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The Production Function of Uzbekistan's Economic Growth: Estimating the Output Elasticities of Capital and Labour (2010–2025)

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Abstract

This paper estimates the sources of Uzbekistan's economic growth in 2010–2025 with a Cobb–Douglas production function. It uses the official series of real GDP, gross fixed capital formation and employment revised by the National Statistics Committee to the 2008 System of National Accounts, and the capital stock is built by the perpetual inventory method. The model is estimated in annual growth rates, allowing for the 2017 structural break and the pandemic, by least squares and Bayesian methods. The output elasticity of capital is 0.35 (95% credible interval 0.19–0.52) and that of labour 0.65, whereas a conventional regression in levels shows the symptoms of a spurious regression ($\beta \approx 2.0$). Total factor productivity (TFP) accounted for 57% of growth in 2011–2016, but capital accounted for 60% in 2017–2025, as TFP growth slowed from 4.2% to 1.7% a year and the incremental capital–output ratio (ICOR) rose from 2.2 to 4.3. In a backtest, the one-year-ahead forecast error of the model averaged 1.0 percentage point, and that of its combination with a simple benchmark 0.6 points. The baseline scenario projects GDP growth of 7.6% in 2026 and 6.0–6.5% a year in 2027–2030. The results point to the need to raise the efficiency of investment and to restore TFP growth.

Keywords

production function; Cobb–Douglas function; output elasticity of capital; output elasticity of labour; total factor productivity; Bayesian estimation; forecasting; Uzbekistan.

JEL classification: C11; C22; C53; E23; O47; O53.

1. Introduction

Between 2010 and 2025, Uzbekistan's real GDP increased 2.62-fold, which corresponds to average growth of 6.6% a year [1]. The reforms launched in 2017, which liberalised the foreign exchange market, prices and the foreign trade regime, gave a strong push to investment: the share of gross fixed capital formation in GDP rose from 21.4% in 2010 to 34.0% in 2025. The "Uzbekistan–2030" strategy, adopted in 2023 and updated in 2026, sets ambitious targets for the size of the economy and for income per capita. Whether such targets can be met depends on what is driving growth. Growth that rests on capital accumulation slows down over time because of diminishing returns to capital [2], whereas the main source of sustained long-run growth is total factor productivity (TFP) [3, 4].

In applied work on Uzbekistan, the production function is often estimated in nominal terms, with annual investment in place of the capital stock and with no allowance for technical change. Regressions of this kind between trending series give spurious results despite a high coefficient of determination [5]. With official data, for instance, a simple regression in levels puts the elasticity of output with respect to labour at 2.0 (Table 3). This value is at odds with economic theory, since it implies that a 1% rise in employment raises output by 2%.

Studies of Uzbekistan usually take the elasticity of capital to be 0.3–0.4 or estimate it from panel data for Central Asia [6–8], and international organisations note that growth has been driven mainly by capital [9]. What is still missing is research that uses the official series revised to include the non-observed economy, covers the period up to 2025, applies methods that give stable estimates in small samples and links the sources of growth to the structural break of 2017.

The aim of this study is to obtain reliable estimates of the output elasticities of capital and labour in a Cobb–Douglas production function [10] from official data for 2010–2025, to identify the sources of economic growth and to produce backtested forecasts for 2026–2030. To this end, (i) real GDP, real investment and the capital stock are derived from the official series, the capital stock by the perpetual inventory method [11]; (ii) the production function is estimated with methods that deal with spurious

regression and small-sample problems; (iii) growth is decomposed into the contributions of capital, labour and TFP; and (iv) the forecasting accuracy of the model is checked in a backtest and scenario forecasts are constructed.

Three hypotheses are tested. **H1**: the output elasticity of capital lies within the range of 0.3–0.4 found in international studies [12, 13]. **H2**: after 2017, growth relied more heavily on capital accumulation, while TFP growth slowed down. **H3**: combining the production-function forecast with a simple statistical forecast improves forecasting accuracy [14].

The study contributes to the literature in four ways. First, the elasticities are estimated from the official 2010–2025 series revised to the 2008 System of National Accounts (SNA). Second, it applies a Bayesian approach [15] that combines international evidence, used as prior information, with the data, which is especially useful for short series, and it shows how sensitive the results are to the prior. Third, it quantifies the shift in 2017 from a TFP-driven to a capital-driven growth model. Fourth, its forecasts are backtested and reported with uncertainty intervals. In practical terms, the results can be used in designing investment and growth policy and in medium-term macroeconomic forecasting.

The paper is organised as follows. Section 2 reviews the literature, Section 3 describes the data and methods, Section 4 presents the results, Section 5 discusses them and Section 6 concludes.

2. Literature review

The production-function approach goes back to Cobb and Douglas, who fitted their function to data for US manufacturing [10]. In the neoclassical growth model, Solow showed that capital accumulation runs into diminishing returns [2]; in a later paper he isolated the part of growth that factor inputs do not explain as technical change, that is, the TFP residual [3]. Development accounting has since shown that a large part of the cross-country differences in labour productivity reflects differences in efficiency rather than in capital [4].

In measuring the elasticities, factor income shares serve as the main benchmark. Gollin showed that once the mixed income of the self-employed is added to labour

income, the labour share across countries lies between 0.65 and 0.80 [12]. Bosworth and Collins set the capital share at 0.35 in their growth accounting for 84 countries [13]. The Penn World Table has made the construction of capital stocks by the perpetual inventory method standard practice [11]. The depreciation rate depends on the asset composition of capital, and empirical studies typically use rates of 4–6% [4]. When the data series is short, the initial capital stock is often derived from a steady-state condition.

Evidence for Uzbekistan and Central Asia points to a large role of capital accumulation. With $\alpha = 0.4$, Yormirzoev et al. attribute 2.93 percentage points of Uzbekistan's annual growth of 5.7% to capital, 1.63 points to labour and 1.15 points to TFP [7]. In a panel of Central Asian countries, Ataev estimates the elasticities of capital and labour at 0.54 and 0.40 and reports that TFP growth in Uzbekistan was 1.56% a year in 2008–2016 but turned negative in 2017–2019 [8]. The World Bank applied $\alpha = 0.3$ to Uzbekistan and showed that domestic estimates range from 0.25 to 0.39 [6]. More recent World Bank Group work stresses that growth has relied mainly on capital accumulation, with a small contribution from TFP [9].

Recent econometric work on Uzbekistan has examined other aspects of its growth and macroeconomic adjustment. Farmonov et al. [16] trace how gold and cotton price shocks pass through to exports and international reserves in this gold-dependent economy and find that the short-run elasticity of reserves with respect to the gold price nearly doubled after 2017, which points to the same reform-related break that is central to the present paper. Farmonov and Rakhimov [17] use dynamic panel models for the regions to measure how inflation and unemployment affect the real growth of household incomes and to forecast that growth. Mardonova and Farmonov [18] examine the links between education expenditure, tertiary enrolment and economic growth in an augmented Solow framework estimated by the ARDL method, and Jidelbekova and Farmonov [19] analyse urbanisation, economic growth and electricity consumption with ARDL models and the Toda–Yamamoto causality test. None of these studies, however, estimates the aggregate production function or decomposes growth into the contributions of capital, labour and TFP.

On the methodological side, regressions between trending series may be spurious, and a coefficient of determination that exceeds the Durbin–Watson statistic is a warning sign [5]. Unit-root tests have little power in short samples and are biased towards non-rejection of a unit root when the series contain structural breaks; if the break date is unknown, it can be estimated from the data. Small-sample inference therefore relies on heteroskedasticity- and autocorrelation-consistent (HAC) standard errors and on the wild bootstrap, while the Bayesian approach allows external evidence to enter the analysis transparently, as a prior distribution, when data are scarce [15]. Forecasts are compared with absolute and squared error measures, and combinations of forecasts from different models are usually more accurate than the individual models [14].

The literature, then, has yet to estimate the elasticities for Uzbekistan from the revised 2010–2025 data while dealing with spurious-regression and small-sample problems, and to analyse the change in the sources of growth after 2017 together with forecasts. This study seeks to fill that gap.

3. Methodology

3.1. Data

The study draws on official annual series from the statistical information system (SIAT) of the National Statistics Committee (Table 1) [1]. All series have been revised in line with the 2008 SNA methodology to include the non-observed economy. Real GDP at 2025 prices is obtained by chain-linking GDP at current prices and GDP at previous-year prices:

$$Y_{t-1} = Y_t \, Y_{t-1}^{\text{nom}} / Y_t^{\text{pr}} \qquad (1)$$

where Y_t^{nom} is GDP at current prices, Y_t^{pr} is GDP at previous-year prices and $Y_{2025} = Y_{2025}^{\text{nom}}$. Real investment ($I_t$) is computed in the same way from the official volume indices of gross fixed capital formation.

Table 1. Variables and data sources

Symbol	Indicator	Unit	Source (SIAT code)
Y	Real GDP (chain-linked, 2025 prices)	bn soum	1.01.01.0001; 1.01.01.0005
I	Gross fixed capital formation (real)	bn soum	1.01.02.0007; 1.01.02.0025
K	Capital stock (perpetual inventory method)	bn soum	Computed from Eqs. (2)–(3)
L	Employment in the economy	thousand persons	2.02.01.1600
R, P	2017–2025 regime; 2020 (pandemic)	0/1	—

Note: SIAT is the statistical information system of the National Statistics Committee (siat.stat.uz); data retrieved on 31 October 2026. All series are revised in line with the 2008 SNA methodology (including the non-observed economy); employment for 2025 is preliminary.

3.2. Capital stock

The capital stock is computed by the perpetual inventory method [11]:

$$K_t = (1-\delta)K_{t-1} + I_t \qquad (2)$$

$$K_{2010} = \kappa\, Y^{\text{nom}}_{2010} / P^{I}_{2010} \qquad (3)$$

where δ is the depreciation rate, κ is the nominal capital–output ratio in 2010 and P^{I}_{2010} is the investment deflator (2025 = 1). The baseline calculations use $\delta = 0.05$ (the midpoint of the 4–6% range applied in empirical studies) and $\kappa = 2.5$. Two bounding estimates are available for κ. The Penn World Table 11.0 puts Uzbekistan's nominal capital–output ratio in 2010 at 5.5 [11], but the capital dynamics in this database do not match the official investment shares. The residual book value of fixed assets on enterprise balance sheets, on the other hand, was equal to 0.78 of GDP in 2024 [1]; these are accounting values, however, and they understate capital. Section 4.4 reports how sensitive the results are to κ and δ, together with the results obtained when the initial capital stock is derived from the steady-state condition.

3.3. Production function

The production possibilities of the economy are represented by the Cobb–Douglas function [10]:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} \qquad (4)$$

where A_t is TFP, and α and β are the output elasticities of capital and labour, respectively. The static log-linear model commonly used to estimate them is

$$\ln Y_t = c + \alpha \ln K_t + \beta \ln L_t + u_t \qquad (5)$$

This model ignores TFP dynamics and may produce spurious results for trending series [5]. The main model is therefore obtained by taking logarithms of (4) and then first differences:

$$\Delta \ln Y_t = \mu_0 + \mu_1 R_t + \alpha\, \Delta \ln K_t + \beta\, \Delta \ln L_t + \gamma P_t + \varepsilon_t \qquad (6)$$

where TFP growth is written as $\Delta \ln A_t = \mu_0 + \mu_1 R_t + \gamma P_t + \varepsilon_t$. The dummy variable R_t equals 1 in 2017–2025 and captures the reform regime that began with the liberalisation of the foreign exchange market in September 2017; P_t equals 1 in 2020 and captures the pandemic shock. The break year was also checked by minimising the residual sum of squares over 2013–2022. Under constant returns to scale (CRS), that is, $\alpha + \beta = 1$, the model takes the per-worker form:

$$\Delta \ln(Y_t/L_t) = \mu_0 + \mu_1 R_t + \alpha\, \Delta \ln(K_t/L_t) + \gamma P_t + \varepsilon_t \qquad (7)$$

3.4. Estimation methods

Models (5)–(7) are estimated by ordinary least squares (OLS). Standard errors are computed by the Newey–West method (two lags), which makes them robust to autocorrelation and heteroskedasticity. Because the sample is small, the confidence interval for α is also obtained by the wild bootstrap with Rademacher weights (9,999 replications). The residuals are checked with the Breusch–Godfrey (autocorrelation), Breusch–Pagan (heteroskedasticity), Jarque–Bera (normality) and RESET (functional form) tests. The stationarity of the series is assessed with the ADF and KPSS tests, and the critical values of the ADF test are computed by Monte Carlo simulation for the exact sample size.

To estimate the elasticities more stably in a short series, models (6) and (7) are also estimated by Bayesian methods [15]:

$$p(\theta, \sigma^2 \mid y) \propto p(y \mid \theta, \sigma^2)\, p(\theta)\, p(\sigma^2), \quad \alpha \sim N\left(0.35,\, 0.10^2\right) \tag{8}$$

where θ is the vector of model coefficients. The prior for capital is based on the capital share reported in international studies [4, 12, 13]. In the unrestricted model (6), the prior for labour is $\beta \sim N\left(0.65,\, 0.10^2\right)$. Wide $N(0,1)$ priors are used for the other coefficients and a non-informative inverse gamma prior for the variance. The posterior distribution is obtained with the Gibbs sampler from 20,000 draws retained after 5,000 burn-in iterations. The influence of the prior is checked with alternative prior distributions.

3.5. Growth accounting and forecasting

On the basis of the estimated elasticity, GDP growth is decomposed into factor contributions, and the efficiency of capital is assessed with the incremental capital–output ratio (ICOR):

$$\Delta \ln Y_t = \alpha\, \Delta \ln K_t + (1-\alpha)\, \Delta \ln L_t + \Delta \ln A_t \tag{9}$$

$$\mathrm{ICOR}_t = I_t / (Y_t - Y_{t-1}) \tag{10}$$

Forecast accuracy is tested in a backtest. Growth in each year from 2021 to 2025 is forecast one year ahead by the model re-estimated only on the data available up to the previous year. The forecasts are compared over the H years by the mean absolute error and the root mean squared error:

$$\mathrm{MAE} = H^{-1} \sum_T |\hat{g}_T - g_T|, \quad \mathrm{RMSE} = \left(H^{-1} \sum_T (\hat{g}_T - g_T)^2\right)^{1/2} \tag{11}$$

Three simple models serve as benchmarks: the average growth of previous years (drift), an AR(1) model and the previous year's growth. An equally weighted combination of the production-function and drift forecasts is also evaluated [14]. In the 2026–2030 scenarios, capital is driven by the real share of investment in GDP, s:

$$K_t = (1-\delta) K_{t-1} + s\, Y_t \tag{12}$$

GDP is then simulated 20,000 times with parameters drawn from the posterior distribution of the Bayesian estimate of model (7) and with random shocks.

4. Results

4.1. Output and factor dynamics

In 2010–2025, real GDP increased 2.62-fold, the capital stock 3.24-fold and employment 1.28-fold (Fig. 1), so that GDP per employed person rose 2.04-fold. The

two subperiods differ sharply. In 2011–2016, GDP grew by 7.6% a year on average, capital by 5.0% and employment by 2.3%. In 2017–2025, GDP growth slowed to 6.0% and capital growth accelerated to 10.3%, while employment grew by 1.3% a year.

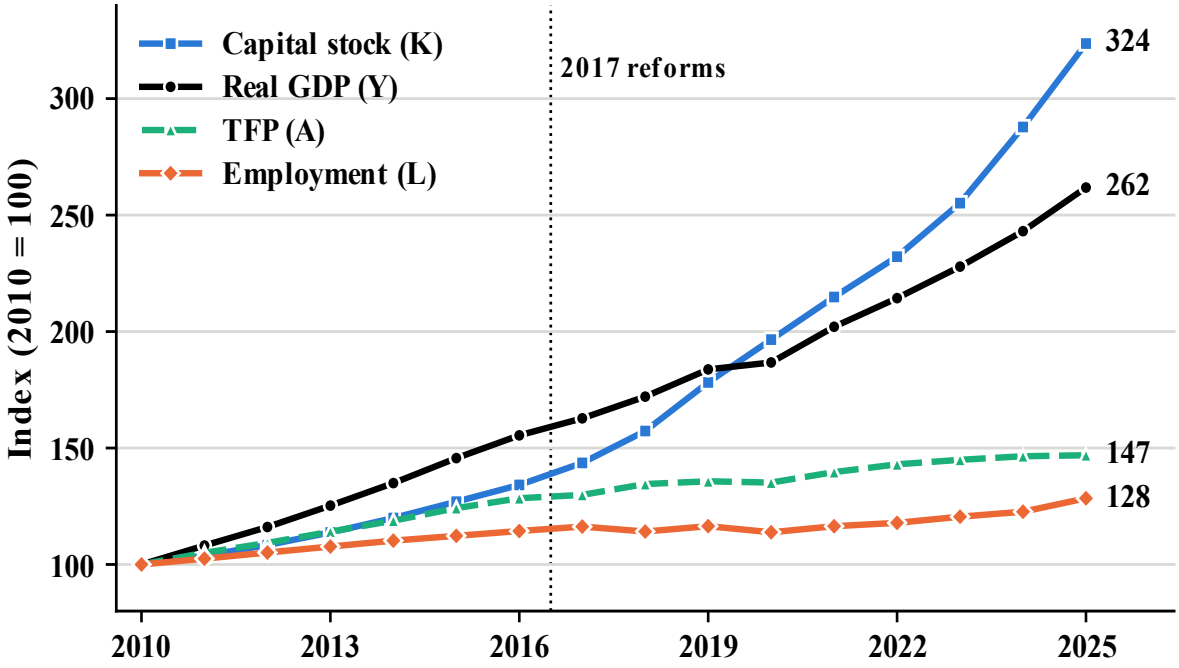

Fig. 1. Indices of real GDP, capital stock, employment and TFP (2010 = 100). Source: author's calculations based on SIAT data.

The rise in investment activity went hand in hand with a fall in its efficiency (Fig. 2). The share of real investment in GDP (at 2025 prices) rose from an average of 15.3% in 2011–2016 to 26.1% in 2017–2025, and the ICOR increased from 2.2 to 4.3 (excluding 2020). In other words, after 2017 roughly twice as much investment was needed for each additional unit of GDP growth.

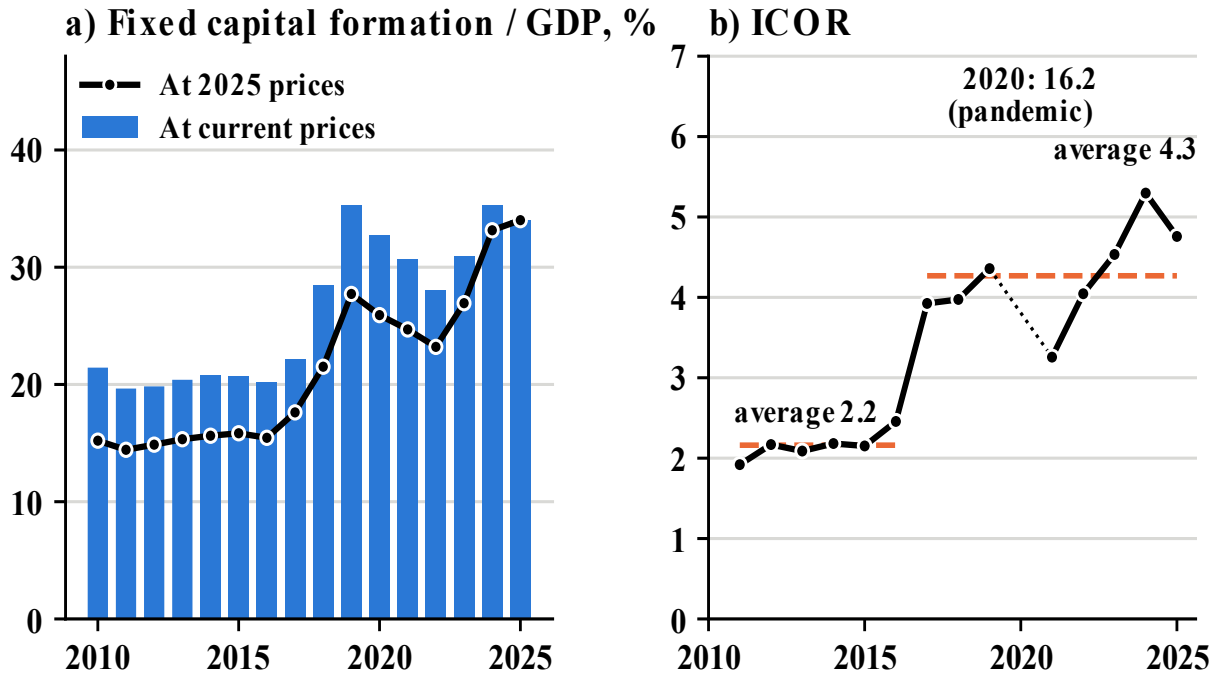

Fig. 2. Share of gross fixed capital formation in GDP (a) and ICOR (b), 2010–2025. Source: author's calculations based on SIAT data.

4.2. Unit root tests

In log levels, the ADF test does not reject the unit-root hypothesis (Table 2), whereas the growth rates of GDP and of GDP per worker are stationary. For the growth rate of capital, the ADF test does not reject a unit root. This is a consequence of the structural break associated with the post-2017 investment boom, under which the ADF test has low power. The KPSS test does not reject the stationarity of the growth of the capital–labour ratio. The main model is therefore estimated in growth rates, and the 2017 break is captured by R_t.

Table 2. Results of the unit root tests

Variable	ADF, level (lags)	KPSS, level	ADF, first difference (lags)	KPSS, first difference
ln Y	−2.48 (0)	0.134	−3.76 (0)	0.236
ln K	−1.59 (2)	0.174	−1.20 (0)	0.537
ln L	−2.03 (2)	0.107	−1.00 (1)	0.147
ln (Y/L)	0.72 (2)	0.161	−4.07 (0)	0.421
ln (K/L)	−2.46 (1)	0.162	−1.91 (0)	0.426

Note: The test equation includes a constant and a trend for levels and a constant for first differences; the number of lags is chosen by the AIC (maximum 2). The 5% critical values of the ADF test are computed by Monte Carlo simulation (20,000 replications) for the exact sample size: −4.35 for levels (T = 16) and −3.56 for differences (T = 15). The 5% critical values of the KPSS test are 0.146 with a trend and 0.463 with a constant.

4.3. Production function estimates

The static model in levels (5) shows the typical symptoms of a spurious regression (Table 3, M1). The coefficient of determination is 0.988, but the Durbin–Watson statistic is only 0.68. The labour elasticity is 2.01 and the sum of the elasticities 2.44, which has no economic justification. The reason is that TFP growth is left out: its effect is absorbed by the coefficient on employment, which also trends upwards.

In the unrestricted growth-rate model (M2), $\alpha = 0.16$ and $\beta = 0.27$, and the F-test rejects the CRS restriction (F = 10.3). The low labour coefficient may reflect noise in annual employment changes: employment fell by 1.8% in 2018 and by 2.3% in 2020 and, according to preliminary data, rose by 4.6% in 2025. Measurement errors of this kind bias the coefficient towards zero. The Bayesian unrestricted model (M4) puts the sum of the elasticities at 0.82, and its 95% credible interval (0.58–1.08) contains one; CRS is therefore imposed in the rest of the analysis.

Table 3. Production function estimates

	M1 OLS, levels	**M2 OLS, growth**	**M3 OLS, growth, CRS**	**M4 Bayes, growth**	**M5 Bayes, growth, CRS**
α (capital)	0.436*** (0.049)	0.162 (0.155)	0.368* (0.186)	0.270 [0.105, 0.443]	0.355 [0.187, 0.520]
β (labour)	2.007*** (0.329)	0.266** (0.114)	0.632 (1 − α)	0.551 [0.373, 0.736]	0.645 [0.480, 0.813]
c (constant)	−11.418*** (2.652)	—	—	—	—

μ_0 (TFP growth 2011–2016), pp	—	5.96*** (0.67)	4.14*** (0.59)	4.80 [3.55, 5.93]	4.17 [3.18, 5.13]
μ_1 (R: 2017–2025 regime), pp	—	−1.69 (0.99)	−2.52** (1.08)	−2.08 [−3.45, −0.83]	−2.45 [−3.88, −0.96]
γ (P: 2020), pp	—	−3.65*** (0.27)	−2.19** (0.82)	−2.52 [−4.52, −0.35]	−2.12 [−4.45, 0.23]
$\alpha + \beta$	2.444	0.428	1 (restriction)	0.822 [0.582, 1.077]	1 (restriction)
CRS test: F (p)	—	10.35 (0.009)	—	P(α+β>1) = 0.08	—
R^2 / σ	0.988 / 0.0347	0.852 / 0.0074	0.387 / 0.0101	— / 0.0090	— / 0.0104
Durbin–Watson	0.68	—	1.86	—	—
Observations	16	15	15	15	15

Note: M1 is Eq. (5) (levels, 2010–2025); M2 and M4 are Eq. (6), and M3 and M5 are Eq. (7) with constant returns to scale (CRS) imposed (annual log growth rates, 2011–2025). OLS columns report Newey–West standard errors (two lags) in parentheses; ***, ** and * denote significance at the 1, 5 and 10% levels. Bayesian columns report posterior means and 95% credible intervals; priors: $\alpha \sim N(0.35, 0.10^2)$, $\beta \sim N(0.65, 0.10^2)$, other coefficients ~ N(0, 1). μ_0 is TFP growth in 2011–2016, and μ_1 and γ are the regime and pandemic effects (in percentage points, pp); σ is the standard deviation of the regression residuals (in log units).

With CRS imposed, the OLS estimate of the capital elasticity (M3) is 0.368 (Newey–West p = 0.073), and its wild bootstrap confidence interval is 0.05–0.69. TFP grew by 4.1% a year in 2011–2016 and slowed by 2.5 percentage points in 2017–2025

(p = 0.040). The residuals show no autocorrelation (Breusch–Godfrey p = 0.83), heteroskedasticity (Breusch–Pagan p = 0.16) or departure from normality (Jarque–Bera p = 0.66), and the functional form is adequate (RESET p = 0.93). The residual sum of squares reaches its minimum in 2017, so the data themselves confirm the break year.

In the Bayesian CRS model (M5), chosen as the main model, the elasticity of capital is 0.355 (95% credible interval 0.19–0.52) and that of labour 0.645. TFP growth is 4.2% in 2011–2016 and 1.7% in 2017–2025 (95% interval 0.2–3.3%). The posterior distribution agrees with both the prior and the OLS estimate but is narrower than either (Fig. 3). The data are thus consistent with the international evidence, and the prior information sharpens the estimate. Hypothesis H1 is therefore confirmed.

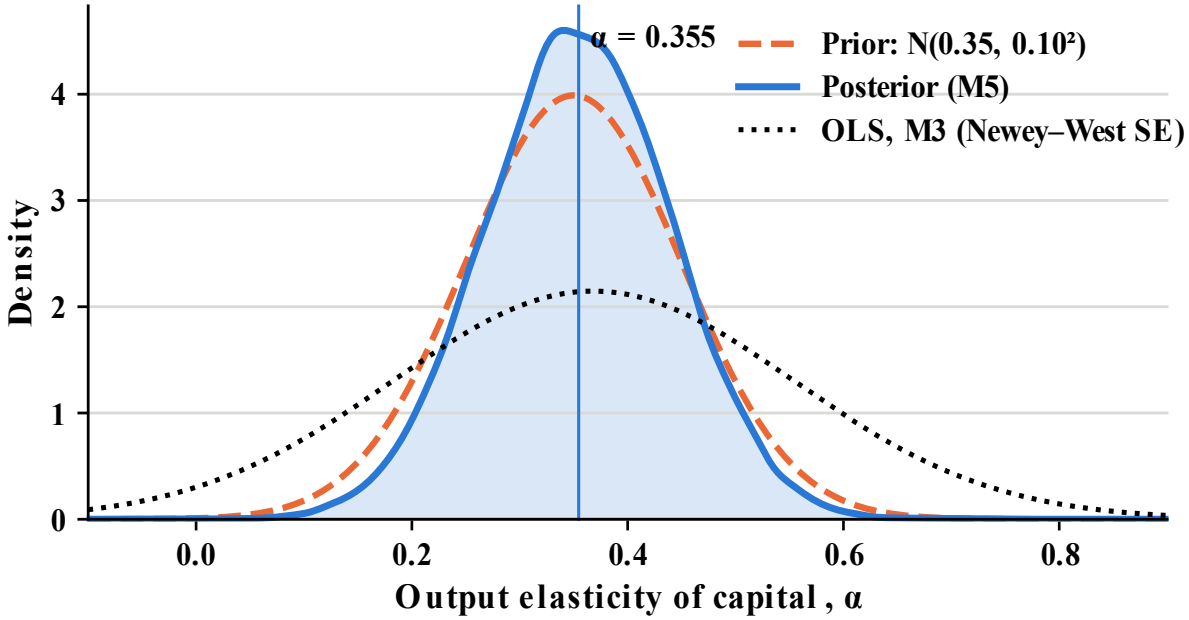

Fig. 3. Prior and posterior distributions of the output elasticity of capital and the OLS estimate (models M3 and M5). Source: author's calculations.

4.4. Robustness of the results

The estimate of α is insensitive to the assumptions used to construct the capital stock and to the composition of the sample (Table 4). The OLS estimates range from 0.33 to 0.49 and the Bayesian estimates from 0.34 to 0.38. When the prior mean is varied from 0.30 to 0.40, the posterior mean stays within 0.32–0.39, and under an almost uninformative prior it equals 0.37. In all specifications, TFP growth slows by 2.0–2.8 percentage points after 2017, and the change is statistically significant at least at the 10% level.

Table 4. Robustness of the estimate of α

Specification	**α, OLS (SE)**	**α, Bayes (SD)**	**TFP growth 2011–2016, %**	**μ_1, pp**
Baseline ($\kappa = 2.5$, $\delta = 0.05$)	0.368 (0.186)	0.356 (0.086)	4.14	−2.52**
$\kappa = 2.0$	0.377 (0.188)	0.359 (0.084)	3.44	−2.25*
$\kappa = 3.0$	0.352 (0.187)	0.351 (0.087)	4.64	−2.60**
Steady-state initial capital ($\kappa \approx 1.7$)	0.373 (0.190)	0.358 (0.083)	2.95	−1.96*
$\delta = 0.04$	0.413 (0.193)	0.368 (0.086)	3.71	−2.52**
$\delta = 0.06$	0.325 (0.176)	0.343 (0.085)	4.49	−2.48**
Construction lag: I_{t-1}	0.486 (0.190)	0.376 (0.091)	4.09	−2.80***
Excluding 2025	0.328 (0.197)	0.343 (0.084)	4.24	−2.09*
Excluding 2020 (instead of dummy P)	0.368 (0.173)	0.355 (0.085)	4.14	−2.52**
Prior $\alpha \sim N(0.30, 0.10^2)$	—	0.318 (0.084)	—	—
Prior $\alpha \sim N(0.40, 0.10^2)$	—	0.390 (0.084)	—	—
Prior $\alpha \sim N(0.35, 0.20^2)$	—	0.360 (0.126)	—	—
Prior $\alpha \sim N(0.35, 1.00^2)$, almost uninformative	—	0.367 (0.171)	—	—

Note: Models M3 (OLS) and M5 (Bayesian); κ is the nominal capital–output ratio in 2010 and δ the depreciation rate. Newey–West standard errors for OLS; μ_1 is the change in TFP growth in 2017–2025 (M3); ***, ** and * denote significance at the 1, 5 and 10% levels. The prior sensitivity analysis is performed for model M5 on the baseline data.

4.5. Sources of economic growth

Growth accounting shows that the growth model changed fundamentally in 2017 (Table 5, Fig. 4). In 2011–2016, average annual log growth of GDP was 7.4%, of which 4.2 percentage points (57%) came from TFP, 1.7 points from capital and 1.4 points from labour. In 2017–2025, the contribution of capital rose to 3.5 points (60%), whereas that of TFP fell to 1.5 points (26%). TFP increased by 47% in total over 2010–2025, but most of this increase occurred before 2017 (Fig. 1). These results confirm hypothesis H2.

Table 5. Sources of economic growth (annual averages, percentage points)

Period	GDP growth, %	Capital contribution	Labour contribution	TFP contribution
2011–2016	7.35	1.74 (24%)	1.44 (20%)	4.17 (57%)
2017–2025	5.79	3.47 (60%)	0.83 (14%)	1.49 (26%)
2011–2025	6.42	2.78 (43%)	1.08 (17%)	2.56 (40%)

Note: Eq. (9) with α = 0.355 (posterior mean of model M5); growth rates are log differences (Δln × 100); shares in GDP growth are given in parentheses. The TFP contribution is computed as a residual and includes the effect of the 2020 pandemic.

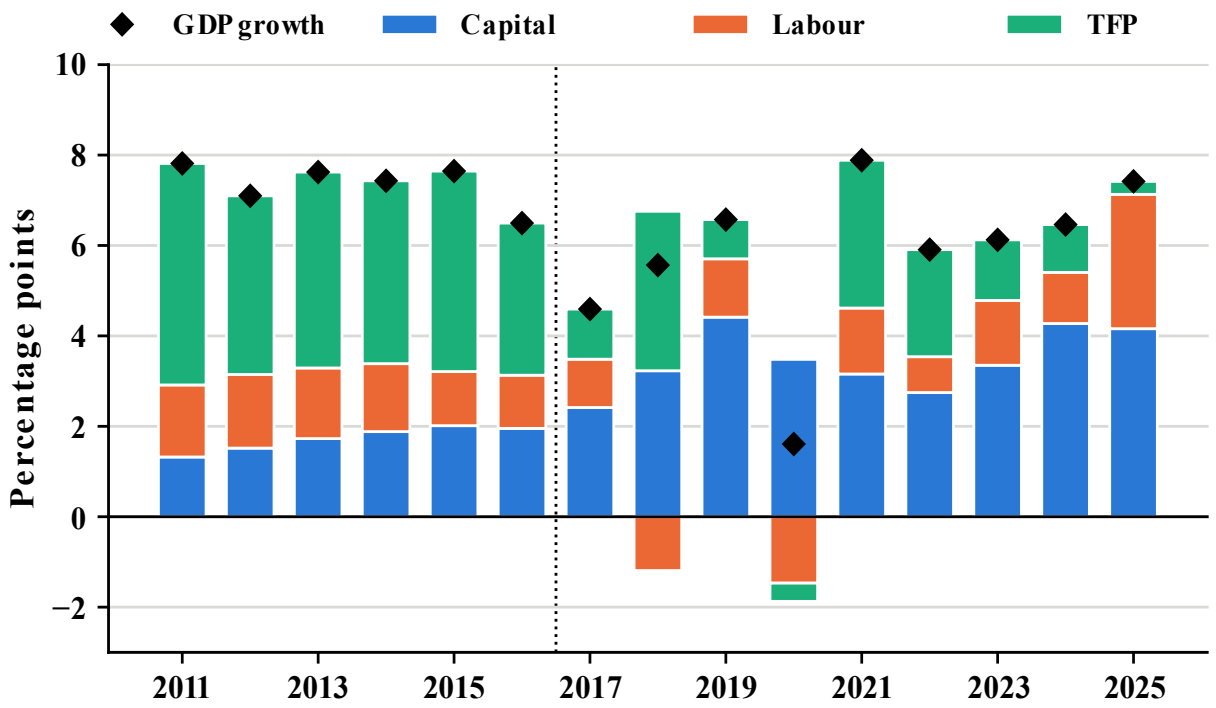

Fig. 4. Sources of real GDP growth, 2011–2025 (percentage points). Source: author's calculations.

4.6. Forecast accuracy and scenarios for 2026–2030

In the backtest, the production function forecast growth one year ahead with an average error of 1.05 percentage points (Table 6). This is more accurate than the AR(1) model (1.37) and the previous-year benchmark (1.95), but less accurate than the drift model (0.71). The model overpredicted growth in 2023–2025: capital accumulation accelerated sharply in these years, but GDP growth did not rise to the same extent, in line with the increase in the ICOR. The equally weighted combination of the two forecasts was the most accurate, with an MAE of 0.60 percentage points and a mean error close to zero. This confirms hypothesis H3.

Table 6. Backtest forecast accuracy (2021–2025, one step ahead)

Model	MAE, pp	RMSE, pp	Mean error, pp
Production function, Bayes (M5)	1.05	1.17	0.38
Production function, OLS (M3)	1.12	1.25	0.34
Average growth (drift)	0.71	0.91	−0.43
AR(1) model	1.37	2.33	−1.23
Naive (previous year's growth)	1.95	2.98	−1.16

Combination: M5 and drift, 50/50	0.60	0.78	−0.02

Note: GDP growth in each year is forecast one step ahead by the model re-estimated on the data available up to the previous year; the production-function forecasts are conditional on the actual growth of capital and labour. pp, percentage points.

The scenario forecasts are reported in Table 7 and Fig. 5. In the baseline scenario, GDP grows by 7.6% in 2026 (80% interval 6.1–9.2%), supported by the real growth of fixed capital investment of 20.1% in January–September 2026 [1]. Growth then declines gradually from 6.5% to 6.0% because of diminishing returns: as capital grows faster than GDP, each additional unit of capital adds less to growth. As a result, real GDP in 2030 is 37% higher than in 2025. These estimates are close to the October 2026 forecasts of the International Monetary Fund (7.8% for 2026 and 6.5% for 2027) and the World Bank (7.9% and 7.5%). GDP growth of 8.3% in January–September 2026 [1] supports the upper part of the forecast interval for 2026. In the optimistic scenario (higher TFP growth and investment share), growth is 7.9–8.9%, and in the pessimistic scenario 4.2–6.3%.

Table 7. Real GDP growth forecasts, 2026–2030 (%)

Scenario	**2026**	**2027**	**2028**	**2029**	**2030**	**2030 / 2025, %**
Baseline	7.6 [6.1–9.2]	6.5 [5.0–8.1]	6.3 [4.8–7.9]	6.2 [4.6–7.8]	6.0 [4.4–7.6]	37.2
Optimistic	8.9 [7.4–10.5]	8.5 [6.8–10.1]	8.2 [6.6–9.9]	8.1 [6.5–9.7]	7.9 [6.3–9.6]	49.1
Pessimistic	6.3 [4.8–7.9]	4.7 [3.1–6.2]	4.5 [3.0–6.0]	4.3 [2.8–5.9]	4.2 [2.6–5.8]	26.4
IMF (WEO, October 2026)	7.8	6.5	—	—	—	—
World Bank (October 2026)	7.9	7.5	7.1	—	—	—

Note: Medians and 80% forecast intervals (20,000 Monte Carlo simulations based on the posterior distribution of the parameters of model M5 and random shocks). The real growth of investment in January–September 2026 (+20.1%) is taken into account for 2026. Baseline scenario: real investment/GDP of 33.6% in 2027–2030 (the 2024–2025 average), employment growth of 1.67% (the 2011–2025 average) and TFP growth equal to the posterior mean for the 2017–2025 regime. Optimistic/pessimistic scenarios: investment/GDP ±3 pp, employment growth ±0.3 pp, TFP growth ±1 pp. External forecasts: IMF, World Economic Outlook (October 2026); World Bank, Europe and Central Asia Economic Update (October 2026).

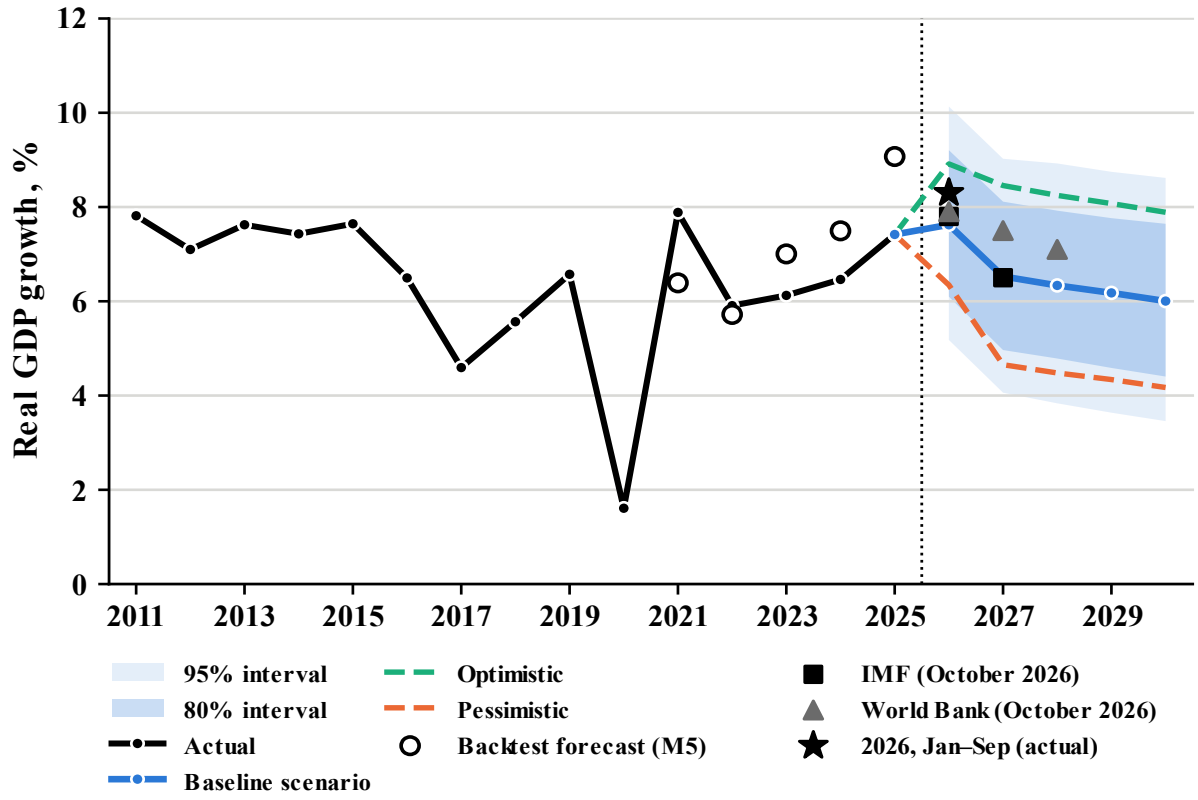

Fig. 5. Real GDP growth: actual values, backtest forecasts and scenarios for 2026–2030 (%). Source: SIAT, IMF and World Bank data; author's calculations.

5. Discussion

The elasticity of capital (0.35) is in line with the value of about one-third adopted in international studies [12, 13] and with the range of domestic estimates for Uzbekistan (0.25–0.39) [6]. It is lower than the estimate from the panel of Central Asian countries (0.54) [8], possibly because panel estimates also absorb structural differences between countries. The elasticity of labour (0.65) is well above the official share of compensation

of employees in GDP (22.3% on average in 2010–2024). This gap is to be expected. A large part of employment in Uzbekistan is in self-employment and the informal sector [6], whose earnings are recorded in the national accounts as mixed income. Once the labour component of mixed income is taken into account, the labour share approaches the range of 0.65–0.80 found by Gollin [12]. Labour elasticities above one obtained from regressions in levels are thus not an economic regularity but the product of a methodological error [5].

The main finding is the shift after 2017 to a growth model that relies on capital accumulation. Although the share of real investment increased 1.7-fold, GDP growth did not accelerate, and TFP growth slowed by 2.4 percentage points a year. This conclusion agrees with the results of Ataev and of the World Bank Group [8, 9]. Over the long run, growth of this kind slows down because of diminishing returns [2]. Several factors may explain the decline in the efficiency of capital. First, housing, energy and infrastructure projects, with long construction and payback periods, account for a large share of investment. Second, a substantial part of investment is allocated through state-owned enterprises and state-guaranteed loans. Third, the liberalisation of the exchange rate and prices in 2017–2018 changed relative prices and set off a reallocation of resources across sectors. Low TFP may also be partly a matter of measurement: the official growth rates before 2017 and the assumption about the initial capital stock may overstate the contribution of TFP in the early period. The results in Table 4, however, show that the TFP slowdown does not depend on these assumptions.

Several implications for economic policy follow. First, growth should be secured by raising the efficiency of investment rather than by expanding its volume further. This calls for competitive project selection and cost–benefit analysis, quality control of public–private partnership projects and reform of state-owned enterprises. Second, restoring TFP growth requires more attention to competition, the quality of institutions, technology adoption and human capital [4]. Third, the forecasts show that if the current investment share and TFP growth are maintained, growth will decline to 6.0% by 2030. Growth of about 8% a year is reached only in the optimistic scenario, in which TFP growth accelerates by about 1 percentage point and the investment share is higher.

The study has limitations. The series is short (16 years), so the OLS estimates are imprecise, and the Bayesian estimates rely partly on prior information (Table 4). The capital stock rests on assumptions about the initial capital–output ratio and the depreciation rate, and labour is measured by the number of employed persons, without adjustment for hours worked or skills. The employment data for 2025 are preliminary. There are also theoretical objections to the aggregate production function, whose parameters depend on restrictive aggregation conditions. Future research could use regional panel data, sector-level estimates and labour input adjusted for human capital, building on augmented Solow models with education variables [18].

6. Conclusions

1. In the Cobb–Douglas function estimated from official data for 2010–2025, the output elasticity of capital is 0.35 and that of labour 0.65. These values agree with international estimates and are insensitive to the assumptions used to construct the capital stock and to the prior distribution.

2. A conventional regression in levels gives spurious results, with a labour elasticity as high as 2.0. Production functions for Uzbekistan should therefore be estimated in growth rates, with TFP dynamics taken into account.

3. After 2017, economic growth shifted from a TFP-based to a capital-based model. The contribution of capital to growth rose from 24% to 60%, TFP growth slowed from 4.2% to 1.7% a year and the ICOR increased from 2.2 to 4.3.

4. Combining the production-function forecast with the drift model reduced the backtest error to 0.60 percentage points. In the baseline scenario, GDP growth is 7.6% in 2026 and slows to 6.0% by 2030.

5. Sustaining high growth rates requires reforms that give priority to raising the efficiency of investment, rather than its volume, and to restoring TFP growth.

Data and code. All data are taken from open official sources. The calculations were carried out in Python (numpy, pandas, scipy, matplotlib). The data set and the code that reproduces all tables and figures are available from the author on request.

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