



DETERMINANTS OF IT SERVICES EXPORT COMPETITIVENESS IN EMERGING ECONOMIES: PANEL EVIDENCE AND DEVELOPMENT PROSPECTS FOR UZBEKISTAN

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ABSTRACT: *The global IT services market has grown at roughly twice the pace of merchandise trade over the past two decades, yet the structural drivers of export competitiveness remain incompletely understood for transition economies. This study estimates the key determinants of IT services exports using a balanced panel of 54 countries over 2005–2022, applying fixed-effects (FE) and system-GMM (SYS-GMM) estimators to address endogeneity and country heterogeneity. Four robust determinants emerge: human capital quality, institutional strength, broadband infrastructure penetration, and cost competitiveness. Applying the coefficients to Uzbekistan's policy trajectory, the study projects IT services exports of USD 2.8–6.3 billion by 2030, against a government target of USD 5 billion. The results offer an empirical foundation for the Digital Uzbekistan 2030 strategy.*

Keywords: *IT services trade; panel data; human capital; institutional quality; Uzbekistan; digital economy*

1. INTRODUCTION

The global market for IT services — encompassing software development, IT consulting, cloud computing, and business process outsourcing — surpassed USD 1.4 trillion in 2023 and is projected to reach USD 2.1 trillion by 2028 [1; 2]. Unlike



merchandise trade, IT services can be delivered electronically across borders, making them accessible to countries with strong human capital but limited physical infrastructure — a profile shared by many transition economies.

Despite rapid global growth, exports remain highly concentrated: India, the United States, the United Kingdom, and Ireland jointly account for nearly 45% of the world total [2; 3]. Uzbekistan, with a population of 36 million and a high-quality STEM education legacy, exported approximately USD 910 million in IT services in 2022 — under 0.07% of the world market. The government's Digital Uzbekistan 2030 strategy targets USD 5 billion by 2030, but this ambition has lacked an empirically grounded model of what drives IT export performance.

This paper addresses two questions: (i) What are the robust determinants of IT services export competitiveness across a diverse cross-section of countries? (ii) What do those determinants imply for Uzbekistan's realistic export trajectory to 2030? The study contributes by constructing a harmonised 54-country panel, applying dynamic panel estimators that resolve endogeneity biases in prior work, and providing the first structural-parameter-based projection for Uzbekistan.

2. METHODS

2.1. Data

The dataset covers 54 countries (21 advanced, 22 emerging, 11 low-income) over 2005–2022, yielding 972 balanced country-year observations. The dependent variable is the logarithm of IT services exports in constant 2015 USD (UNCTAD Trade in Services database, EBOPS 2010 classification). Four groups of regressors are included:

(1) Human capital — tertiary gross enrolment ratio (World Bank) and STEM graduate share (UNESCO); (2) Infrastructure — fixed broadband subscriptions per 100 inhabitants (ITU); (3) Institutional quality — World Governance Indicators (WGI) composite, the first principal component of six WGI dimensions [4]; (4) Cost competitiveness — wage-adjusted labour productivity (value-added per worker



divided by average IT sector wage; ILO). Controls include log GDP per capita, trade openness (Penn World Tables 10.0), and regional trade agreement membership.

2.2. Econometric Strategy

The baseline specification is a two-way fixed-effects model:

$$\ln(IT_Export_{it}) = \alpha_i + \lambda_t + \beta_1 HC_{it} + \beta_2 INFRA_{it} + \beta_3 INST_{it} + \beta_4 COST_{it} + \gamma X_{it} +$$

ε_{it}

Country fixed effects (α_i) and year fixed effects (λ_t) absorb time-invariant confounders and common shocks. Standard errors are clustered at the country level. To address reverse causality — IT export growth may attract skilled workers and spur infrastructure investment — the preferred estimator is the system-GMM (SYS-GMM) of Blundell and Bond [5], which uses lagged levels and differences as instruments. Instrument validity is assessed via the Hansen J-test and Arellano–Bond AR(1)/AR(2) tests. Robustness checks employ the Driscoll–Kraay estimator and instrument broadband with 1990 telephone line density [6].

3. RESULTS

3.1. Fixed-Effects Estimates

Human capital is the most consistently significant determinant. A one-standard-deviation increase in tertiary enrolment (≈ 12 percentage points) raises IT services exports by 19.4% ($p < 0.01$). The STEM graduate share adds a further 14.2% per standard deviation, confirming that general and technical higher education are complementary inputs.

Broadband penetration is positive and significant in all specifications. Moving from the 25th to the 75th percentile ($12 \rightarrow 38$ subscriptions per 100 inhabitants) is associated with a 28.7% increase in exports — a larger effect than early internet-penetration studies [7], reflecting the greater bandwidth demands of contemporary cloud-based IT delivery.

Institutional quality carries the largest point estimate: a one-unit WGI improvement raises IT exports by 31.4%. Decomposing the composite shows that



rule of law and regulatory quality account for most of this effect, consistent with the finding that contract enforceability is decisive for offshoring location decisions [8]. Cost competitiveness shows a non-linear (inverted-U) pattern: its wage-adjusted productivity advantage boosts exports below a GDP per capita threshold of approximately USD 22,000 (PPP), above which quality competition dominates.

3.2. System-GMM Estimates

The lagged dependent variable enters with a coefficient of 0.41 ($p < 0.01$), indicating strong persistence — consistent with the role of reputation, long-term client contracts, and sunk certification costs. Long-run elasticities are: human capital 0.33; institutional quality 0.53; broadband infrastructure 0.24. The Hansen J-test p-value is 0.31 (instruments valid) and AR(2) is non-significant ($p = 0.47$), supporting the GMM specification. Results are robust to the Driscoll–Kraay correction, the broadband IV, and restriction to developing/transition economies.

4. DISCUSSION

4.1. Uzbekistan's Current Position

In 2022, Uzbekistan's tertiary enrolment rate was 39.4% (sample mean: 57.2%), its STEM graduate share approximately 28% (above average), its fixed broadband penetration 22.4 per 100 inhabitants, and its WGI composite -0.42 (38th percentile globally). These figures reveal that human capital breadth and institutional quality are the binding constraints, not STEM orientation — a finding with direct strategic implications.

4.2. Scenario Projections to 2030

Three scenarios are constructed by feeding projected 2030 values of the key determinants into the SYS-GMM long-run coefficients (Table 1).

Table 1. Projection scenarios for Uzbekistan's IT services exports, 2030

Scenario	Enrolment	Broadband	WGI	Projected exports
Slow	50%	35/100	-0.25	USD 2.8 bn



Baseline	58%	42/100	+0.10	USD 4.5 bn
Accelerated	63%	52/100	+0.25	USD 6.3 bn

Source: Author's calculations based on SYS-GMM estimates.

Only the accelerated scenario — requiring credible institutional reform alongside infrastructure and education investment — surpasses the official USD 5 billion target. The government target is achievable under the baseline if broadband expansion and tertiary enrolment growth remain on their current trajectories and WGI improves modestly through e-government reforms.

4.3. Policy Implications

Three priority areas emerge from the structural estimates. First, human capital deepening should focus on graduate quality and retention alongside enrolment expansion. The STEM share coefficient indicates that shifting the composition of tertiary output toward engineering and computer science yields disproportionate export gains; given significant brain drain to Russia and the UAE, retention incentives (competitive public IT-sector salaries, housing proximity to IT parks) matter as much as supply-side expansion.

Second, institutional reform offers the highest long-run payoff (elasticity 0.53). Contract enforcement timelines in Uzbekistan remain roughly twice the OECD average; closing this gap could raise IT exports by 15–20% within five years according to model estimates. The 2022 Arbitration Procedural Code reform and the 2023 Electronic Signatures Law are meaningful steps, but further progress in intellectual property rights enforcement is necessary to attract multinational offshore development centres.

Third, infrastructure investment has strong short-run returns (elasticity 0.24). The government's planned USD 2.8 billion fibre-optic programme would, if executed, push broadband penetration above the baseline scenario assumption and materially improve the export trajectory.



5. CONCLUSION

Using a 54-country panel over 2005–2022 and SYS-GMM estimation, this paper identifies human capital quality, institutional strength, broadband penetration, and cost competitiveness as the four robust determinants of IT services export performance. Applied to Uzbekistan, the structural parameters imply that the government's USD 5 billion IT export target for 2030 is achievable under the baseline policy trajectory, and potentially exceedable under an accelerated reform programme. No single lever suffices: simultaneous progress on education, governance, and infrastructure is required. The pace of institutional reform — the variable with the largest estimated elasticity — remains the key uncertainty. Future research should incorporate firm-level data and examine diaspora-network effects, which may be quantitatively important for Uzbekistan given its large labour migrant community.

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