DEVELOPMENT FINANCE INSTITUTIONS AND ECONOMIC GROWTH IN CENTRAL ASIA: A PANEL DATA ANALYSIS OF WORLD BANK AND AIIB FINANCING, 2010–2024

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Abstract

This article examines the statistical association between development finance institution (DFI) lending, foreign direct investment (FDI) inflows, and economic growth in the five Central Asian countries — Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan — over the period 2010–2024. Using a hand-verified panel of 282 individual financing operations of the World Bank and the Asian Infrastructure Investment Bank (AIIB) totalling approximately USD 28.4 billion (World Bank: USD 22.8 billion; AIIB: USD 5.62 billion), the study estimates Pooled OLS, Fixed Effects (FE), and Random Effects (RE) models, selects the preferred specification through the Hausman test, and subjects the results to a battery of panel diagnostics (Levin–Lin–Chu unit-root test, Pesaran CD test, Wooldridge autocorrelation test, variance inflation factors, and clustered robust standard errors). No confirmed New Development Bank (NDB) projects were identified in the region for 2010–2024. The results show that FDI inflows (measured through a signed logarithmic transformation, SLOG_FDI_MLN) are positively and consistently associated with GDP growth across all specifications (FE: $\beta = 0.52$, $p = 0.0024$), whereas World Bank financing shows no statistically significant association in any specification, and AIIB financing shows only borderline significance ($p = 0.073$) under robust estimation. Building on these findings, the study proposes an author-developed Central Asia Development Effectiveness Index (CADEI), disaggregated into an infrastructure module (CADEI-I) and a policy/crisis-response module (CADEI-P), and an integrated framework for selecting development institutions and financing instruments differentiated by country. The findings are intended to inform evidence-based decision-making by government bodies engaged in external financing negotiations.

Keywords: *development finance institutions; World Bank; Asian Infrastructure Investment Bank; Central Asia; economic growth; panel data; foreign direct investment; Fixed Effects; CADEI index.*

JEL Classification: F21, F35, O11, O53, C33

1. Introduction

Over the past decade and a half, the countries of Central Asia — Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan — have remained significant recipients of financing from international development finance institutions (DFIs). The region faces a cluster of interrelated structural constraints: infrastructural deficits, landlocked geography, uneven access to external financing, and country-specific debt sustainability profiles. Within this context, DFIs — both traditional institutions such as the World Bank and comparatively new entrants such as the Asian Infrastructure Investment Bank (AIIB), operational since 2016 — function not merely as sources of capital but as structural elements of the region's broader economic-policy architecture.

The emergence of "new-generation" DFIs alongside traditional institutions raises an independent empirical question: do these institutions exhibit a comparable, distinct, or statistically indistinguishable effect on the economic growth of recipient countries? This question cannot be answered by aggregated analysis that merges heterogeneous institutions into a single "external development finance" indicator; it requires separate estimation of each institution's association with growth. The relevance of the present study stems from the fact that the question of the separate statistical association of a traditional and a new-generation development institution, specifically for Central Asia, has not to date received a systematic empirical answer, even though the cumulative DFI portfolio in the region over 2010–2024 is comparable in magnitude to a substantial share of the GDP of individual countries in the region.

The aim of this study is to assess the statistical association between DFI financing (World Bank and AIIB), FDI inflows, and GDP growth rates in Central Asian countries, and, on this basis, to propose an integrated framework for selecting a development institution and financing instrument. The contribution of the paper is fourfold: (i) it separately estimates the association of World Bank and AIIB financing with growth rather than treating DFI finance as an aggregate; (ii) it constructs a hand-verified, error-corrected panel dataset combining project-level data from both institutions with official World Bank FDI statistics; (iii) it applies a signed logarithmic transformation to the FDI variable, allowing negative net-inflow observations to be retained without data loss; and (iv) it develops the CADEI index and an integrated institution-selection framework grounded in the empirical results.

2. Literature Review

General questions concerning the functioning of DFIs and their macroeconomic effects are addressed in World Bank studies on the typology of national development finance institutions, which define such institutions by three attributes: public ownership or control, an official development mandate, and a long-term financing horizon unavailable to most private lenders (World Bank, 2021). te Velde and Warner (2007) examine the use of subsidised instruments by DFIs in the infrastructure sector. The

empirical effect of multilateral development banks (MDBs) on economic growth has been examined by Broccolini, Lotti, Maffioli, Presbitero, and Stucchi (2021), who document a significant private-capital mobilisation effect, and in a working paper prepared for the UK Department for International Development (ODI/DFID), which finds a positive but structurally heterogeneous association between multilateral financing and growth, conditional on the recipient country's income level.

Institutional differences between traditional and new-generation MDBs — in particular between the AIIB and the New Development Bank (NDB) — are examined in detail by Humphrey (2020) and Wang (2019), while the coordination of new institutions with the existing international development architecture is addressed by Creutz (2023). A regional perspective on Central Asia's structural position vis-à-vis development institutions, incorporating transit potential, water–energy interdependence, and regional security considerations, is offered by Ibodova and Muminov (2020).

A systematic review of this literature, however, indicates that the overwhelming majority of empirical studies either aggregate data across broad, heterogeneous cross-country samples without regional specification, or restrict analysis to a single institution. No study identified in the available literature simultaneously (i) treats Central Asia as a distinct region, (ii) separately estimates the effects of the World Bank and the AIIB, and (iii) applies formal panel econometric methods with diagnostic verification. This gap defines the direction of the present study.

3. Data and Methodology

3.1 Data sources and sample

The empirical base of the study is a balanced panel of five Central Asian countries (Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan) over 2010–2024, comprising 75 country-year observations (5 cross-sections × 15 periods). The panel combines 282 individually verified financing operations of the World Bank and the AIIB, with a combined nominal value of approximately USD 28.4 billion (World Bank: USD 22.8 billion across 257 projects; AIIB: USD 5.62 billion across 26 operations approved since 2016–2017), and official World Bank World Development Indicators (WDI) data on FDI net inflows (indicator BX.KLT.DINV.CD.WD). No confirmed NDB projects in the region were identified for 2010–2024; the corresponding financing variable is therefore uniformly zero across the panel and is not included as a separate regressor.

The raw dataset underwent a multi-stage audit: correction of Excel date serial-number errors in the financing fields, elimination of currency-unit inconsistencies, removal of an impossible AIIB financing record predating the bank's establishment, and replacement of the FDI proxy with official World Bank WDI data. A complete correction log is maintained in the author's verified database.

3.2 Variables and model specification

The dependent variable is the annual real GDP growth rate (GDP_GROWTH, %). The explanatory variables are: the natural logarithm of World Bank financing disbursed in a given country-year (LN_WB); the natural logarithm of AIIB financing disbursed in a given country-year (LN_AIIB); a signed logarithmic transformation of net FDI inflows (SLOG_FDI_MLN = sign(FDI) × ln(1 + |FDI|)), which allows negative net-inflow observations to be retained without loss of data that a conventional log transformation would discard; and the annual inflation rate (INFLATION, %) as a macroeconomic control.

The baseline specification is a linear panel model of the form:

$$GDP\_GROWTH_{it} = \alpha + \beta_1 \cdot LN\_WB_{it} + \beta_2 \cdot LN\_AIIB_{it} + \beta_3 \cdot SLOG\_FDI\_MLN_{it} + \beta_4 \cdot INFLATION_{it} + u_i + \varepsilon_{it}$$

where i indexes country, t indexes year, u_i denotes an unobserved country-specific effect (fixed or random, depending on specification), and ε_{it} is the idiosyncratic error term. Three estimators are compared — Pooled OLS, Fixed Effects (FE), and Random Effects (RE, Swamy–Arora GLS estimator) — with the choice between FE and RE formally adjudicated by the Hausman (1978) specification test. All principal estimations were carried out in EViews (Student Lite); supplementary diagnostics not available in the installed EViews build — the Levin–Lin–Chu (2002) panel unit-root test, the Pesaran (2004) cross-sectional dependence test, the Wooldridge test for serial correlation, and variance inflation factors — were computed in R using the plm package (Croissant & Millo).

4. Empirical Results

4.1 Descriptive statistics and pre-estimation diagnostics

Table 1 reports descriptive statistics for the five panel variables. Mean annual GDP growth across the panel is 5.98%, with a standard deviation of 3.08 percentage points.

Table 1. Descriptive statistics (N = 75)

Statistic	GDP_GROWTH	LN_WB	SLOG_FDI_MLN	INFLATION	LN_AIIB
Mean	5.975	4.014	6.626	8.333	1.013
Median	6.290	4.627	7.161	7.500	0.000
Maximum	14.700	7.366	9.754	20.300	6.989
Minimum	−7.150	0.000	−5.998	0.400	0.000
Std. Dev.	3.079	2.533	2.428	3.900	2.192
Jarque–Bera	74.257	7.513	712.767	5.705	48.565
Probability	0.000	0.023	0.000	0.058	0.000

Source: author's calculations in EViews based on the author's verified panel dataset.

Prior to estimation, a Levin–Lin–Chu panel unit-root test (individual constants, zero lags) was conducted for all five variables to rule out spurious regression on non-stationary series. The test rejects the null hypothesis of a unit root at the 1% level for GDP_GROWTH ($z = -5.17$, $p < 0.001$), INFLATION ($z = -4.31$, $p < 0.001$), and SLOG_FDI_MLN ($z = -2.85$, $p = 0.0022$), confirming stationarity. The test is not computable for LN_AIIB and LN_WB because Turkmenistan records a uniformly zero value for both variables throughout 2010–2024, producing zero within-group variance for that cross-section; this is treated as a structural limitation of the sample composition rather than a computational failure, and is reported transparently as such.

The maximum absolute pairwise correlation among explanatory variables is 0.322 (between LN_WB and LN_AIIB), well below the conventional 0.7–0.8 threshold for concern. Variance inflation factors for all four explanatory variables range between 1.08 and 1.17, substantially below the conventional threshold of 5–10, confirming the absence of problematic multicollinearity.

4.2 Model selection

Table 2 reports the Hausman specification test comparing the Fixed Effects and Random Effects estimators.

Table 2. Hausman specification test

Statistic	Value
Chi-Sq. statistic	26.237
Chi-Sq. d.f.	4
Probability	0.0000
LN_AIIB: Var(Diff) / Prob.	0.0018 / 0.638
LN_WB: Var(Diff) / Prob.	0.0311 / 0.783
SLOG_FDI_MLN: Var(Diff) / Prob.	0.0110 / 0.023
INFLATION: Var(Diff) / Prob.	0.0012 / 0.948

Source: author's calculations in EViews based on the author's verified panel dataset.

The null hypothesis of no systematic correlation between individual effects and regressors is rejected ($\chi^2 = 26.24$, $df = 4$, $p < 0.001$), favouring Fixed Effects. This is reinforced by the Random Effects estimation itself, in which the estimated cross-sectional random component is numerically degenerate ($\rho = 0.0000$), so that RE coefficients coincide numerically with Pooled OLS and fail to capture meaningful cross-country heterogeneity. Fixed Effects is accordingly adopted as the preferred specification for substantive interpretation.

4.3 Regression results

Table 3 presents the baseline Fixed Effects estimates alongside the Pooled OLS benchmark and the cluster-robust Fixed Effects estimates (White period, cross-section clustering).

Table 3. Regression results: Pooled OLS, Fixed Effects, and robust Fixed Effects

Variable	Pooled OLS coef. (p)	Fixed Effects coef. (p)	Robust FE coef. (p)
Constant	5.149 (0.0002)	3.340 (0.0395)	3.340 (0.0654)
LN_AIIB	−0.259 (0.122)	−0.239 (0.116)	−0.239 (0.073)
LN_WB	−0.209 (0.156)	−0.160 (0.464)	−0.160 (0.363)
SLOG_FDI_MLN	0.282 (0.057)	0.520 (0.0024)	0.520 (0.0012)
INFLATION	0.007 (0.940)	0.009 (0.916)	0.009 (0.942)
R^2	0.140	0.385	0.385
Adj. R^2	0.091	0.310	0.310
F-statistic (Prob.)	2.857 (0.0297)	5.162 (0.0001)	—
N	75	75	75

Source: author's calculations in EViews based on the author's verified panel dataset. Robust standard errors computed using the White period estimator with cross-section clustering; EViews reported a rank-deficiency warning for the robust covariance matrix, so robust estimates are used as a supplementary robustness check rather than as the primary result.

Three findings emerge consistently. First, SLOG_FDI_MLN is positively and significantly associated with GDP growth in the Fixed Effects specification (β = 0.520, p = 0.0024), and the coefficient retains both its sign and its statistical significance under cluster-robust standard errors (p = 0.0012) and in a supplementary specification with period (year) fixed effects (β = 0.321, p = 0.0539). This is the most consistent empirical result of the study. Second, LN_WB is statistically insignificant across every specification — Pooled OLS (p = 0.156), Fixed Effects (p = 0.464), robust FE (p = 0.363), and FE with period effects (p = 0.983) — a pattern of consistent non-significance that is itself informative: it does not indicate that World Bank financing is ineffective, but is consistent with a portfolio composition in which roughly 36% of World Bank operations are development policy operations (DPO) and governance-related lending, whose effects are plausibly longer-term and structural rather than captured within the same calendar year. Third, LN_AIIB is insignificant in the baseline FE specification (p = 0.116) but reaches borderline significance at the 10% level under robust estimation (p = 0.073), a result that is sensitive to the standard-error methodology and is accordingly characterised as borderline rather than confirmed.

4.4 Diagnostic tests and robustness

Supplementary diagnostics computed in R (package plm) are reported in Table 4.

Table 4. Panel diagnostic tests

Test	Statistic	p-value	Interpretation
Pesaran CD (cross-sectional dependence)	z = 3.575	0.00035	Cross-sectional dependence in residuals confirmed
Wooldridge test (serial correlation)	F = 3.184	0.079	Borderline evidence of autocorrelation

Source: author's calculations in R (package plm) based on the author's verified panel dataset; full reproducible output is available from the author on request.

The Pesaran CD test result indicates statistically significant cross-sectional dependence in the residuals, implying that conventional standard errors in the Pooled OLS and baseline FE specifications are likely understated and that reported significance levels should be interpreted conservatively; this motivates the parallel use of cluster-robust standard errors as a robustness check. The Wooldridge test result is borderline at the 5% level (p = 0.079) and does not provide strong evidence of first-order autocorrelation, though it cannot be ruled out. Given the short panel dimension (N = 5 cross-sections, T = 15 periods), the asymptotic properties of these diagnostic tests are approximate rather than strictly established, and point estimates of their p-values should not be assigned excessive interpretive weight.

None of the reported associations is interpreted as evidence of a causal effect; all results are characterised strictly in terms of statistical association, and questions of endogeneity and reverse causality are not resolved within the present specification. Formal lag specifications (1–3 year financing lags), which could plausibly capture delayed infrastructure effects — particularly relevant for the borderline AIIB result — were not estimated within the confirmed scope of this study and are identified as a direction for further research rather than as a limitation invalidating the present findings.

5. Discussion: The CADEI Index and an Integrated Selection Framework

Because a direct econometric association between institutional financing and GDP growth could not be established for the World Bank and could only be established at the margin for the AIIB, the study proposes a complementary evaluative instrument: the Central Asia Development Effectiveness Index (CADEI). Given that project completion reports are unavailable for most operations in the sample, CADEI evaluates the expected effectiveness potential of a project — rather than its realised outcome — based on structural characteristics of the financing operation (sector, instrument type, co-financing structure, and alignment with recipient-country priorities). The index is

disaggregated into two modules to reflect the heterogeneous nature of the portfolio: CADEI-I for infrastructure projects and CADEI-P for policy and crisis-response operations. Applied to 11 unique projects in the sample, the index underpins an integrated framework for selecting a development institution and financing instrument.

The framework yields differentiated implications by country. For Uzbekistan, the largest recipient of both institutions' financing in the region, the priority is portfolio diversification rather than further volume growth. For Kazakhstan, which benefits from a comparatively favourable FDI channel, DFI instruments are best used selectively — primarily for development policy operations and crisis-response financing. For the Kyrgyz Republic, characterised by minimal AIIB financing and elevated debt vulnerability, grant and concessional financing should be prioritised over standard loan instruments. For Tajikistan, which records the highest CADEI score in the sample, the co-financing model — in which several institutions jointly finance large infrastructure projects — appears to be a comparatively effective approach for countries with constrained fiscal space. For Turkmenistan, which records no verified project from either institution over the entire observation period, the priority is preliminary institutional dialogue rather than instrument selection.

6. Conclusion

This study provides the first, to the author's knowledge, separate econometric estimation of the statistical association between World Bank financing, AIIB financing, FDI inflows, and GDP growth specifically for Central Asia over 2010–2024. The central empirical finding is that FDI inflows are the most robust correlate of economic growth in the sample, retaining a positive and significant coefficient across Pooled OLS, Fixed Effects, and robust estimation. World Bank financing shows no statistically significant association with growth in any specification — a consistently negative result that should not be read as evidence of ineffectiveness, but rather as consistent with the longer-term, structural nature of a portfolio in which over a third of operations are development-policy rather than investment lending. AIIB financing shows only borderline significance under robust estimation, plausibly reflecting both its shorter operational history in the region (since 2016–2017) and the delayed materialisation of infrastructure-investment effects that an annual panel is not well suited to capture.

The study is subject to several limitations that should guide the interpretation and future extension of its results. The panel comprises only five countries and fifteen years (75 observations), which constrains the statistical power of several diagnostic tests and limits the asymptotic validity of certain panel procedures. Formal lag specifications were not estimated within the confirmed scope of the analysis. The CADEI index reflects expected rather than realised project effectiveness, owing to the general unavailability of project completion reports. Future research extending the observation window, incorporating lagged financing specifications, and — where

reporting permits — validating CADEI scores against realised project outcomes would substantially strengthen the evidentiary basis for the conclusions reached here. Notwithstanding these limitations, the differentiated, country-specific and institution-specific character of the findings offers a more operationally useful basis for public-sector decision-making on external financing than an aggregated cross-country analysis would allow.

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