The Human-Capital J-Curve: Short-Run Costs and Delayed Dividends of Uzbekistan's Leap to Universal Higher Education

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Abstract

In just eight years Uzbekistan moved from elite to universal access to higher education: the gross tertiary enrollment ratio rose from 8.6% in 2017 to 59.8% in 2025. This thesis asks when such a leap starts to pay off in economic growth and what it costs in the meantime. Using annual World Bank data for 1999–2025, we estimate finite distributed-lag and Almon polynomial distributed-lag models of per-capita GDP growth and test for a long-run relationship with the ARDL bounds test. The growth response follows a human-capital J-curve: a 10% rise in the enrollment ratio lowers per-capita growth by about 0.64 percentage points in the following year and raises it by about 0.38 points a year later, while the cumulative multiplier after two years is still negative (−3.14; $p = 0.003$). No cointegration is found, which is consistent with an economy that is still in transition. Lagged public spending on education is positively associated with growth (+3.40; $p = 0.078$), yet between 2017 and 2023 real public education spending per capita rose by only about half while the enrollment ratio rose 5.3-fold. Lifting and shortening the J-curve therefore depends on funding quality, not only quantity.

Keywords

human capital; massification of higher education; tertiary enrollment; distributed-lag models; J-curve; public education spending; Uzbekistan.

JEL classification: C22, I23, I25, O15.

1. Introduction

Few higher education systems have expanded as fast as Uzbekistan's. After almost two decades in which the gross tertiary enrollment ratio stayed between about 8% and 14%, it rose from 8.6% in 2017 to 59.8% in 2025, an almost sevenfold increase [1]. The expansion took place under the Concept for the Development of the Higher Education System until 2030, which set the goal of raising higher education coverage above 50% [2]. On the gross enrollment measure, this threshold was passed as early as 2024, when the ratio reached 56.5% [1]. In Martin Trow's classic typology, a system that enrolls up to about 15% of the age group is elite, and access becomes universal as participation approaches 50% [3]. Uzbekistan crossed both thresholds within eight years, a passage that took decades in the post-war systems Trow described.

Growth theory gives such a leap a clear long-run promise: in the augmented Solow model, investment in human capital raises the steady-state level of income per capita [4]. The empirical record is less generous. The rapid spread of schooling in developing countries often failed to accelerate growth [5]; what matters is the cognitive skills that schooling produces rather than years of enrollment [6]; and expanding higher education alone is not a reliable growth strategy [7].

Speed adds a timing problem that has rarely been examined for a single economy. During a massification wave, students partly withdraw from work, teaching resources are spread over many more learners, and graduates reach the labor market only four or more years after admission. The growth payoff should therefore be delayed and may even be negative at first, tracing a J-shaped path.

This thesis therefore shifts the question from whether education spending raises

growth to when a massification shock pays off and how public funding shapes that path. It has three aims: to document the gap between enrollment and public education resources, to estimate the year-by-year lag profile of the enrollment effect, and to derive principles for managing the transition.

2. Data and methods

The analysis uses annual data for 1999–2025 from the World Bank's World Development Indicators [1]: GDP per capita in constant 2015 US dollars, the gross tertiary enrollment ratio, gross capital formation as a share of GDP and government expenditure on education as a share of GDP. The spending series covers 2013–2023 in the World Bank database and is completed for 2011–2012 from the UNESCO Institute for Statistics [8]. To set enrollment against the resources behind it, we construct real public education spending per capita (the spending share multiplied by real GDP per capita) and index both series to 2017 = 100, the year the reforms began.

The core of the analysis is a finite distributed-lag (DL) model that links per-capita growth to current and past changes in enrollment:

$$g_{y,t} = \alpha + \sum_{j=0}^{L} \gamma_j \, \Delta \ln s_{H,t-j} + \beta \, \Delta \ln s_{K,t} + \psi \, D20_t + u_t,$$

where $g_{y,t}$ is per-capita GDP growth in percent, s_H is the gross tertiary enrollment ratio and s_K the investment share. The coefficients γ_j measure the effect of a change in the log enrollment ratio that occurred j years earlier ($j = 0, \dots, L$), and $D20$ marks the 2020 pandemic shock. The cumulative multiplier after k years is

$$M_k = \sum_{j=0}^{k} \gamma_j.$$

The model is estimated with $L = 2$, 3 and 4 on samples that start in 2008–2010. Because lag coefficients are collinear in short samples, a quadratic Almon polynomial

is imposed on the lag weights as a check [9]. Standard errors are heteroskedasticity- and autocorrelation-consistent [10]. A long-run relationship between income, physical capital, human capital and population growth is tested with the ARDL bounds test [11], which remains valid when the regressors mix $I(0)$ and $I(1)$ processes; the Akaike criterion selected an ARDL(1,2,2,2) model with a trend. Finally, the growth effect of the previous year's spending is estimated by regressing per-capita growth on the lagged log spending share and the pandemic dummy over 2012–2024 (n = 13). All models were estimated in Python with the statsmodels library.

3. Results

3.1. Enrollment outran public resources

Between 2017 and 2023 the gross tertiary enrollment ratio rose 5.3-fold, while real public education spending per capita rose only about 1.5-fold, from US$153 to US$234 at 2015 prices (Figure 1). As a share of GDP, public spending on education stayed within 4.1–6.3% and showed no upward trend, and higher education received only about 10% of it in 2019 [12]. Public resources therefore grew far more slowly than the student body they had to serve.

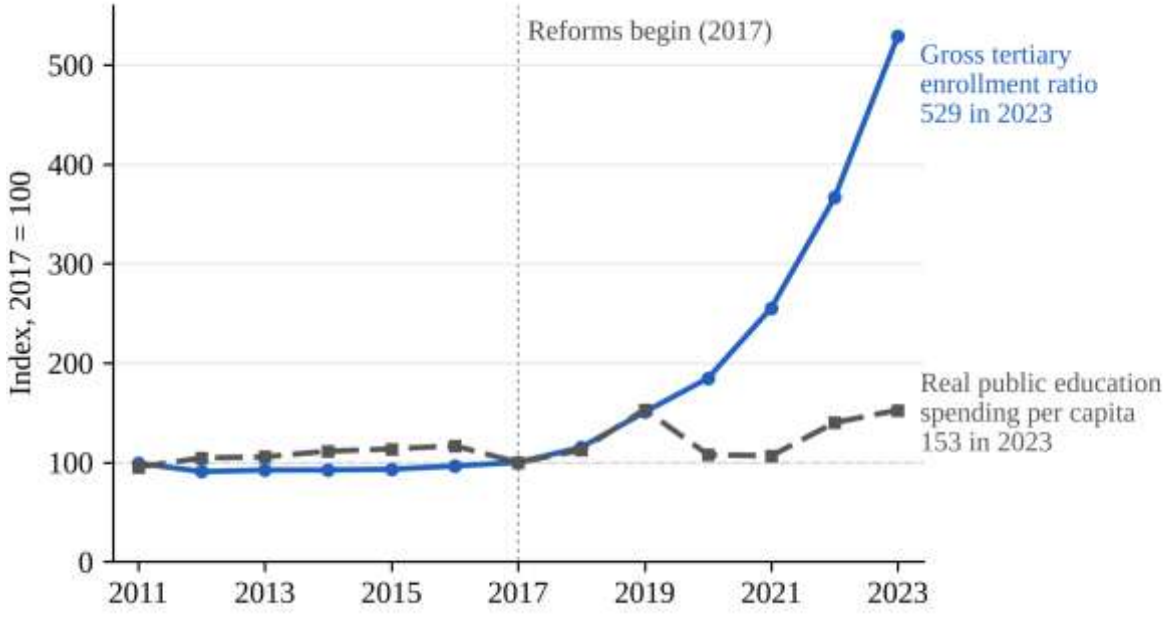


Figure 1. Gross tertiary enrollment ratio and real public education spending per capita in Uzbekistan, 2011–2023 (index, 2017 = 100)

Source: authors' calculations based on World Bank WDI [1] and, for 2011–2012 spending, UNESCO UIS [8].

3.2. A human-capital J-curve

The growth response to enrollment expansion is delayed and J-shaped (Table 1). The contemporaneous effect is close to zero, the effect one year later is negative and significant, and the effect two years later turns positive. Because the dip is deeper than the rebound, the cumulative multiplier after two years is still negative and significant.

Table 1. Lag profile of the growth effect of tertiary enrollment, DL(2) model, 2008–2025 (n = 18)

Years after the enrollment change	**Lag coefficient**	***p*-value**	**Effect of a 10% rise in enrollment on growth, pp**	**Cumulative multiplier**
0	−0.50	0.746	−0.05	−0.50
1	−6.45	0.034	−0.64	−6.94
2	+3.81	0.096	+0.38	−3.14 (p = 0.003)

Source: authors' estimates; Newey–West standard errors.

The shape survives changes in lag length: with three or four lags, the first-year effect stays negative, the second-year effect stays positive, and the cumulative multiplier remains significant at −2.73 to −3.88. The Almon polynomial smooths the profile into an early dip (−2.65 in the current year) followed by positive weights at lags one to three (+0.64, +1.58 and +0.15); its weight at lag four (−3.63) is imprecise.

3.3. No long-run anchor yet, but spending helps

The bounds test finds no cointegration: the F-statistic of 3.43 lies below even the lower 10% critical bound of 3.47 [11]. The only significant long-run component is a trend of 4.8% a year. In the short-run dynamics, a 10% rise in enrollment coincides with

growth roughly one percentage point lower in the same year (coefficient −0.096; p = 0.039), and the 2020 shock cut growth by 4.9 points. Spending pulls in the opposite direction: a 10% higher spending share in the previous year, for example 5.5% instead of 5.0% of GDP, is associated with growth about 0.3 percentage points higher (coefficient 3.40; p = 0.078; n = 13).

4. Conclusions and policy implications

Uzbekistan's leap from elite to universal higher education has not yet paid off in growth, and the evidence suggests that a quick payoff was never likely. The growth response follows a human-capital J-curve: a dip one year after an enrollment surge, a rebound in the second year, and a cumulative effect that is still negative in data up to 2025. The large cohorts admitted in 2019–2021 entered the labor market only in 2023–2025, so most of the dividend still lies ahead. Its size will depend on choices made now:

1. **Fund the bottom of the curve.** Public education resources grew about 1.5-fold while enrollment grew more than fivefold. Linking higher education funding to student numbers and raising public education spending to at least 6% of GDP would protect quality during the dip.

2. **Shorten the lag.** Internships, dual education and programs co-designed with employers move graduates into productive work sooner and pull the rebound forward.

3. **Measure quality, not only coverage.** Accreditation results, learning outcomes and graduate employment rates should become headline indicators next to enrollment, because skills rather than years of schooling drive growth [6].

4. **Budget with the lag in mind.** Returns to education investment appear two to four years after admission, so assessing them within one budget cycle understates them.

The estimates rest on short samples of 13–25 observations, and the expansion coincided with currency liberalization, wider reforms and the pandemic, so the results are indicative rather than definitive. They should be re-estimated as data up to 2030

become available, ideally with regional panels and direct measures of graduates' skills. The J-curve is not a verdict against mass higher education; it is a reminder that its dividend must be financed and organized.

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