought-provoking and underexplored in many prior comparative units' cost, tuition revenue, operating margins and HEIs financial evaluation studies.

USA's institutions' operating revenue margin (surplus or deficit) to expenditure and return on net assets, differs significantly from both Nigeria and the UK at 1% level. Nigeria and the UK did not differ significantly from each other on these two financial performance measures, though the absolute ratios remained below the return on net assets sustainability benchmark. The UK versus USA difference is only significant for tuition revenue. This confirms that the main driver of cross-country variation is the gap between Nigeria, a low-income and the two high-income systems, particularly in cost structure and cost recoverability capacity: more so, given Nigeria's weak public sector financial reporting practice. The magnitude of difference is most pronounced in unit cost and tuition revenue, reflecting the role of national fee regulation regimes. UK-USA differences are smaller and only significant at 5% level, aligned with a high-cost, high-tuition cluster mixed with high-cost, middle-fee, and declining subvention system. The robustness checks support the main ANOVA findings and rule out the possibility that a single outlier is driving the results.

4.1.4. Summary of Findings

Financial performance indicators vary systematically with national tuition and subvention regimes, in tandem with expected trends in HEIs operating under different cost structures. Higher cost recovery through tuition is associated with stronger operating surpluses, whilst lower cost recovery leads to slim operating margins or operating deficits to expenditure, and operating surplus is only achievable when cost growth is controlled. High reliance on government funding increases vulnerability to fiscal shocks and limits reinvestment capacity, further confirming that financial indicators vary systematically with national tuition and subvention regimes. Tuition fees regulation, under-recovery of costs and subsidy spending across countries minimised operating margin to institutions' expenditure across the three funding systems and countries. Similarly, tuition fees regulation, under-recovery of costs, with high education subsidisation across countries, reduce operating return on assets and reinvestment capacity.

4.2. Discussion

Low-cost recovery and high fiscal dependence with group GFRR mean of 36% CRR and 64% GFRR indicates that HEIs recover less than 40% of unit cost through tuition, with the balance absorbed by governments subvention funding, is material fiscal dependence that should be disclosed in public sector financial statements. Results confirm that regulated tuition creates a persistent gap between cost and revenue; and Nigeria's 16% cost recovery implies that the government covers 84% of instructional costs per student. In the UK and USA, higher fees reduce subvention but not eliminate under-recovery (House of Commons Public Accounts Committee, 2024). These trends are consistent with countries practicing low-cost, high subvention, high-cost, high-tuition mixed-with high-cost, middle-fee, and declining subvention regimes. The substantial under-recovery rate obtained is consistent with IPSAS 1 requirement for disclosure of service delivery costs un-covered by users-charge revenue (IPSASB, 2024). Tuition policy is a primary determinant of revenue differences in the extreme F-value for tuition revenue, reflecting near-complete separation between country models, with 99% of variance explained country-wise as in some EU countries (OECD, 2019).

Finding on CRR, education subsidies and GFRR validates RDT, that regulated pricing of education reduces revenue autonomy, forcing institutions to depend on subvention funding in meeting operational needs. This dependence constrains universities strategic investments and increases vulnerability to fiscal consolidation, as in the UK's post-2017 tuition freeze (Hubble & Bolton, 2018) and supports RDT and cost-sharing model with lower proportion of cost borne by

participants (Johnstone, 2004). Regulated tuition reduces revenue autonomy and increases reliance on subvention funding and aligns with Baumol's cost disease, which assumes that as unit costs rise faster than regulated fees, widening gap over time (Oni, 2013; Yusuf et al., 2023). Nigeria's low-cost recovery reflects a policy environment that prioritises access over cost recovery, higher ratios in UK and USA reflect partial liberalisation of fees (Bolton & Lewis, 2025; Murphy et al., 2017). Findings illuminate facts that cost recovery and financial efficiency are not the same, alluding that financial efficiency depends more on expenditure control, economies of scale, and asset utilisation than on revenue levels alone.

Weak financial sustainability reflected in only 3 of 12 institutions achieving 4% operating margin (surplus) to expenditure ratio benchmark during the period; notably University of Lagos in Nigeria, University of Warwick in the United Kingdom and Pennsylvania State University in USA. Three of the United States institutions recorded extra-ordinary operating deficits ranging from 16% to 21% or more on aggregate annual expenditure(s), which in our view, low-income countries are likely to be sustainable. The inability of most institutions to meet the 4–5% surplus benchmark raises questions about long-term capacity to maintain quality without additional public support or fee reform. None of the 12 universities recorded five percent return on net assets and in tandem with prior research studies that report education investment projects around 2.5% to 5% (OECD, 2025b). Results align with prior trends in a low cost, high subvention clusters as in Nigeria, UK's high-cost, high-tuition with mixed-with high-cost, middle-fee, and declining subvention system in USA. Negative mean POSR and return on net assets across countries, suggest that higher fees do not guarantee financial resilience when costs rise faster than revenue, but supports Baumol's cost disease argument that education-sectors face structural cost pressures. USA's institutions' recording of lower efficiency despite mid-level funding raises questions about cost escalation, enrolment population, diseconomies of scale and governance.

Results suggest that Nigeria's public universities do not fully capture cost-of-service delivery as expected in a low-cost, high subvention cluster; they should endeavour to make disclosure of under-cost-of service delivery in financial statements (IPSASB, 2024a). The supplementary disclosure of cost recovery rates, and fiscal reliance ratios in HEIs would improve transparency by revealing the magnitude of subsidies spending on education and sustainability of pricing regimes. Findings have practical implications for university's financial controllers, as cost recovery ratio provides a straightforward metric to communicate funding gaps to governing boards and state agencies. Institutions recording below 30% recovery should prioritise cost transparency and activity-based costing to identify inefficiencies. There is no singular "best" fiscal funding model. The UK model achieves lean sustainability through high tuition-fees but raises equity concerns. Nigeria preserves access through a low tuition-fees regime but risks quality erosion from suboptimal expenditure management, underfunding and un-necessarily increase in establishment of public universities. The USA model struggles with efficiency and enrollment overloads despite higher resources.

5. CONCLUSION

This study examined effects of tuition-fee regulation, cost of education and financial performance public HEIs across Nigeria, the U K and USA, using a harmonised measurement framework, ANOVA based on 2019-2022 data. We found statistically significant differences in unit cost, tuition revenue, government subsidy, operating margin to expenditure and return on assets across countries.

Nigeria's HEIs recovered the smallest proportion of cost-sharing from tuition-fee, meaning it relies on subvention funding for operations. Findings attest that Nigeria's public universities / HEIs do not fully capture cost-of-service delivery as expected in a low-cost, high subvention cluster; and make disclosures of under-recovery cost-of service delivery in financial statements which enhances transparency. On scale(s) versus efficiency, Nigerian institutions spent and collected far less per-student than their UK and USA counterparts. USA's institutions committed highest unit production costs, lowest cost recovery ratio with declining subvention funding alongside posted largest deficits. The UK's institutions operate under a high-cost, high-tuition-fee system with large subvention and in the middle of economies of scale and efficiency. In other words, Nigeria's public universities

operate a low-cost, low fee, subvention dependent systems, with low net assets, UK's universities run a high-cost, high-tuition-fee system, and strong financial efficiency, while the USA sits in middle of cost and tuition-fees with weaker financial efficiency. On financial health, despite the lower spending pattern, Nigerian public universities show similar financial efficiency to UK institutions on both financial performance measures whereas USA's institutions performed significantly lower on financial efficiency compared to both Nigeria and the UK probably due extremely high student enrolment and education production spending). Results support the core argument that regulated-fee policy reduces revenue autonomy and increases reliance on government subvention, consistent with resource dependency theory.

For Nigeria/other low-cost, low-tuition and subvention dependent systems, tuition-fee increases alone are neither politically feasible nor sufficient, thus policy should prioritise revenue diversification through research grants, endowments, industry partnerships, and targeted government subsidies for priority programmes. Protecting access while improving quality of university education will require cost-management strategies that Nigeria's institutions use but are weak. The huge tuition-fee model in the UK (though not optimal is financially sustainable) must be balanced with unhindered accessibility. Policy in this context should strengthen income-contingent loan systems and means-tested aid to ensure high tuition does not translate to exclusion of disadvantaged students. Priority in USA is not revenue generation, but on excessive student enrolment capacity and financial stewardship. Policy and institutional operations management focus should shift towards establishing optimum enrolment levels, expenditure rationalisation, asset productivity, and governance reforms to improve operating margins without increasing student debt burden.

Policy makers should consider transparent fee-indexing mechanisms that ties inflation or relevant unit-cost to growth from general and comparative perspectives on "Fee-Indexing", given the significant tuition-revenue differences across countries. The core trade-off is that fee-indexing improves cost recovery and institutional stability, whereas subventions protect equity plus easy access but expose HEIs to budget constraints, cuts, and fiscal shocks. Fee freezing without compensating increases in subventions erode financial sustainability, and indexing regulated fees to inflation, even where partially implemented, could reduce annual widening gap particularly in the UK and USA. This policy strategy would reduce ad-hoc fee increases, improve cost-recovery predictability, and institutional financial performance without frequent annual (re)negotiations. However, "fee-indexing" alone may compromise equity if implemented without concurrent student-support schemes. Policy design must therefore couple indexation with income-contingent loans or needs-based grants. For low-fee situations as in Nigeria and other countries; moderate fee-indexing combined with targeted financial assistance could narrow funding gaps while preserving access. The indexation system should be capped and linked to measurable improvements in service quality to maintain public legitimacy. A sustainable model for public HEIs requires a calibrated mix; limited, transparent fee-indexing to secure cost recovery, and targeted subventions to protect access and quality. Policy must therefore balance the revenue stability of indexation with equity objectives, while monitoring both cost recovery and financial efficiency.

Subvention policy strategies, where cost recovery from tuition-fees is a limiting factor should be sustained subventions and remain essential for maintaining quality and access in public HEIs, with performance-linked mechanisms to incentivise efficiency while protecting academic units and operational activities. For efficiency focus, post-comparative case reporting in USA necessitates subventions should be structured to reward financial efficiency, not just enrollment and performance-based funding components can address observed weakness in operating margins without increasing students' burden. In resource-constrained environments, subvention policy should prioritise protected funding for high-cost, high-impact programmes, while allowing institutions flexibility to generate complimentary revenue. Available evidence from integrated low-cost, low-fee and government-dependent funding systems with a mixture of high-cost, high-fee, and middle-fee with declining subvention funding. This suggests that there is no single funding model or system is sufficient or perfect.

It is suggested that comparative higher education policy, governments, and regulatory agencies institutionalise unit cost of education based on a transparent and verifiable expenditure absorption rate system, and monitor cost recovery and financial performance as separate indicators. An Institutions that balances its budget can still be financially inefficient, this requires deeper scrutiny

by HEIs regulators and financial reporting standards authorities and even the IPSASB. Cross-country learning should focus on the manner institutions manage costs and not merely on how much they charge. Second, in view of the prevailing funding constraints, need for public universities to achieve financial sustainability and global competitiveness, HEIs should diversify revenue streams to expand IGR via public-private-partnerships (PPPs), and endowments. HEIs should embrace collaborative innovations with industries with more concentration on commercialisable outcomes including commercial agriculture as knowledge acquisition evidence (implemented in China) rather than mere research project reporting without usage in the Nigerian case.

The study provides comparative evidence that tuition fee regulation contributes to cost under-recovery and limits financial sustainability in public universities across countries. The paper identified emerging proximity in Nigeria and UK's public universities' operating margins and net asset returns despite very different cost/tuition levels, which represents underexplored aspect of HEIs financial evaluation in literature. We established that Nigeria's public universities do not fully capture cost-of-service delivery and make disclosure(s) of cost under-recovery in financial statements as expected in a low-cost, high subvention systems. However, the gap is most acute in Nigeria and sustainable financing requires aligning revenue policy with actual cost trends, either through calibrated fee adjustments or increased public subsidy. The standardised metrics developed can be used by accountants, auditors, and policymakers to assess institutional financial health and fiscal impact of regulatory policy. Findings suggest that tuition regulation without commensurate public funding undermines financial sustainability and limits institutions capacity for quality investment. It demonstrates that standardised unit cost and sustainability metrics can support cross-national benchmarking and policy evaluation. The contribution is empirical and methodological in nature and provides a replicable framework for assessing cost recovery and testing its application across contrasting regulatory environments.

This study has three distinct limitations. First, the sample is limited to 12 public universities, four per country may not fully represent the diversity of public higher education systems, particularly in the USA where institutional heterogeneity is high. Second, it relies on audited financial statements and publicly available student enrolment statistics alongside other related dataset, which constrains granularity of cost allocation and excludes private universities that operate under different regulatory regimes. The analysis covers 2019-2022, a period affected by COVID-19 disruptions to teaching and university operations. Although averaging across four years mitigates year-specific anomalies, the results reflect conditions during exceptional periods. In the context studied, financial commitments to staff and students were maintained, and change adopted disruption was virtual learning due to movement restrictions. Interpretation should therefore consider the limited generalisability to non-pandemic periods.

Future research should extend this work in three directions. Broaden the sample and scope by including more institutions and additional countries with varying degrees of tuition regulation to test the generalisation of findings. A larger panel would allow for dynamic panel analysis of how changes in regulation affect cost recovery over time and enhance cost efficiency. Disaggregate cost and revenue streams via access to ABC data would enable analysis at programme or departmental level, clarify which academic units are most affected by under-recovery, funding shortfalls and where efficiency gains are feasible. Inclusion of private HEIs mix with public HEIs the use of Purchasing Parity Price-adjusted exchange rate translation to moderate or direct comparability to test whether these patterns hold across economic cycles. Quantitative metrics can be complemented with case studies on governance, stakeholder influence, political economy factors that shape tuition policy. This would strengthen the link between resource dependence mechanisms and observed outcomes. By addressing these gaps, future research can generate more granular evidence to guide sustainable financing models for public HEIs while protecting access or quality.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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