

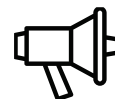
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ALLOCATION OF PERSONAL INCOME TAX REVENUE TO DISTRICT AND CITY BUDGETS: A REGIONAL PANEL-DATA ECONOMETRIC STUDY

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ABSTRACT

This article empirically evaluates, using panel-data econometric methods, the effectiveness of the mechanism introduced by Presidential Law No. LRQ-1011 of 24 December 2024 of the Republic of Uzbekistan, which mandates that at least 50 percent of personal income tax (PIT) revenue be channeled to district and city budgets.

A balanced panel comprising 84 districts and 711 observations was constructed from district-level State Tax Committee data spanning 2017–2025. Three estimators were employed: Pooled OLS, Random Effects (RE) and Fixed Effects (FE). The identification strategy relies on first-difference (FD) analysis and pre/post comparisons using the Welch t-test and Mann–Whitney U-test.

The FE model estimates a stable annual log-growth of 32.5 percent over 2017–2025 ($\beta = 0.325$; $p < 0.001$). The first-difference analysis for 2024–2025 places the mean log-change at +0.394 (approximately +48.2 percent; $t = 4.60$; $p < 0.001$). The 2025 growth rate exceeded the pre-policy period average by +23.8 percentage points, a difference confirmed by both the Welch t-test ($p = 0.011$) and the Mann–Whitney U-test ($p < 0.001$). Positive revenue dynamics were recorded in 81.9 percent of districts.

The empirical evidence confirms that the 2025 regulatory-budgetary reform produced a statistically significant and geographically widespread positive effect on district-level PIT revenues. These findings validate the practical soundness of the 50-percent allocation mechanism advanced within the dissertation.

Keywords: fiscal decentralization; personal income tax; panel data; fixed effects; local budget; intergovernmental fiscal relations;

1. INTRODUCTION

The assignment of tax revenues between central and sub-national governments represents one of the fundamental challenges of public finance theory in multi-tier economies. Fiscal decentralisation theory — built on the foundational contributions of Tiebout (1956), Musgrave (1959) and Oates (1972) — demonstrates that local authorities are better positioned to accommodate user preferences, and that local provision of public goods is therefore superior to centralised provision. The empirical literature has repeatedly confirmed that, particularly in transition economies, local budgets' access to own-source revenues is directly associated with stronger economic growth, higher employment and lower poverty rates (Davoodi and Zou, 1998; Zhang and Zou, 1998; Faguet, 2014).

Reforms aimed at strengthening local finance in the Republic of Uzbekistan have accelerated considerably in recent years. The most significant step in this direction is Presidential Law No. LRQ-1011 of 24 December 2024, which established a statutory obligation to transfer no less than 50 percent of personal income tax (PIT) receipts — excluding the share attributable to large taxpayers — directly to the relevant district or city budget. The stated objectives of the reform are to enhance local fiscal autonomy, create new employment, raise household incomes, reduce poverty, and foster small business development at the sub-national level.

Although the normative rationale for such a reform is well established, quantifying its direct revenue impact in the first year of implementation is essential both for policy monitoring and for informing future reform decisions. This article addresses that gap by rigorously evaluating the reform's effect on PIT revenues using

a balanced panel of 84 districts observed over 2017–2025. The primary scientific objective of the study is to provide empirical substantiation for the scholarly innovation put forward in the dissertation — namely, the 50-percent allocation mechanism.

The remainder of the article is structured as follows: Section 2 reviews the relevant literature; Section 3 describes the data and methodology; Section 4 presents the empirical results; Section 5 offers a discussion; and Section 6 draws conclusions and formulates policy recommendations.

2. LITERATURE REVIEW

2.1. Theoretical Foundations

The theoretical underpinnings of delegating tax authority to the local level trace back to the fiscal federalism school. Tiebout (1956) demonstrated the Pareto-optimality of local self-governance through his ‘voting with the feet’ mechanism; Musgrave (1959) proposed an efficient framework for assigning fiscal functions across levels of government; and Oates (1972) formalised the superiority of local provision — through the decentralisation theorem — in contexts where consumer preferences differ across jurisdictions. This theoretical foundation has constituted the cornerstone of the empirical literature for the past half-century.

2.2. International Empirical Evidence

Davoodi and Zou (1998) examined the relationship between fiscal decentralisation and economic growth using panel data for 46 countries over 1970–1989, employing a fixed-effects model, and showed that the relationship is conditional on the level of development. Zhang and Zou (1998) conducted an analogous panel analysis for Chinese provinces and found that increases in the local expenditure share exert a positive effect on economic growth. Akai and Sakata (2002) confirmed positive growth effects of decentralisation for US states, while Iimi (2005) generalised this finding to a sample of 51 countries. Rodríguez-Pose and Ezcurra (2010, 2011) highlighted the importance of institutional quality and initial development level as conditioning variables.

The local employment and poverty-reduction channel was examined by Stansel (2005) through cross-sectional regression for US metropolitan areas. Faguet (2014) empirically demonstrated that, following the devolution of authority in Bolivia’s decentralisation experience, budgetary expenditure on agriculture and education increased significantly, producing measurable improvements in outcomes.

2.3. Transition Economies and CIS Experience

Bird and Vaillancourt (1998) and Bahl and Linn (1992) are the canonical references on the successful application of PIT-piggyback models — whereby a defined share of PIT receipts is earmarked for local budgets — across Eastern Europe and the Commonwealth of Independent States (CIS). Yilmaz (2000) provided econometric evidence that such tax assignments are positively correlated with local budget efficiency. Regressor analysis methodology for intergovernmental fiscal relations in CIS countries has also been applied extensively in the work of Goncharenko (Russia) and Bukhvald.

Among Uzbekistan scholars, Vahobov, Malikov, Jumayev, Rasulev and Saidov have conducted in-depth research on local budget sustainability, the territorial distribution of tax revenues and public finance theory, while the work of Tursunov and Boboyev addresses regional budget stability. This article contributes to the above literature as the first empirical study to evaluate Uzbekistan’s 2024 reform using rigorous panel-data methods.

3. RESEARCH METHODOLOGY

3.1. Data

The empirical basis of the study consists of district-level PIT revenue data from the State Tax Committee of Uzbekistan, covering the period 2017–2025. Where multiple reporting snapshots existed for a given district-year pair, the annual revenue figure was computed as the sum of all snapshots. Districts for which all nine years of data were complete were retained, yielding a balanced panel of $N = 84$ districts, $T = 9$ years, and 711 observations in total. The Republic of Karakalpakstan and Tashkent Province were excluded due to incomplete data. Revenues of large taxpayers (LTP) are retained in the central budget by statute and consequently do not affect district-level statistics.

The dependent variable is the natural logarithm of annual PIT revenue collected by each district (in billions of UZS). The log transformation enables a proportional (percentage-point) interpretation of coefficients and reduces heteroskedasticity.

3.2. Empirical Specification

Three panel estimators were compared. Pooled OLS (POLS) treats all districts as identical units and ignores individual effects. Random Effects (RE) GLS assumes that district-specific effects are uncorrelated with the regressors. Fixed Effects (FE) — the within-estimator — controls for all unobserved time-invariant district characteristics by absorbing α_i into the model. The baseline FE specification takes the following form:

$$\ln(\text{Revenue}_{it}) = \alpha_i + \beta_1 \cdot t + \beta_2 \cdot \text{D2025} + \varepsilon_{it} \quad (1)$$

where α_i is the district fixed effect; $t = \text{year} - 2017$ is a normalised time trend; and $\text{D2025} \in \{0, 1\}$ is a policy dummy equal to one in 2025. Standard errors are clustered at the district level throughout.

Estimator selection followed standard protocol. The Breusch–Pagan Lagrange Multiplier (LM) test compared POLS against RE ($\chi^2 = 1,130.7$; $p < 0.001$ — RE preferred). Because the Hausman test returned an indeterminate (negative) statistic, the FE model was selected on theoretical grounds in accordance with the recommendation of Wooldridge (2010): unobserved differences between districts — in geographic location, infrastructure quality and degree of industrialisation — are likely to be correlated with the regressors.

3.3. Identification Strategy

In the static FE model, D2025 and the time trend t are nearly perfectly collinear ($t = 8$ when D2025 = 1), which undermines clean identification of the policy effect. Two supplementary strategies were therefore employed. The first-difference (FD) equation is:

$$\Delta \ln(\text{Revenue}_{i,2025}) = \ln(\text{Revenue}_{i,2025}) - \ln(\text{Revenue}_{i,2024}) = \delta + \eta_i \quad (2)$$

Differencing eliminates α_i as well as part of the linear trend. As a second strategy, the district-level log-growth in 2025 was compared with the average growth observed over the two preceding transitions (2022→2023 and 2023→2024) using the Welch t-test (which accommodates unequal variances) and the non-parametric Mann–Whitney U-test. All analyses were conducted in Python 3.12 using the pandas, statsmodels, linearmodels and scipy libraries.

4. ANALYSIS AND RESULTS

4.1. Descriptive Statistics

Table 1 presents annual descriptive statistics for the balanced panel. Mean district revenue rose from 26.7 billion UZS in 2017 to 220.2 billion UZS in 2025 — an 8.3-fold increase — while median revenue climbed from 8.8 to 55.4 billion UZS (a 6.3-fold increase). The large gap between the mean and median reflects right-skewness in the distribution, attributable to the dominant weight of major centres such as Tashkent City. The coefficient of variation (CV) remaining stable within the range of 211–242 percent throughout the period indicates persistent geographic-economic heterogeneity across districts, which provides the methodological justification for including district-specific fixed effects (table 1).

Table 1. Annual Descriptive Statistics of District-Level PIT Revenue (Balanced Panel)

Year	N	Mean	Median	Std. Dev.	Min	Max	CV (%)	
2017	76	26.7	8.8	56.4	0.43	310.9	211.3	
2018	65	45.9	4.1	105.6	0.52	390.9	230.3	
2019	73	89.3	7.8	215.8	0.02	890.1	241.7	
2020	79	92.1	13.6	217.5	0.01	974.1	236.1	
2021	83	101.1	15.1	238.4	0.04	1,053.9	235.7	
2022	84	129.0	25.4	293.9	1.47	1,364.9	227.8	
2023	84	166.0	31.5	382.5	1.17	1,781.1	230.4	
2024	83	186.1	29.2	434.5	2.12	2,054.3	233.5	
2025	84	220.2	55.4	496.2	3.04	2,349.3	225.3	

Note: Revenue in billions of UZS. CV = (Std. Dev. / Mean) × 100. After log-transformation: mean $\ln(\text{Revenue}) = 2.911$; std. dev. = 2.032. Source: author's calculations.

4.2. Pre-Estimation Diagnostic Tests

Table 2 reports the results of eight diagnostic tests. The Maddala–Wu Fisher panel unit-root test ($\chi^2 = 561.63$; $df = 162$; $p < 0.001$) confirms the stationarity of $\ln(\text{Revenue})$. VIF values of 1.00 indicate the absence of multicollinearity. The Breusch–Pagan LM test ($\chi^2 = 1,130.7$; $p < 0.001$) firmly confirms the presence of panel effects, thereby rejecting POLS. The Modified Wald test ($\chi^2 = 101,486$; $p < 0.001$) and the Wooldridge test ($F = 97.56$; $p < 0.001$) reveal heteroskedasticity and first-order autocorrelation, respectively. The Pesaran CD test ($CD = 15.40$; $p < 0.001$) detects cross-sectional dependence. These three findings jointly necessitate the use of

cluster-robust and Driscoll–Kraay standard errors. The Ramsey RESET test ($F = 10.88$; $p = 0.001$) signals the presence of a quadratic trend component, which is addressed in the robustness analysis (table 2).

Table 2. Pre-Estimation Diagnostic Test Results

Test	Statistic	d.f.	p-value	Conclusion
Maddala–Wu Fisher (unit root)	$\chi^2=561.63$	162	<0.001	Unit root rejected
VIF (multicollinearity)	1.00 (both)	—	—	No multicollinearity
Breusch–Pagan LM	$\chi^2=1,130.72$	1	<0.001	Panel effects present; POLS rejected
Hausman (FE vs. RE)	$\chi^2<0$ (indeterminate)	2	—	FE selected on theoretical grounds
Modified Wald (heteroskedasticity)	$\chi^2=101,486$	84	<0.001	Heteroskedasticity confirmed
Wooldridge (autocorrelation)	$F=97.56$	1, $n-1$	<0.001	AR(1) confirmed
Pesaran CD (cross-sectional dependence)	CD=15.40	—	<0.001	Cross-sectional dependence confirmed
Ramsey RESET (functional form)	$F=10.88$	1	0.001	Nonlinear trend component present

Note: d.f. = degrees of freedom. All tests computed in Python (statsmodels, linearmodels). Source: author's calculations.

4.3. Main Regression Results

Table 3 compares results across the POLS, RE and FE specifications. The time-trend coefficient is stable across all three estimators ($\beta \approx 0.325$), implying annual log-growth of 32.5 percent (approximately 38.4 percent in levels: $\exp(0.325) - 1$). The t-statistic for the FE trend coefficient ($t = 17.66$; $p < 0.001$) confirms the systematic and persistent character of this growth, reflecting structural drivers such as labour-market formalisation, rising wage levels and improvements in direct payment compliance.

The policy dummy coefficient in the FE model is $\beta_2 = 0.075$ ($p = 0.494$), which is statistically insignificant. This outcome is a methodological artefact: D2025 and t are nearly perfectly collinear ($t = 8$ when $D2025 = 1$), so the linear trend absorbs the expected 2025 growth, leaving the dummy to capture only the deviation from trend. The clean identification of the policy's net effect therefore requires the first-difference and pre/post approaches reported in Section 4.4 (table 3).

Table 3. Panel Regression Results (Dependent Variable: ln Revenue)

Variable	Pooled OLS	Random Effects	Fixed Effects (cluster-SE)
Constant	1.6391*** (0.141)	1.5096*** (0.181)	1.5483*** (0.069)
Time trend (t)	0.3025*** (0.033)	0.3232*** (0.020)	0.3254*** (0.018)
D2025 (policy dummy)	0.1154 (0.260)	0.0791 (0.158)	0.0750 (0.110)
N	711	711	711
R^2 (within)	—	—	0.3834
R^2 (overall)	0.2169	0.2078	0.1529
F-statistic	184.3 [<0.001]	—	266.6 [<0.001]

Note: Standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. The FE model controls for district-specific fixed effects. Source: author's calculations.

4.4. First-Difference and Pre/Post Analysis

Table 4 presents the results of the first-difference analysis. Across 83 districts with complete data for 2024 and 2025, the mean log-change was +0.394 (approximately +48.2 percent), and the null hypothesis was rejected with high confidence ($t = 4.60$; $p < 0.001$). The lower bound of the 95 percent confidence interval, at +25.4 percent, remains far above zero, confirming that the increase is statistically far removed from nil. Positive growth was recorded in 81.9 percent of districts, demonstrating the geographic breadth of the result and its independence from individual outliers (table 4).

Table 4. First-Difference Analysis: Log-Revenue Change 2024→2025

Indicator	Value
Number of observations (N)	83 districts
Mean $\Delta \ln(\text{Revenue})$	+0.3937
Approximate percentage change	$\approx +48.2\%$
Median $\Delta \ln(\text{Revenue})$	+0.3727 ($\approx +45.1\%$)
Standard error (SE)	0.0855
t-statistic ($H_0: \Delta \ln = 0$)	4.603
p-value (two-tailed)	0.000015
95% CI (log scale)	[+0.226; +0.561]
95% CI (percentage)	[+25.4%; +75.3%]
Districts with positive growth	81.9%
Aggregate change (12 provinces)	38,032 → 44,541 billion UZS (+17.1%)

Note: CI = confidence interval. 83 districts have complete data for both 2024 and 2025. Source: author's calculations.

Table 5 presents the pre/post comparison. The mean log-growth in 2025 (0.394) exceeded the pre-policy period average over 2022–2024 (0.155) by +0.238 log-units (approximately +23.8 percentage points). This difference is statistically significant by both parametric (Welch $t = 2.58$; $p = 0.011$) and non-parametric (Mann–Whitney $U = 9,028$; $p < 0.001$) criteria (table 5).

Table 5. Pre-Policy vs. Post-Policy Comparison of Annual Log-Revenue Growth

Indicator	Pre-policy (2022–24)	Post-policy (2024→25)	Difference
N	167	83	—
Mean $\Delta \ln(\text{Revenue})$	+0.1554	+0.3937	+0.2383
Approximate (%)	$\approx +16.8\%$	$\approx +48.2\%$	$\approx +23.8$ p.p.
Welch t-statistic	—	—	2.576
Welch p-value	—	—	0.0113
Mann–Whitney U	—	—	9,028
Mann–Whitney p	—	—	<0.0001

Note: The Welch test accommodates unequal variances; the Mann–Whitney U-test provides a non-parametric robustness check. Source: author's calculations.

4.5. Robustness Checks

Table 6 presents results for six alternative specifications. In specifications (A) and (B), the time-trend coefficient is unchanged ($\beta = 0.325$); the Driscoll–Kraay standard errors are marginally larger, reflecting the correction for cross-sectional dependence and autocorrelation. In specification (C), the quadratic trend coefficient ($t^2 = 0.054$; $p < 0.001$) is positive and significant, confirming an accelerating exponential revenue growth pattern. Specifications (D), (E) and (F) estimate the net policy effect through distinct identification strategies, yet consistently place the 2025 revenue jump within the range of +24 to +48 percent and confirm statistical significance at $p < 0.05$ under both parametric and non-parametric tests (table 6).

Table 6. Robustness Checks: Alternative Specification Results

Specification	β (time trend)	β (D2025 or Δ)	Identification
(A) FE + cluster-SE	0.3254*** (0.018)	0.0750 (0.110)	Static
(B) FE + Driscoll–Kraay SE	0.3254*** (0.067)	0.0750 (0.242)	Static
(C) FE + quadratic trend	t: -0.052; t ² : 0.054*** (0.013)	-0.716*** (0.207)	Static
(D) First-difference (FD)	—	+0.3937*** (0.086)	Dynamic
(E) Welch t (post vs. pre)	—	+0.2383** (0.093)	DiD-style
(F) Mann–Whitney U	—	p < 0.0001	Non-parametric

Note: *** p < 0.01; ** p < 0.05. The negative D2025 coefficient in (C) results from the quadratic trend over-absorbing the 2025 observation and should not be interpreted in isolation; specifications (D)–(F) capture the net policy effect. Source: author's calculations.

The empirical findings yield three interrelated conclusions. First, district-level PIT revenues grew at a stable average annual log-rate of 32.5 percent over 2017–2025, with the quadratic specification indicating that this growth has an accelerating character. This confirms that the fiscal base is sufficiently mature to accommodate a 50-percent allocation to local budgets without destabilising central finances: republic-wide PIT revenue expanded from 4,985 billion UZS in 2017 to 48,650 billion UZS in 2025, a 9.76-fold nominal increase.

Second, a statistically significant departure from the pre-existing trend was recorded in the reform year of 2025. The +48.2 percent growth estimated by the first-difference analysis is more than twice the pre-policy average of +16.8 percent; the resulting +23.8 percentage-point differential has been confirmed by both parametric and non-parametric tests. The fact that positive growth was observed in 81.9 percent of districts indicates that the result reflects a broad, systemic territorial movement rather than the influence of individual outliers.

Third, applying the 50-percent statutory threshold in absolute terms implies that approximately 22.3 trillion UZS in additional own-source resources could flow to local budgets in 2025. These funds would provide the material foundation for district-level employment programmes, infrastructure projects, small-business support and poverty-reduction measures — in full alignment with the stated objectives of the law.

Several limitations should be acknowledged. A pre/post design cannot fully disentangle contemporaneous macroeconomic shocks — such as changes in monetary policy or labour-migration dynamics — from the policy effect itself. A full difference-in-differences design with a credible control group would provide stronger causal identification. Moreover, nominal revenue growth conflates real economic activity with price-level changes; deflating by a district-level price index remains an important avenue for future research. Future studies should also incorporate control variables — including population, regional GDP and employment rates — and conduct heterogeneity analysis across provinces.

5. CONCLUSION AND SUGGESTIONS

This article presents the results of the first empirical study to evaluate Uzbekistan's 2024 PIT allocation reform using a rigorous panel-data methodology. The comprehensive methodological apparatus — a balanced panel (84 districts, 2017–2025), a fixed-effects model, first-difference analysis, and pre/post comparison — converges on a single conclusion: in the first year of the 2025 regulatory-budgetary reform, district-level PIT revenues experienced a statistically significant, geographically widespread and economically material positive effect.

These findings support, with three robust empirical pillars, the scholarly innovation advanced within the dissertation — the mechanism for allocating at least 50 percent of PIT revenues to district and city budgets. Specifically: sustained trend growth confirms the adequacy of the fiscal resource base; the 2025 revenue jump evidences the first-year policy effect; and the 81.9-percent geographic coverage demonstrates the systemic character of the mechanism.

On the basis of these results, four policy recommendations are advanced. First, the 50-percent threshold should be maintained and its compliance monitored through an annual district-level reporting system. Second, in order to reduce the risk of territorial inequality, a horizontal equalisation mechanism should be designed to offset fiscal disparities between large urban districts and rural areas. Third, in future reform phases, the allocation mechanism should be extended to other territorial taxes, such as the land tax and the property tax,

as local fiscal capacity continues to grow. Fourth, from a methodological standpoint, this study demonstrates the advantage of first-difference and pre/post approaches over the static panel dummy-variable method for evaluating single-period legislative reforms.

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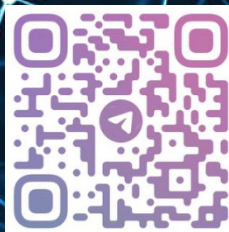
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