LOGISTICS EFFICIENCY AND ECONOMIC DEVELOPMENT: AN EMPIRICAL STUDY OF THE LOGISTICS PERFORMANCE INDEX AND GDP PER CAPITA IN UZBEKISTAN

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Abstract: The logistics sector links global supply chains to domestic economic activity and is widely treated by policymakers and international financial institutions as a pillar of national competitiveness. For double-landlocked countries such as Uzbekistan, overcoming geographic transit barriers is less a discretionary policy choice than a structural precondition for sustained growth. This paper examines the statistical relationship between logistics efficiency — measured through the World Bank's Logistics Performance Index (LPI) — and GDP per capita in Uzbekistan, using verified data spanning the 2007–2023 LPI evaluation cycles (World Bank, 2007–2023).

Using Pearson correlation and Ordinary Least Squares (OLS) regression on Uzbekistan's published LPI scores and World Bank GDP-per-capita series, the study finds a positive but statistically weak and non-significant association between the aggregate LPI score and the natural logarithm of nominal GDP per capita ($r = 0.349$, $p = 0.442$, $n = 7$). Disaggregating the index using 2007–2018 component scores similarly yields positive but non-significant coefficients for customs clearance and infrastructure — the two dimensions theorized to matter most for landlocked economies. The paper attributes this attenuated result to three features of a short, biennial, single-country series: (i) the small number of available observations ($n = 6$–7); (ii) the mechanical distortion of USD-denominated GDP per capita by Uzbekistan's 2017 currency liberalization; and (iii) the omission of confounding macroeconomic variables such as commodity prices and remittance inflows.

These single-country findings are read alongside three strands of comparator literature — the CIS factor-analytic panel of Sharipbekova and Raimbekov (2018), the global mediator-effect study of Civelek, Uca, and Cemberci (2015), and the Turkey-and-neighbors regression of Demircı Çelikkol and Keskin (2021) — each of which, by pooling observations across countries and/or years, detects a statistically significant logistics–income relationship. This contrast is best read as reflecting differences in statistical power and research design rather than as evidence against the logistics-led growth hypothesis: Uzbekistan's own trajectory — a rising LPI score, an improving global rank, and a broadly rising GDP per capita — remains directionally consistent with that hypothesis. The paper closes with policy recommendations on customs digitization, dry-port investment, and supply chain finance.

Keywords: Logistics Performance Index (LPI); GDP per Capita; Uzbekistan; Economic Growth; Supply Chain Infrastructure; Landlocked Developing Countries (LLDCs); Trade Facilitation; Pearson Correlation; OLS Regression; CIS Countries; Mediator Effect.

1. Introduction

Efficient logistics networks have moved from an operational concern to a recognized driver of macroeconomic performance and national competitiveness. A country's logistics environment is closely

linked to its trade elasticity, pricing power, and industrial flexibility: well-functioning systems shorten cash-conversion cycles and lower cross-border transaction costs, while underdeveloped transport infrastructure and cumbersome border procedures are associated with capital stagnation, elevated freight costs, and supply disruptions that can feed into domestic inflation. This is not a purely theoretical concern — as Section 2 shows, logistics performance and national income move together across the Commonwealth of Independent States (CIS), across Turkey and its trading neighbors, and across the large cross-country samples used in the international mediator-effect literature.

For Uzbekistan, situated at the center of Central Asia, logistics is a structural rather than discretionary concern. Uzbekistan is one of only two double-landlocked countries in the world, along with Liechtenstein, meaning that any export or import destined for maritime trade must cross the territory of at least two other sovereign states. This geography imposes an implicit "distance tax" on trade, requiring Uzbek firms to absorb higher transport costs, longer delivery times, and dependence on the infrastructure and institutions of neighboring transit corridors.

Since 2017, a program of structural reform — including the unification and liberalization of the foreign-exchange market — has aimed to convert this geographic constraint into a strategic advantage, repositioning Uzbekistan as a regional transit hub connecting Europe, China, Russia, and South Asia. Assessing the returns to these investments requires a standardized benchmark. The World Bank's Logistics Performance Index (LPI) provides such a tool: an internationally comparable measure of trade logistics efficiency published for Uzbekistan in 2007, 2010, 2012, 2014, 2016, 2018, and, under a revised methodology, in 2023 (World Bank, 2023).

This study addresses a gap in the regional literature by quantifying the statistical relationship between Uzbekistan's published LPI scores and its GDP per capita across all comparable evaluation cycles. Every observation used in the regression analysis is drawn directly from the World Bank's LPI database and national-accounts GDP series, cross-checked against CEIC Data, Macrotrends, and Trading Economics. The analysis is read alongside three comparator studies: a CIS-wide factor-analytic panel (Sharipbekova & Raimbekov, 2018), a global mediator-effect study linking the Global Competitiveness Index, LPI, and GDP (Civelek et al., 2015), and a regression study of Turkey and nine neighboring economies (Demircı Çelikkol & Keskin, 2021). By reporting the true strength of the Uzbekistan-specific relationship — rather than assuming it matches the panel literature — and by explaining why a short single-country series understates the logistics–growth channel relative to panel estimates, the study aims to give policymakers and international financial institutions an evidence-based basis for infrastructure investment decisions.

The remainder of the paper proceeds as follows. Section 2 reviews the theoretical foundations of logistics-led growth, the construction of the LPI, and evidence from the CIS, Turkish, and global mediator-effect literatures. Section 3 sets out data sources, model specification, and hypotheses. Section 4 reports descriptive statistics and regression results. Section 5 discusses the findings against the comparator literature and considers data limitations. Section 6 concludes with policy recommendations.

2. Literature Review

2.1 Theoretical Foundations of Logistics-Driven Growth

The relationship between logistics capability and macroeconomic expansion draws on both classical and endogenous growth theory. Infrastructure functions as a supply-side input: by lowering the marginal cost of production and distribution, transport networks expand an economy's production possibility frontier. In trade theory, efficient logistics reduce what economists term "iceberg trade costs" — the notional share of goods lost in transit to inefficiency, spoilage, and delay (Arvis et al., 2014).

Empirical work extends this foundation by showing that, in emerging markets, logistics investment tends to generate above-average returns, particularly when paired with complementary trade-facilitation reforms. Studies of Central Asian economies find that improvements in logistics efficiency are associated with measurable gains in real GDP per capita over multi-year horizons (Makhmudov, 2024). This pattern is most visible in developing countries, where improved logistics can open access to global value chains and support a shift of labor from low-productivity agriculture toward manufacturing and services. Cross-country panel studies spanning multiple LPI waves consistently detect statistically significant logistics–growth elasticities (Huynh, 2022); the single-country time-series design used in this paper has far fewer degrees of freedom, a limitation revisited in Section 5.

2.2 The World Bank Logistics Performance Index Framework

To quantify logistics performance at the country level, the World Bank introduced the LPI in 2007 (Arvis et al., 2014). Drawing on surveys of international freight forwarders together with objective tracking data, the index scores countries from 1 (lowest) to 5 (highest) across six dimensions: Customs (clearance efficiency and predictability); Infrastructure (transport and ICT assets); Ease of Arranging International Shipments; Quality of Logistics Services; Tracking and Tracing; and Timeliness (World Bank, 2023). Demircı Çelikkol and Keskin (2021, citing Uca, Civelek, & Çemberci, 2019) note that these six dimensions jointly capture both the "hard" physical infrastructure and the "soft" institutional aspects of a country's logistics environment, which explains the index's wide use in cross-country and longitudinal research.

In 2025 the World Bank introduced a redesigned "LPI 2.0" methodology based on shipment-level tracking data from maritime, aviation, and postal operators rather than survey perceptions. Because this series is not yet directly comparable to the historical run for Uzbekistan, and covers a smaller comparison set of 139 economies rather than 160, this study relies on the final vintage of the original, survey-based LPI (2007–2023), consistent with most published country-level work to date.

2.3 Cross-Country and Panel Evidence: The CIS, Turkish, and Mediator-Effect Literatures

Three studies serve as comparators for interpreting Uzbekistan's single-country result. Each uses the same two core variables — the LPI and a measure of national income — but achieves statistical power through a different route: pooling countries, pooling years, or both.

Sharipbekova and Raimbekov (2018) analyze ten CIS countries — Azerbaijan, Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, and Uzbekistan — using 2007–2016 LPI data together with sixteen logistics and macroeconomic variables. Principal-component factor analysis extracts four latent factors explaining 96 percent of the variance in these variables: Factor 1 (industry, agriculture, investment, and trade), Factor 2 (road transport, freight turnover, and communications), Factor 3 (rail and air transport, services, and internet use), and Factor 4 (exports). Regressing GDP on these factors together with the LPI score yields $R^2 = 0.962$ (adjusted $R^2 = 0.915$, $F(5, 21.56) = 71.26$ under the Welch test, $p < 0.001$), with Factors 2, 3, and 4 each carrying statistically significant, positive coefficients. The authors interpret this as evidence of a strong, panel-level relationship between logistics efficiency and economic development, notwithstanding substantial cross-country variation in GDP and LPI trajectories. Their country table separately reports Uzbekistan's 2016 GDP at US$67.22 billion and 2014 LPI score at 2.39 — matching, to two decimal places, the 2014 value used independently in Table 1 below, an external check on the data series employed here.

Civelek, Uca, and Cemberci (2015) test, across four LPI waves (2007, 2010, 2012, 2014) and roughly 95–98 countries per wave, whether the LPI mediates the relationship between the Global

Competitiveness Index (GCI) and GDP, using the Baron and Kenny (1986) hierarchical-regression procedure. GCI–LPI correlations range from r = 0.677 (2012) to r = 0.911 (2007), all significant at $p < .001$. In the 2007 model, the standardized coefficient on GCI falls from $\beta = 0.672$ to $\beta = 0.146$ (no longer significant, $p = 0.362$) once LPI is entered as a mediator, while LPI itself remains significant ($\beta = 0.587$, $p < .001$). The authors conclude that logistics capacity accounts for much of the relationship between competitiveness and income. This is directly relevant to the Uzbekistan case discussed in Section 5: because the bivariate model used here omits GCI and other competitiveness measures, any mediated effect running from competitiveness through logistics to GDP would not be separately visible in a two-variable, seven-observation series.

Demircı Çelikkol and Keskin (2021) examine Turkey together with eight land and sea neighbors (Greece, Bulgaria, Georgia, Armenia, Azerbaijan, Iran, Syria, and Iraq) across six LPI waves (2007–2018), pooling forty country-year observations. Regressing LPI on GDP per capita yields $R = 0.615$, $R^2 = 0.379$ (adjusted $R^2 = 0.362$), $F(1, 38) = 23.16$, $p < .001$, with a significant positive standardized coefficient (0.615, $t = 4.813$, $p < .001$). By contrast, the authors find no significant relationship between Turkey's own LPI and its neighbors' LPI scores, concluding that Turkey's logistics performance reflects domestic infrastructure and institutions rather than cross-border spillovers. Both patterns recur, in modified form, in the Uzbekistan results below: a positive but statistically insignificant LPI–income relationship (Section 4), and an emphasis on domestic customs and infrastructure investment rather than external spillovers (Section 5).

2.4 Empirical Evidence in Landlocked and Central Asian Economies

In landlocked economies, the relative weight of the six LPI dimensions shifts: while coastal countries' trade volumes are shaped heavily by "soft" factors such as service quality and ease of arranging shipments, landlocked developing countries (LLDCs) are disproportionately constrained by customs efficiency and physical infrastructure (Simpson, 2024). This is corroborated by Demircı Çelikkol and Keskin (2021), who note that customs is Turkey's own lowest-scoring dimension, and by Sharipbekova and Raimbekov (2018), whose Factor 1 groups agriculture, industry, and trade with capital formation — a "hard" structural bundle distinct from the "softer" service and communications indicators loaded onto Factor 2.

Uzbekistan's logistics environment historically showed considerable institutional friction and slow border clearance, contributing to its low ranking in the inaugural 2007 LPI, when its aggregate score stood at 2.16 (World Bank Logistics Performance Index database, 2007–2023). Following investment in dry-port development, rail electrification, and customs modernization, the aggregate score reached 2.60 in the 2023 release, ranking 88th of 160 countries — eleven places above the 2018 ranking of 99th (World Bank, 2023; UzDaily, 2025). Under the differently scoped 139-country LPI 2.0 methodology, Uzbekistan and Russia share 107th place with an identical score of 2.6, behind Kazakhstan (95th, 2.7) and ahead of Tajikistan (124th, 2.5) and Kyrgyzstan (133rd, 2.3) — a reminder that rank comparisons across the two LPI vintages are not directly comparable even where the underlying score is unchanged (Qazinform, 2025). Despite this progress, firm-level evidence indicates that Uzbek enterprises still hold higher-than-average safety-stock levels relative to international peers, tying up working capital because of residual transit uncertainty at neighboring borders (Juraboev, 2026). This combination of rising aggregate scores and persistent firm-level friction motivates the country-specific regression analysis that follows.

2.5 Research Gap and Contribution

Together, the CIS, global mediator-effect, and Turkish-neighbors literatures indicate that the logistics–growth relationship is detectable once a sufficiently rich panel — across countries, years, or both — is assembled. None of the three, however, provides a transparent, single-country time-series estimate for Uzbekistan using verified, non-simulated data. Existing Uzbekistan-specific work (Samatov & Samatov, 2021; Makhmudov, 2024; Juraboev, 2026) is descriptive, restricted to a subset of LPI waves, or does not report formal correlation or regression statistics against GDP per capita. This paper closes that gap and, in doing so, offers a methodological caution: researchers who attempt to replicate CIS-panel or Turkey-panel findings using only a single country's seven or eight published LPI waves should expect a much weaker, often non-significant, result for purely statistical reasons — even where the underlying relationship is the same one documented in the panel literature.

3. Research Methodology

3.1 Data Sources and Variable Operationalization

This study adopts a quantitative, longitudinal design covering the official World Bank LPI evaluation cycles from 2007 through 2023. Logistics indicators are drawn from the World Bank's Logistics Performance Index database (World Bank, 2007–2023), cross-referenced against the peer-reviewed compilation in Samatov and Samatov (2021), which reproduces the World Bank's published rank-and-score tables for Uzbekistan across the 2007–2018 cycles, and further checked against the CIS-wide data table in Sharipbekova and Raimbekov (2018), which independently reports Uzbekistan's 2014 LPI score as 2.39 — identical to the figure used here. Macroeconomic data are sourced from the World Bank national accounts database (indicator NY.GDP.PCAP.CD), cross-verified against CEIC Data, Macrotrends, and Trading Economics compilations of the same underlying series. No values in this study are projected, simulated, or otherwise estimated by the author; every year–variable pair reported in Section 4 corresponds to a publicly documented figure.

The dependent variable (Y) is the natural logarithm of nominal GDP per capita in current US dollars, ln(GDP per capita); the logarithmic transformation stabilizes variance and allows regression coefficients to be read as approximate semi-elasticities. The independent variables (X) are the aggregate LPI score (LPI_Agg), used in the baseline bivariate model (n = 7 country-years: 2007, 2010, 2012, 2014, 2016, 2018, 2023), and three constituent sub-indices for which a fully consistent, independently published time series is available across six waves (2007–2018): Customs (CUST), Infrastructure (INFR), and Timeliness (TIME).

3.2 Model Specification

To evaluate the relationship between aggregate logistics performance and economic development, a baseline simple linear regression model is specified:

$$\ln(\text{GDP per capita}, t) = \beta_0 + \beta_1(\text{LPI_Agg}_t) + \varepsilon_t \quad (1)$$

To examine structural drivers within the logistics ecosystem, a restricted multivariable OLS model is estimated over the six waves for which sub-index data are available:

$$\ln(\text{GDP per capita}, t) = \beta_0 + \beta_1\text{CUST}_t + \beta_2\text{INFR}_t + \beta_3\text{TIME}_t + \varepsilon_t \quad (2)$$

where β_0 is the model intercept; $\beta_1 \ldots \beta_3$ are partial regression coefficients measuring the marginal association between each logistics dimension and economic output; and ε_t is the error term, assumed independently and identically distributed with mean zero. The Pearson product-moment correlation coefficient underlying the bivariate test in Section 4.2 is computed as:

$$r = \Sigma(X_i - \bar{X})(Y_i - \bar{Y}) / \sqrt{[\Sigma(X_i - \bar{X})^2 \, \Sigma(Y_i - \bar{Y})^2]} \quad (3)$$

and overall model fit is assessed via the coefficient of determination:

$R^2 = 1 - SS_res / SS_tot$ (4)

where SS_res is the residual sum of squares and SS_tot is the total sum of squares of the dependent variable around its mean. All regressions are estimated in Python using the statsmodels and SciPy libraries; the coefficients, standard errors, t-statistics, and p-values reported in Section 4 are the direct, unedited output of those estimations.

3.3 Research Hypotheses

H_1: The aggregate Logistics Performance Index score is positively related to nominal GDP per capita in Uzbekistan.

H_2: Physical infrastructure (INFR) and customs clearance efficiency (CUST) carry larger positive coefficients on Uzbekistan's GDP per capita than the timeliness (TIME) sub-dimension.

Both hypotheses follow directly from the comparator literature reviewed in Section 2: H_1 mirrors the significant, positive LPI–GDP relationships reported for the CIS panel (Sharipbekova & Raimbekov, 2018), the global mediator-effect sample (Civelek et al., 2015), and Turkey and its neighbors (Demircı Çelikkol & Keskin, 2021), while H_2 follows the theoretical expectation, documented for other LLDCs by Simpson (2024), that "hard" infrastructure and border-clearance efficiency bind more tightly than shipment-scheduling reliability in landlocked economies. As Section 4 shows, both hypotheses receive directional — but not statistically significant — support in the Uzbekistan-only series, a result interpreted at length in Section 5.

4. Data Analysis and Results

4.1 Descriptive Statistics

Table 1 presents Uzbekistan's LPI and GDP per capita across seven evaluation cycles, compiled from the World Bank LPI database and World Bank national accounts data. Both series rise over 2007–2023, though not monotonically: GDP per capita in 2018 falls visibly below the surrounding trend, a pattern that coincides with Uzbekistan's September 2017 currency liberalization (discussed in Section 5.1).

Year	Agg. LPI	Customs (CUST)	Infrastructure (INFR)	Timeliness (TIME)	GDP/Capita (current US$)
2007	2.16	1.94	2.00	2.73	933
2010	2.79	2.20	2.54	3.72	1,384
2012	2.46	2.25	2.25	2.96	1,878
2014	2.39	1.80	2.01	3.08	2,033
2016	2.40	2.32	2.45	2.83	2,123
2018	2.58	2.10	2.57	3.09	1,608
2023	2.60	—	—	—	2,879

Note. Table 1. Historical logistics and economic indicators for Uzbekistan (2007–2023). Compiled by the author from the World Bank Logistics Performance Index database (World Bank, 2007–2023) and World Bank national accounts data, indicator NY.GDP.PCAP.CD, cross-verified against CEIC Data, Macrotrends, and Trading Economics, and against the 2014 LPI figure (2.39) independently reported in Sharipbekova and Raimbekov (2018). Sub-index scores for 2023 have not yet been re-published in a directly comparable format following the LPI 2.0 transition and are reported as unavailable (—) rather

than estimated. All GDP figures are nominal, current US$; see Section 5.1 for discussion of the 2017–18 currency-reform distortion visible in this series.

4.2 Pearson Correlation Analysis

To test H_1, a Pearson correlation was computed between the aggregate LPI score and the natural logarithm of nominal GDP per capita across all seven verified country-years. The resulting coefficient is $r = 0.349$, two-tailed $p = 0.442$. As a robustness check, the Spearman rank correlation — less sensitive to the 2018 outlier — was also computed ($\rho = 0.143$, $p = 0.760$), and the Pearson correlation was re-estimated after excluding the 2018 observation ($r = 0.381$, $p = 0.456$, $n = 6$).

4.3 OLS Regression Results: Baseline Bivariate Model

Estimation of the baseline model (Equation 1) over the full seven-year sample yields:

$$\ln(\text{GDP per capita}) = 5.900 + 0.629(\text{LPI_Agg}) \quad (5)$$

The model produces $R^2 = 0.122$; the overall model is not significant at conventional levels ($F(1, 5) = 0.696$, $p = 0.442$), and the LPI coefficient is imprecisely estimated ($\beta_1 = 0.629$, SE = 0.754, $t = 0.834$, $p = 0.442$). Table 2 reports the full output.

Statistic	Value
Intercept (β_0)	5.900 (SE = 1.878, t = 3.142, p = 0.026)
LPI_Agg coefficient (β_1)	0.629 (SE = 0.754, t = 0.834, p = 0.442)
R^2	0.122
Adjusted R^2	−0.053
F-statistic (1, 5 df)	0.696
Prob (F-statistic)	0.442
N (country-years)	7 (2007, 2010, 2012, 2014, 2016, 2018, 2023)

Note. Table 2. Baseline bivariate OLS regression output — ln(GDP per capita) on aggregate LPI score. Dependent variable: ln(GDP per capita), current US$. Estimated by the author in Python (statsmodels OLS) using the data in Table 1.

4.4 Multivariable OLS Regression: Sub-Dimension Analysis

To test H_2, a restricted multivariable OLS model (Equation 2) was estimated using Customs (CUST), Infrastructure (INFR), and Timeliness (TIME) over the six waves (2007–2018) for which disaggregated component scores are independently documented (Samatov & Samatov, 2021; World Bank Logistics Performance Index database). With six observations and three predictors, the model has two residual degrees of freedom; the coefficients are accordingly indicative rather than precise point estimates. Table 3 reports the results.

Variable	β (Unstd.)	Std. Error	t-Statistic	p-Value
Model Intercept (β_0)	6.599	2.790	2.365	0.142
Customs Clearance (CUST)	0.296	1.664	0.178	0.875
Trade Infrastructure (INFR)	0.172	1.484	0.116	0.919
Timeliness (TIME)	−0.078	0.759	−0.102	0.928

Note. Table 3. Multivariable OLS regression coefficients (n = 6, 2007–2018). Dependent variable: ln(GDP per capita). Model $R^2 = 0.086$; adjusted $R^2 = -1.284$; $F(3, 2) = 0.063$, $p = 0.975$. Estimated by the author in Python (statsmodels OLS).

Directionally, both customs clearance ($\beta = 0.296$) and trade infrastructure ($\beta = 0.172$) carry positive coefficients exceeding that on timeliness ($\beta = -0.078$). None of the individual coefficients, nor the overall model ($F = 0.063$, $p = 0.975$), reaches statistical significance; this is discussed in Section 5.2.

4.5 Correlation Structure Among LPI Dimensions and Income

Table 4 reports the Pearson correlation matrix among the aggregate LPI, its three modeled sub-dimensions, and ln(GDP per capita) for the six waves in which sub-index data are available (2007–2018), following the diagnostic approach used by Civelek, Uca, and Cemberci (2015). LPI_Agg correlates strongly with TIME (r = 0.906) and with INFR (r = 0.787), indicating that the three predictors in Equation 2 are far from independent — a multicollinearity pattern that inflates standard errors and limits the precision of the individual β coefficients reported in Table 3.

	LPI_Agg	CUST	INFR	TIME	ln(GDP)
LPI_Agg	1.000	0.425	0.787	0.906**	0.249
CUST	0.425	1.000	0.725	0.136	0.282
INFR	0.787	0.725	1.000	0.514	0.236
TIME	0.906**	0.136	0.514	1.000	0.011
ln(GDP)	0.249	0.282	0.236	0.011	1.000

Note. Table 4. Pearson correlation matrix — LPI dimensions and ln(GDP per capita), n = 6 (2007–2018). ** $p < 0.05$ (two-tailed). Estimated by the author in Python (SciPy/pandas) using the sub-index series in Table 1.

4.6 Bivariate Correlations of Individual LPI Sub-Dimensions with Income

Table 5 reports the simple bivariate correlation of each of the six LPI sub-dimensions with ln(GDP per capita) individually — a more stable diagnostic than the multivariable model given the small sample and the collinearity documented in Table 4.

LPI Sub-Dimension	Pearson r	p-value
Logistics Competence (COMP)	0.480	0.335
Customs (CUST)	0.282	0.588
Infrastructure (INFR)	0.236	0.653
Tracking & Tracing (TRAC)	0.210	0.689
International Shipments (SHIP)	0.179	0.734
Timeliness (TIME)	0.011	0.983

Note. Table 5. Simple bivariate correlations of individual LPI sub-dimensions with ln(GDP per capita), n = 6 (2007–2018). Estimated by the author in Python (SciPy) using the sub-index series in Table 1 and in Samatov and Samatov (2021).

5. Discussion

The results reported in Section 4 are less "clean" than a stylized case study might present — but precisely because they are drawn entirely from verified World Bank data rather than illustrative figures, they are also more informative about the real challenges of measuring the logistics–growth relationship within a single developing country over a short, biennial time series.

5.1 Why the Country-Level Result Is Weak, and Why That Is Informative

Three factors plausibly explain why Uzbekistan's own LPI–GDP correlation ($r = 0.349$, $p = 0.442$) falls well short of statistical significance, even though the underlying theoretical channel — better logistics lowering transaction costs and supporting output — remains well supported in the broader literature reviewed in Section 2.3.

First, statistical power: with only seven published LPI waves for Uzbekistan since 2007, even a true population correlation as high as $r \approx 0.6$–0.7 — comparable to the GCI–LPI correlations of $r = 0.68$ to 0.91 reported by Civelek et al. (2015) — would frequently fail to reach conventional significance thresholds in a sample this small; the confidence interval around the observed $r = 0.349$ is wide enough to be consistent with a substantially stronger true relationship. This pattern is common in country-level LPI studies and is one reason the broader literature increasingly favors cross-country panel designs (Huynh, 2022; Durán, 2025), and both robustness checks in Section 4.2 (the Spearman coefficient and the 2018-excluded re-estimate) confirm that the weak, non-significant result is not an artefact of a single outlying year.

Second, and most consequential, the 2017 foreign-exchange liberalization mechanically altered the mapping between real economic activity and USD-denominated GDP per capita. Because the official som/dollar rate was devalued by roughly 100 percent in September 2017 to match the previously separate market rate, GDP per capita measured in current US dollars fell sharply around 2017–2019 even as real, som-denominated output and living standards continued to rise. This is a measurement artefact of the exchange-rate regime, not evidence against the logistics–growth channel, and it directly explains the depressed 2018 data point in Table 1.

Third, a single-country regression of this kind necessarily omits other macroeconomic drivers of income — commodity export prices (natural gas, cotton, gold), workers' remittance inflows from Russia and Kazakhstan, and the COVID-19 shock embedded in the gap between the 2018 and 2023 waves — all of which move GDP per capita independently of logistics performance and add noise to a bivariate regression with few degrees of freedom.

This reading is consistent with the wider literature, which typically finds strong, significant logistics–growth elasticities only once panel data across many countries and years are exploited, multiplying the effective sample size and allowing country and year fixed effects to absorb exactly the exchange-rate and commodity-price confounds identified above (Huynh, 2022; Durán, 2025). Uzbekistan's own trajectory — LPI rising from 2.16 in 2007 to 2.60 in 2023, alongside a near tripling of nominal GDP per capita over the same period — remains directionally consistent with the logistics-led growth hypothesis, even though the country-specific series is too short to establish this statistically on its own.

5.2 Structural Drivers: Infrastructure and Customs

Notwithstanding the lack of statistical significance, the sign and relative magnitude of the coefficients in Tables 3 and 5 are substantively consistent with the double-landlocked logistics narrative that motivates this paper: both customs clearance and trade infrastructure carry larger positive point

estimates than timeliness, consistent with the theoretical expectation that landlocked economies are more sensitive to "hard" infrastructure and border-clearance bottlenecks than to shipment-scheduling reliability per se. When exports must cross multiple international borders before reaching maritime trade routes, inefficiency at any single checkpoint functions as an implicit tariff on domestic production; prolonged clearance times and transit uncertainty are associated with elevated safety-stock buffers that tie up working capital that could otherwise fund investment, technological upgrading, or labor expansion (Juraboev, 2026).

These point estimates are qualitatively consistent with observable investment activity: development of the Navoi Free Economic Zone as an air-cargo and dry-port hub, rail-freight electrification along the Tashkent–Samarkand–Bukhara corridor, and the phased rollout of a single-window customs platform. These investments plausibly help explain why Uzbekistan's infrastructure and customs sub-scores rose over 2007–2018 even as the country experienced a temporary GDP-per-capita trough driven by currency reform. Faster, digitized customs procedures alongside hard-infrastructure investment are associated with lower transaction costs for domestic enterprises and a more attractive environment for foreign direct investment — a channel also emphasized in the CIS panel, where Factor 1 (industry, agriculture, trade, and investment together) is the single largest source of common variance across the ten CIS economies (Sharipbekova & Raimbekov, 2018).

5.3 Timeliness as a Downstream, Not Independent, Correlate

The near-zero correlation of the timeliness dimension with GDP per capita ($r = 0.011$) does not imply that delivery reliability is unimportant to the Uzbek economy; rather, it suggests that the binding constraints are upstream structural factors — physical infrastructure and customs governance — whose improvement is a prerequisite for meaningful gains in end-to-end delivery timeliness. This aligns with broader evidence on LLDCs, where hard and institutional bottlenecks must be resolved before soft-dimension improvements translate into measurable economic gains (Simpson, 2024), and it echoes the strong co-movement between TIME and the aggregate LPI score documented in Table 4 ($r = 0.906$): timeliness moves almost in lock-step with the overall index, yet carries essentially none of the index's already weak association with income, suggesting that timeliness is best read as a downstream symptom of the broader logistics environment rather than an independent policy lever.

5.4 Uzbekistan in Comparative Perspective

Table 6 places this study's headline statistics alongside the three comparator studies reviewed in Section 2.3. The contrast is informative rather than merely a statistical curiosity: every comparator study that pools observations across multiple countries and/or years reports a statistically significant logistics–income relationship, while the single-country, seven-observation Uzbekistan series does not.

Study	Design / Sample	Key Statistic	Significance
Present study (Uzbekistan)	Single country, n = 7 country-years (bivariate); n = 6 (multivariable)	$r = 0.349$; $R^2 = 0.122$	Not significant ($p = 0.442$)
Sharipbekova & Raimbekov (2018) — CIS panel	10 CIS countries, 2007–2016, 16 variables reduced to 4 factors	$R^2 = 0.962$; Adj. $R^2 = 0.915$	Significant ($F(5, 21.56) = 71.26$, $p < .001$)
Civelek, Uca & Cemberci (2015) — global mediator study	≈ 95–98 countries per wave, 4 waves (2007–14)	GCI–LPI $r = 0.68$–0.91; LPI–GDP $\beta = 0.72$ (2007)	Significant (all $p < .001$)

Study	Design / Sample	Key Statistic	Significance
Demircı Çelikkol & Keskin (2021) — Turkey & neighbors	Turkey + 8 neighbors, 6 waves, n = 40 pooled	R = 0.615; R^2 = 0.379	Significant (F(1, 38) = 23.16, p < .001)

Note. Table 6. Comparative summary of LPI–income relationships across studies. Figures for comparator studies are drawn from the cited publications and reproduced in summary form; see Section 2.3 for full detail. "Significant" denotes rejection of the null hypothesis of no relationship at α = 0.05.

Three parallels are worth drawing out. First, the CIS panel's Factor 2 (road transport, freight turnover, and communications) and Factor 3 (rail and air transport, services, and internet use) are the factors found to significantly predict GDP (Sharipbekova & Raimbekov, 2018); both map conceptually onto the infrastructure- and service-related sub-dimensions that also carry the largest, though here insignificant, positive point estimates in Tables 3 and 5, suggesting the underlying structural relationship is qualitatively similar even where the country-specific estimate lacks power. Second, the mediator-effect result of Civelek et al. (2015) — that LPI absorbs much of the direct effect of competitiveness (GCI) on GDP — implies that a bivariate LPI-only model, such as the one estimated here, likely understates the full logistics-related channel to growth, since part of what appears as a GCI effect in a richer model is transmitted through logistics. Third, Demircı Çelikkol and Keskin's (2021) finding that Turkey's own LPI is not significantly related to its neighbors' LPI, while GDP per capita is significantly related to LPI once many country-years are pooled, mirrors this paper's emphasis on domestic infrastructure and customs reform — rather than reliance on neighboring transit corridors — as the primary policy lever available to Uzbekistan.

5.5 Data Limitations and Directions for Future Research

Several limitations qualify these findings. The LPI is published biennially, limiting the analysis to seven country-year observations for the bivariate model and six for the multivariable model — both far smaller than the 40-observation panel of Demircı Çelikkol and Keskin (2021) or the roughly 95–98-country cross-sections of Civelek et al. (2015). The transition to the redesigned LPI 2.0 methodology in 2025 further complicates direct comparison of pre- and post-2023 scores, and Uzbekistan-specific sub-index scores for the 2023 wave were unavailable in a comparable format at the time of writing; this gap is reported transparently in Table 1 rather than filled with an estimated figure. Because nominal, current-US-dollar GDP per capita is sensitive to exchange-rate regime changes unrelated to logistics performance, future work would benefit from re-estimating the same specifications using GDP per capita in constant local-currency or PPP-adjusted terms, from extending the sample with a genuine cross-country panel of Central Asian and other LLDC economies — following the designs of Sharipbekova and Raimbekov (2018) or Demircı Çelikkol and Keskin (2021) — and from incorporating firm-level survey data (e.g., safety-stock levels, lead times) as a higher-frequency proxy for logistics-related cost savings between LPI waves.

6. Conclusion and Policy Recommendations

This study set out to quantify, using only verified World Bank data, the empirical relationship between logistics efficiency and economic development in Uzbekistan, read in dialogue with the CIS, global mediator-effect, and Turkish comparator literatures. The resulting picture is more nuanced than a simple significant-correlation narrative: the aggregate LPI score and nominal GDP per capita move together directionally over 2007–2023 (LPI rose from 2.16 to 2.60 while GDP per capita nearly tripled), but the statistical relationship estimated from Uzbekistan's own seven biennial observations is positive

yet not significant at conventional confidence levels ($r = 0.349$, $p = 0.442$) — a result driven substantially by small-sample statistical power and by the mechanical effect of the 2017 currency liberalization on USD-denominated income. Disaggregating the index shows that customs clearance and trade infrastructure carry the largest, and timeliness the smallest, point-estimate coefficients, consistent with the theoretical expectation for a double-landlocked economy, even though none of these estimates individually reaches statistical significance in a six-observation multivariable model.

Read alongside the broader panel literature — which does find significant, positive logistics–growth elasticities once sample size is expanded across countries and years, as shown by the CIS-wide factor analysis of Sharipbekova and Raimbekov (2018, $R^2 = 0.962$), the mediator effect documented by Civelek, Uca, and Cemberci (2015) across four global LPI waves, and the significant Turkey-and-neighbors regression of Demircı Çelikkol and Keskin (2021, $R^2 = 0.379$) — these findings support cautious optimism about Uzbekistan's logistics-led growth strategy while underscoring the need for methodological restraint in country-specific, small-sample time-series work. Given the sample size ($n = 6–7$), these results should be read as suggestive of an underlying relationship rather than as a definitive test of it. To build on Uzbekistan's documented logistics gains, three policy interventions follow directly from the empirical patterns above.

Accelerate automated, risk-based customs systems.

Because customs clearance carries the largest positive point estimate among the three modeled sub-dimensions (Table 3) and is independently identified as Turkey's own weakest LPI dimension (Demircı Çelikkol & Keskin, 2021), Uzbekistan should prioritize integrating risk-management algorithms into the national single-window customs platform, with automated document validation at high-volume border crossings to reduce clearance times and administrative delays for trade-dependent firms.

Expand multimodal dry ports along priority transit corridors.

Public–private partnerships should target dry ports, cold-chain warehousing, and inland container depots along the highest-volume corridors, including the prospective China–Kyrgyzstan–Uzbekistan railway, consistent with the CIS panel finding that transport and communications infrastructure (Factor 2) is among the strongest significant predictors of GDP across the ten CIS economies (Sharipbekova & Raimbekov, 2018).

Support adoption of supply chain finance instruments.

Given firm-level evidence that transit uncertainty leads Uzbek enterprises to hold elevated safety stocks (Juraboev, 2026), the domestic banking sector should be supported in offering invoice factoring and reverse factoring to logistics and manufacturing firms, freeing working capital currently held against extended international transit windows.

Future research should extend the dataset as additional LPI 2.0 cycles accrue, re-estimate these models on real (constant-price or PPP-adjusted) GDP per capita to remove exchange-rate distortions, and, following the panel designs reviewed in Section 2.3, incorporate a genuine cross-country or firm-level panel to further examine the pathways linking logistics investment and productivity outcomes in Uzbekistan and the wider Central Asian region.

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