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THE RELATIONSHIP BETWEEN GREEN INVESTMENT AND ECONOMIC GROWTH: MECHANISMS OF UZBEKISTAN'S TRANSITION TO A LOW-CARBON ECONOMY

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Abstract. This article examines, from both theoretical and empirical perspectives, the relationship between the volume and structure of green investment and the rate of economic growth. Drawing on an augmented Cobb–Douglas production function, the study assesses the contribution of green capital to gross domestic product (GDP) growth and develops three scenarios for Uzbekistan's transition to a low-carbon economy through 2030. A system of financial, institutional, market-based and technological mechanisms for this transition is substantiated.

Keywords: green investment, economic growth, low-carbon economy, green bonds, carbon intensity, renewable energy, Uzbekistan.

INTRODUCTION

Global climate change and the commitments undertaken under the Paris Agreement require national economies to fundamentally reconsider their growth models. International experience has shown that the conventional growth model, reliant on natural resources and fossil fuels, cannot ensure long-term sustainability under environmental constraints. Consequently, the concept of green growth – reconciling the expansion of economic activity with the reduction of adverse environmental impacts – has become central to the strategic documents of many countries [6].

Uzbekistan's economy is among the most energy-intensive: natural gas dominates the national energy mix, and greenhouse gas emissions per unit of GDP are several times higher than in developed countries [11]. To address this challenge, Presidential Resolution No. PQ-4477 of 4 October 2019 approved the Strategy for the Transition of the Republic of Uzbekistan to a Green Economy for 2019–2030, while Presidential Resolution No. PQ-436 of 2 December 2022 set the targets of raising the share of renewable energy sources to 40 percent and reducing greenhouse gas emissions per unit of GDP by 35 percent relative to 2010 levels by 2030 [1; 2].

The aim of this study is to assess the relationship between green investment and economic growth and to substantiate a system of mechanisms for Uzbekistan's transition to a low-carbon economy. The research hypothesis holds that growth in green capital does not slow the pace of economic growth in the short term, while in the medium and long term it exerts a positive effect on GDP growth through total factor productivity.

LITERATURE REVIEW

Research on the relationship between environmental quality and economic growth originates in the Environmental Kuznets Curve hypothesis advanced by G. Grossman and A. Krueger, according to which pollution rises in the early stages of income growth and declines once a certain threshold is

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reached [8]. M. Porter and C. van der Linde argued that environmental regulation stimulates innovation and thereby enhances firms' competitiveness (the "Porter hypothesis") [10].

The Stern Review demonstrated that failure to take timely action against climate change could lead to future losses of 5–20 percent of GDP, whereas preventive investment would amount to roughly 1 percent of GDP [12]. In their model of directed technical change, D. Acemoglu and co-authors showed that a combination of taxes and subsidies can secure the transition to clean technologies without sacrificing economic growth [3]. The positive effect of green finance instruments – green bonds in particular – on firms' environmental performance and market valuation has been confirmed empirically by C. Flammer [7].

Studies of transition economies, including Central Asia, remain relatively scarce and have focused mainly on energy sector reforms and renewable energy potential [11]. The quantitative assessment of green investment's contribution to macroeconomic growth, and its linkage to institutional mechanisms, has received insufficient attention; this gap defines the scientific novelty of the present study.

METHODOLOGY

The study employs a systems approach, comparative and logical analysis, economic and mathematical modelling, and scenario-based forecasting. To assess the effect of green capital on growth, an augmented Cobb–Douglas production function is applied:

$$Y_t = A_t \cdot K_t^{\alpha} \cdot G_t^{\beta} \cdot L_t^{\gamma} \cdot E_t^{-\delta}, \qquad (1)$$

where Y is GDP; A is total factor productivity; K is conventional fixed capital; G is green capital (the accumulated stock of investment in renewable energy, energy efficiency, waste recycling and environmental infrastructure); L is labour; E is energy intensity (energy consumption per unit of GDP); and α, β, γ, δ are elasticity coefficients. Taking logarithms of the function yields the growth-rate equation:

$$gY = gA + \alpha \cdot gK + \beta \cdot gG + \gamma \cdot gL - \delta \cdot gE, \qquad (2)$$

The information base comprises data from the Statistics Agency under the President of the Republic of Uzbekistan, the Ministry of Economy and Finance, the World Bank and the International Energy Agency. The elasticity coefficients were calibrated on the basis of empirical studies of developing countries: $\alpha = 0.35$; $\beta = 0.05$; $\gamma = 0.55$; $\delta = 0.08$. The forecast horizon is 2026–2030.

RESULTS

Modelling was conducted for three scenarios. In the inertial scenario, the share of green investment in total fixed capital investment remains at its current level. The moderate scenario assumes full attainment of the targets set out in government programmes. The accelerated scenario additionally incorporates a carbon pricing mechanism and a sharp expansion of green finance. The results are presented in Table 1.

Table 1. Scenarios for Uzbekistan's transition to a low-carbon economy (2026–2030)

Indicator	I. Inertial	II. Moderate	III. Accelerated
Share of green investment in total investment, %	8–10	15–18	22–25
Annual growth of green capital, %	6–7	12–14	18–20

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Additional contribution of green capital to GDP growth, p.p.	0.30–0.35	0.60–0.70	0.90–1.00
Average annual GDP growth, %	5.5–5.8	6.0–6.4	6.4–6.9
Reduction in energy intensity of GDP (2030/2025), %	8–10	18–22	25–30
GHG emissions per unit of GDP (relative to 2010), %	−20…−22	−30…−35	−36…−40

Source: author's calculations.

According to the calculations, raising the annual growth rate of green capital from 6–7 percent to 12–14 percent adds a further 0.3–0.35 percentage points to GDP growth. The main source of this gain is not direct capital investment as such, but rather the decline in energy intensity and the rise in total factor productivity. As a result, relative decoupling occurs between economic growth and greenhouse gas emissions: GDP continues to grow while its carbon intensity declines steadily.

The analysis found that the greenhouse gas target set by Resolution No. PQ-436 can be achieved only under the moderate and accelerated scenarios. Under the inertial scenario, the outcome falls short of the target by 13–15 percentage points, indicating that current investment rates and mechanisms are insufficient to meet the 2030 goals.

Based on the analysis, the mechanisms for the transition to a low-carbon economy were classified into four groups (Table 2).

Table 2. System of mechanisms for the transition to a low-carbon economy

Type of mechanism	Key instruments	Expected effect
Financial	Sovereign and corporate green bonds, green credit lines, blended finance, interest rate subsidies	Lower cost of capital for green projects
Institutional	Green taxonomy, ESG reporting standards, public–private partnerships, green public procurement	Greater transparency and reduced uncertainty for investors
Market-based	Liberalisation of energy tariffs, carbon pricing, emissions trading	Behavioural change through price signals
Technological and digital	Smart meters, energy management systems, smart city solutions and digital monitoring platforms	Improved energy efficiency and verification of outcomes

Source: developed by the author.

DISCUSSION

The findings are consistent with the conclusions of the Porter hypothesis and the theory of directed technical change [3; 10]: green investment emerges not as a constraint on growth but as a

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source of improvement in its quality. At the same time, the elasticity of GDP with respect to green capital ($\beta \approx 0.05$) is considerably lower than that of conventional capital, suggesting that the effect operates predominantly through long-term and indirect channels — energy savings, reduced import costs and the emergence of new industries.

The following principal constraints on green finance in Uzbekistan were identified: the national green taxonomy is still at the formative stage; commercial banks lack the capacity to appraise green projects; energy tariffs remained below cost-recovery levels for an extended period; and the domestic capital market is shallow. At the same time, the country's placement of Sustainable Development Goal bonds in 2021 and sovereign green bonds in 2023 on the London Stock Exchange, denominated in the national currency, confirms that demand for green instruments exists in international capital markets.

The author's research on social services within the mahalla system indicates that public acceptance of the low-carbon transition depends largely on local-level mechanisms. Measures such as the nationwide "Yashil Makon" (Green Space) project, household solar panel installation programmes and incentives for energy saving prove more effective when implemented through the mahalla institution. It is therefore essential to align energy tariff reform with mechanisms that protect socially vulnerable segments of the population.

The limitations of the study include the absence of separately reported official statistics on green investment and the fact that the elasticity coefficients were determined through calibration. Future research should undertake econometric estimation based on regional panel data.

CONCLUSION

The study leads to the following conclusions. First, there is a positive relationship between green investment and economic growth: under the moderate scenario, growth in green capital adds a further 0.6–0.7 percentage points to GDP growth. Second, if current investment rates persist, the environmental targets set for 2030 will not be met; achieving them requires raising the share of green investment in total investment to at least 15–18 percent. Third, the transition to a low-carbon economy calls for the integrated application of financial, institutional, market-based and technological-digital mechanisms.

The following practical measures are recommended: adopting a national green taxonomy and integrating it into banking supervision requirements; introducing a concessional refinancing facility for green lending by commercial banks; establishing a digital platform to monitor carbon intensity and green investment at the regional level; and aligning energy tariff reform with targeted social protection at the mahalla level.

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