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Article

Credit Volume and Economic Growth: A Panel Data Analysis of Five CIS Economies

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Abstract: This study investigates the relationship between banking sector credit volume and economic growth across five CIS economies — Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan and Azerbaijan — over the period 2013–2023, using an unbalanced panel of 55 observations. The dependent variable is the annual real GDP growth rate (Y); the three explanatory variables are credit to the private sector as a share of GDP (X_1), the CPI inflation rate (X_2), and trade openness as (Exports+Imports)/GDP (X_3). Three estimation strategies are applied and compared: Pooled OLS, Fixed Effects (LSDV) and Random Effects (GLS). An F-test for individual fixed effects ($F = 19.714 >> F^{men} = 2.570$) confirms significant cross-country heterogeneity, making Pooled OLS inconsistent; the Hausman test ($\chi^2 = 4.493 < 7.815$) indicates that Random Effects is preferred over Fixed Effects, but the Fixed Effects model is retained as a robust conservative specification. In the FE model, trade openness is the dominant and statistically significant driver of growth ($t = 6.026 >> 2.012$), while private credit exerts a negative but borderline-insignificant effect ($t = -1.808$), consistent with the "too-much-finance" literature when credit expansion outpaces institutional capacity. The results carry concrete policy implications for credit market development and financial sector reform in the region.

Keywords: panel data, credit volume, economic growth, fixed effects, random effects, Hausman test, CIS economies, financial development, Uzbekistan, econometrics.

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1. Introduction

The finance-growth nexus has been one of the most extensively studied relationships in empirical macroeconomics ever since Schumpeter argued that a well-functioning banking system is essential for channelling savings into productive investment and thereby driving economic development [1]. The core theoretical logic is straightforward: by reducing information asymmetries, screening borrowers, mobilising savings and providing payment services, financial intermediaries raise the return on capital and accelerate capital accumulation, ultimately boosting long-run growth [2].

However, a growing body of post-2008 evidence challenges the view that "more finance is always better." Arcand, Berkes and Panizza document a non-linear, inverted-U-shaped relationship between private credit and growth: beyond a threshold of roughly 80–100% of GDP, further credit expansion may reduce rather than enhance growth, a phenomenon they term "too much finance" [3]. In less financially developed economies — such as those of the CIS — where credit-to-GDP ratios remain well below this threshold, theory still predicts a positive finance-growth relationship, but empirical identification is

complicated by cross-country heterogeneity, endogeneity, and the confounding role of institutional quality.

The five economies examined in this study — Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan and Azerbaijan — present a highly heterogeneous laboratory for testing the finance-growth hypothesis. Their private credit ratios range from 12% to 45% of GDP (well below the global "too much finance" threshold), yet their growth experiences diverge sharply: Tajikistan averaged 7.16% annual growth over 2013–2023, while Azerbaijan averaged only 1.61%. Disentangling the role of credit from structural differences across countries requires the application of panel data methods that explicitly control for unobserved country-specific heterogeneity[4].

This paper makes three contributions. First, it constructs a balanced panel dataset for five CIS economies over 2013–2023 using official World Bank and IMF data. Second, it compares Pooled OLS, Fixed Effects (LSDV) and Random Effects (GLS) estimators and selects the appropriate specification via formal diagnostic tests. Third, it offers country-specific and aggregate policy recommendations grounded in the empirical results. The remainder of the paper is organised as follows: Section 2 reviews the relevant literature; Section 3 describes data and methodology; Section 4 presents and interprets the results; and Section 5 concludes[5].

2. Literature Review

The theoretical and empirical literature on the finance-growth nexus spans three interrelated strands.

The foundational theoretical contribution is due to Goldsmith and McKinnon , who argued that financial deepening — measured by the ratio of bank assets or credit to GDP — proxies for the efficiency of capital allocation and thus positively affects output growth [4]. King and Levine provided the first systematic cross-country evidence, showing in a sample of 77 countries that initial financial depth is a robust predictor of subsequent growth even after controlling for education, trade and inflation [5]. Levine, Loayza and Beck (2000) extended this analysis using GMM panel estimation and confirmed a positive causal relationship from financial intermediation to growth, running from both credit volume and banking efficiency [6].

A second strand emphasises institutional complementarities. Demetriades and Hussein used time-series cointegration methods for 16 countries and found substantial heterogeneity: while finance leads growth in some economies, the reverse — growth leading financial development — holds in others [7]. This finding underscores the importance of using panel methods that accommodate country-specific intercepts, motivating the Fixed Effects specification adopted in this paper. La Porta, Lopez-de-Silanes, Shleifer and Vishny showed that the legal and regulatory framework — particularly creditor rights and contract enforcement — is a first-order determinant of financial development, which in the CIS context implies that cross-country variation in institutional quality confounds naive cross-sectional comparisons [8].

The third strand addresses the "too much finance" concern. Arcand, Berkes and Panizza (2015) estimate a turning point at approximately 80–80% credit-to-GDP. Cecchetti and Kharroubi (2015) argue that rapid credit growth crowds out R&D investment because finance sector growth competes for high-skilled labour with the technology sector [9]. For the CIS economies, where financial systems remain relatively shallow and credit-to-GDP ratios are far below any plausible threshold, the implication is that credit expansion should still be growth-enhancing in theory, provided it is directed towards productive uses. Empirical work specifically on CIS and Central Asian panel data is sparse: Hamza and Saadaoui (2018) and Norbaev et al. find positive but heterogeneous finance-growth effects across transition economies, recommending country-specific analysis [10].

3. Materials and Methods

The study constructs an unbalanced panel for five CIS economies (N = 5) over 2013–2023 (T = 11), yielding 55 total observations. All data are drawn from publicly accessible official databases. Table 1 defines each variable, its unit of measurement, and the primary data source.

Table 1. Variable definitions, units and data sources

Symbol	Variable	Definition	Unit	Source
Y	GDP Growth	Annual real GDP growth rate	%	World Bank WDI [13]
X_1	CREDIT	Credit to private sector (% of GDP)	% of GDP	IMF Financial Access Survey [14]
X_2	INFL	Consumer Price Index — annual inflation rate	%	World Bank WDI [15]
X_3	TRADE	Trade openness: (Export+Import)/GDP	% of GDP	World Bank WDI [16]

Source: compiled by the authors based on data from World Bank World Development Indicators, IMF Financial Access Survey

The general panel regression model estimated in this study is:

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \varepsilon_{it}$$

where Y_{it} is the GDP growth rate of country i in year t; α_i is a country-specific intercept (fixed or random effect); β_1–β_3 are slope coefficients measuring the partial effects of credit (X_1), inflation (X_2) and trade openness (X_3); and ε_{it} is the idiosyncratic error term with $E[\varepsilon_{it}|X] = 0$.

Three estimation strategies are compared:

1. **Pooled OLS** treats all observations as a single cross-section and imposes a common intercept ($\alpha_i = \alpha$ for all i). This estimator is unbiased only if there are no omitted country-specific effects correlated with the regressors; otherwise it is inconsistent.
2. **Fixed Effects (LSDV)** estimates country-specific intercepts by including N−1 country dummy variables. This removes all time-invariant unobserved heterogeneity and is consistent even when α_i is correlated with the regressors. The slope estimator is the "within" estimator obtained by demeaning each variable within entities.
3. **Random Effects (GLS)** treats α_i as random draws from a distribution uncorrelated with the regressors, and applies Generalised Least Squares using the quasi-demeaning transformation with parameter $\theta = 1 - \sqrt{(\sigma^2\varepsilon / (T\sigma^2\mu + \sigma^2\varepsilon))}$. RE is more efficient than FE when its orthogonality assumption holds.

Model selection proceeds via two formal tests: (i) the F-test for joint significance of individual fixed effects (H_0: all α_i equal), and (ii) the Hausman specification test, which evaluates whether the RE estimate is consistent (H_0: $Cov(\alpha_i, X_{it}) = 0$).

Critical values used throughout: $t^{men}(df=47, \alpha=0.05) = 2.012$; $F^{men}(7,47) = 2.212$; $F^{men}(4,47) = 2.570$; $\chi^{2men}(3) = 7.815$.

4. Results and Discussion

Table 2 presents the full panel dataset for 2013–2023. Notable features include: Uzbekistan exhibits the highest average credit growth and stable output expansion; Kazakhstan and Azerbaijan experienced negative growth in 2020 (COVID-19 shock) and 2016 (oil price collapse), respectively; Kyrgyzstan registered the lowest credit ratio (12.3–

22.8%) but the highest trade openness; Tajikistan maintained the most consistent growth trajectory despite the lowest credit ratio among post-2016 observations[11].

Table 2. Panel dataset: GDP growth, credit, inflation and trade openness (2013–2023)

Country	Year	Y GDP Growth (%)	X_1 Credit/GDP (%)	X_2 CPI Inflation (%)	X_3 Trade Openness (%)
Uzbekistan	2013	8.0	28.3	6.8	61.2
	2014	8.1	30.1	6.1	58.4
	2015	8.0	33.4	5.6	52.3
	2016	6.1	36.2	8.4	48.6
	2017	4.5	31.8	14.4	62.1
	2018	5.4	29.6	17.5	65.8
	2019	5.8	32.4	15.2	70.3
	2020	1.6	35.9	12.9	58.7
	2021	7.4	38.7	10.8	64.2
	2022	5.7	42.1	11.4	69.8
	2023	6.0	45.3	8.8	72.4
Kazakhstan	2013	6.0	38.6	5.8	72.3
	2014	4.2	37.4	6.7	68.1
	2015	1.2	34.8	13.6	58.4
	2016	1.1	32.6	8.5	54.2
	2017	4.1	33.1	7.4	60.3
	2018	4.1	35.8	6.1	65.7
	2019	4.5	37.9	5.4	64.2
	2020	−2.6	36.1	6.8	56.3
	2021	4.3	37.4	8.0	60.8
	2022	3.2	36.8	15.0	65.4
	2023	5.1	35.9	9.8	63.2
Kyrgyzstan	2013	10.9	19.4	6.6	138.4
	2014	4.0	20.1	7.5	130.2
	2015	3.9	20.8	6.5	128.6
	2016	4.3	19.3	0.4	119.8
	2017	4.7	19.8	3.2	125.4
	2018	3.5	20.6	1.5	124.6
	2019	4.6	21.3	1.1	122.3
	2020	−8.4	20.8	6.3	108.7
	2021	3.6	21.5	11.9	118.4
	2022	7.0	22.4	13.9	128.9
	2023	6.3	22.8	8.2	132.1
Tajikistan	2013	7.4	24.2	3.7	80.3
	2014	6.7	25.1	7.4	76.8
	2015	6.0	20.4	5.1	68.4
	2016	6.9	15.8	5.9	62.1
	2017	7.1	13.3	7.3	65.8
	2018	7.3	14.7	3.8	68.4
	2019	7.4	14.4	8.0	70.2
	2020	4.5	12.3	8.6	62.4
	2021	9.2	13.7	9.0	72.8
	2022	8.0	14.9	7.2	78.4
	2023	8.3	15.8	5.4	76.2
Azerbaijan	2013	5.8	28.4	2.4	74.6

	2014	2.8	26.8	1.4	72.3
	2015	1.1	22.3	4.0	64.8
	2016	−3.1	18.6	12.4	56.2
	2017	0.1	17.4	12.9	61.4
	2018	1.5	16.8	2.3	68.2
	2019	2.5	17.2	2.7	72.4
	2020	−4.3	16.4	2.8	60.3
	2021	5.6	16.8	6.7	68.7
	2022	4.6	17.4	13.9	74.2
	2023	1.1	18.2	8.8	70.6

Source: World Bank World Development Indicators (https://databank.worldbank.org); IMF Financial Access Survey (https://data.imf.org)

Descriptive statistics and cross-country comparison

Table 3 presents pooled descriptive statistics across all 55 country-year observations, and Table 4 decomposes averages by country[12].

Table 3. Pooled descriptive statistics (N=5, T=11, n=55 observations)

Variable	Observations	Mean	Std. Dev.	Min	Max
Y — GDP Growth (%)	55	4.41	3.44	−8.40	10.90
X_1 — Credit/GDP (%)	55	25.63	8.90	12.30	45.30
X_2 — CPI Inflation (%)	55	7.63	4.00	0.40	17.50
X_3 — Trade Openness (%)	55	77.74	24.80	48.60	138.40

Source: authors' calculations

Average GDP growth across the panel stands at 4.41% per annum with a standard deviation of 3.44 percentage points — reflecting substantial heterogeneity driven largely by resource-price cycles (Kazakhstan, Azerbaijan) and COVID-19. Private credit ranges from 12.3% to 45.3% of GDP, with a mean of 25.63%, well below the "too much finance" threshold. Mean inflation of 7.63% disguises sharp differences: Uzbekistan averaged 10.72% reflecting monetary reform pass-through, while Kyrgyzstan averaged 6.10%[13].

Table 4. Average indicators by country, 2013–2023

Country	Avg. GDP Growth (%)	Avg. Credit/GDP (%)	Avg. CPI (%)	Avg. Trade Openness (%)
Uzbekistan	6.05	34.89	10.72	62.16
Kazakhstan	3.20	36.04	8.46	62.63
Kyrgyzstan	4.04	20.80	6.10	125.22
Tajikistan	7.16	16.78	6.49	71.07
Azerbaijan	1.61	19.66	6.39	67.61
Panel Average	**4.41**	**25.63**	**7.63**	**77.74**

Source: authors' calculations based on World Bank WDI data

Table 4 reveals an inverse cross-sectional pattern between credit depth and growth: Tajikistan, with the lowest average credit ratio (16.78%), recorded the highest average growth (7.16%), while Kazakhstan, with the highest credit ratio (36.04%), grew at only 3.20%. This "raw" negative correlation motivates the use of panel methods that control for country-fixed characteristics before interpreting the credit-growth relationship[14].

Regression results: Pooled OLS, Fixed Effects and Random Effects

Table 5 presents estimated coefficients, t-statistics and model diagnostics for all three specifications. Table 5 is the central results table of this paper.

Table 5. Panel regression results: comparison of Pooled OLS, Fixed Effects (LSDV) and Random Effects (GLS)

	Pooled OLS	Fixed Effects (LSDV)	Random Effects (GLS)
Constant (β_0)	2.769	— (absorbed in α_i)	−7.813
X_1 (Credit/GDP)	0.016	−0.169	−0.013
[t-statistic]	[0.278]	[−1.808]	[−0.067]
X_2 (CPI Inflation)	0.004	−0.138	−0.082
[t-statistic]	[0.035]	[−1.592]	[−0.399]
X_3 (Trade Openness)	0.015	0.313***	0.170
[t-statistic]	[0.742]	[6.026]	[1.833]
Model diagnostics			
R^2 (overall)	0.011	0.631	—
Adjusted R^2	−0.047	0.576	—
F-statistic	0.186	11.462***	—
F-test (individual effects)	—	19.714***	—
Observations	55	55	55
Countries (N)	5	5	5
Time periods (T)	11	11	11

Note: *p<0.05; **p<0.01; ***p<0.001. Standard errors clustered at country level. t-critical (df=47, α=0.05) = 2.012. Source: authors' calculations

The Pooled OLS model (column 1) performs very poorly: $R^2 = 0.011$ and the F-statistic of 0.186 does not approach the critical value of 2.786, indicating that the model fails to explain the data once country heterogeneity is ignored. All three coefficients are individually insignificant. This is the expected result when unobserved country-level factors (resource endowments, institutional quality, reform timing) confound the within-country dynamics[15].

The Fixed Effects model (column 2) yields a dramatically improved fit ($R^2 = 0.631$, $F = 11.462 >> 2.212$). Trade openness (X_3) is highly significant ($t = 6.026 >> 2.012$), confirming that greater integration into global markets is a powerful growth driver across CIS economies. Private credit (X_1) carries a negative coefficient of −0.169 with $t = -1.808$ — borderline insignificant but economically suggestive of the "too much finance" or resource misallocation channel within this sample: as credit ratios expanded in the post-2017 reform period (especially in Uzbekistan), short-run absorption constraints may have dampened the growth payoff. Inflation exerts a negative but insignificant effect ($t = -1.592$), consistent with a mild growth-dampening role of price instability that is partially absorbed by the country fixed effects.

The Random Effects GLS estimates (column 3) sit between Pooled OLS and FE, with trade openness approaching but not attaining significance ($t = 1.833$). The RE specification is less appropriate here given the significant individual effects documented by the F-test[16].

Table 6 reports the estimated country-specific intercepts (α_i) from the LSDV model. All are negative, reflecting that the common time trend and explanatory variables must be supplemented by substantial country-level adjustments. Kazakhstan ($\alpha = -9.145$, $t = -2.381$), Kyrgyzstan ($\alpha = -30.789$, $t = -5.099$), Tajikistan ($\alpha = -11.345$, $t = -3.251$) and Azerbaijan ($\alpha = -15.343$, $t = -4.553$) all exhibit individually significant fixed effects, confirming that unobserved country-specific characteristics (geographic isolation, commodity dependence, institutional development) play a decisive role in determining the level of GDP growth over and above the observed regressors.

Table 6. Country-specific fixed effects (α_i) — Fixed Effects (LSDV) model

Country	Fixed Effect (α_i)	t-statistic	t-critical (df=47)	Significance
Uzbekistan	−6.027	−1.575	2.012	Marginal
Kazakhstan	−9.145	−2.381*	2.012	Significant
Kyrgyzstan	−30.789	−5.099***	2.012	Highly sig.
Tajikistan	−11.345	−3.251***	2.012	Highly sig.
Azerbaijan	−15.343	−4.553***	2.012	Highly sig.

Note: ***p<0.001; *p<0.05. t-critical (df=47, α=0.05) = 2.012.

Source: authors' calculations

Model selection: F-test and Hausman test

Table 7 summarises the two formal model-selection tests applied in this study.

Table 7. Model selection diagnostics: F-test for individual effects and Hausman specification test

Criterion	Value	Critical Value (α=0.05)	Decision
Hausman χ^2 statistic	4.493	χ^{2T3W} (df=3) = 7.815	H_0 not rejected
Degrees of freedom	3	—	RE preferred over FE
F-test for individual fixed effects	19.714	F^{T3W} (4,47) = 2.570	H_0 rejected: FE needed
Conclusion	**FE model adopted as conservative, robust estimator**		

Source: authors' calculations

The F-test for individual fixed effects yields F = 19.714, far exceeding the critical value of 2.570, and decisively rejects the null hypothesis that all country intercepts are equal. This conclusively establishes that Pooled OLS is inconsistent and that country-specific effects must be modelled explicitly. The Hausman statistic of 4.493 falls below the chi-squared critical value of 7.815, indicating that the RE estimator is not significantly different from FE — formally suggesting RE is preferred on efficiency grounds. However, given the substantive economic reasons (institutional divergence, reform heterogeneity) to expect correlation between country-level unobservables and the regressors, we adopt the Fixed Effects model as the primary specification following standard practice in transition economy panel studies.

5. Conclusion

This paper has applied Pooled OLS, Fixed Effects (LSDV) and Random Effects (GLS) estimation to a panel of five CIS economies over 2013–2023 to investigate the credit-growth nexus. Three principal findings emerge.

First, cross-country heterogeneity is the dominant feature of the data. The F-test for individual effects (F = 19.714 >> 2.570) conclusively rejects Pooled OLS in favour of panel models with country-specific intercepts. The fixed effects themselves are large in magnitude and individually significant for four of five countries, confirming that unobserved structural characteristics — commodity dependence, geographic isolation, institutional development — are the first-order determinants of growth performance in this sample.

Second, trade openness is the dominant observable growth driver within the FE model (t = 6.026 >> 2.012, coefficient = 0.313): each additional percentage point of (Exports+Imports)/GDP is associated with a 0.313-percentage-point increase in annual GDP growth, ceteris paribus. This underscores the importance of trade facilitation, export diversification and regional integration for sustained growth in CIS economies.

Third, private sector credit carries a negative and borderline-insignificant coefficient (−0.169, t = −1.808) within the FE model. This result should not be interpreted as evidence that financial development harms growth; rather, it reflects the short-run dynamics of rapid credit expansion in economies with limited absorptive capacity and institutional development. As credit grew rapidly in Uzbekistan post-2017 reform and in Kazakhstan, the lag between credit disbursement and productive deployment may suppress the contemporaneous growth return. A lagged credit specification or a threshold model might reveal a positive long-run finance-growth relationship.

On the basis of these findings, four policy recommendations are advanced:

Direct credit toward high-productivity sectors. Governments and central banks in CIS economies should strengthen sectoral allocation guidance and improve credit quality oversight to ensure that private sector credit flows support productive investment rather than consumption or real estate speculation.

Deepen trade integration. Given that trade openness is the single most significant growth driver in the panel, policies promoting export diversification, customs modernisation, participation in regional agreements (EAEU, WTO accession for non-members), and reduction of non-tariff barriers deserve priority.

Strengthen financial institutions alongside credit expansion. In Uzbekistan, where private credit has grown rapidly since the 2017 liberalisation, simultaneous investment in credit bureau infrastructure, risk-based prudential regulation and judicial enforcement of creditor rights is essential to improve the growth return on credit.

Extend the empirical framework. Future research should incorporate lagged credit, threshold panel regressions, and additional controls (institutional quality, human capital, fiscal policy) to more precisely identify the finance-growth causal channel and determine country-specific optimal credit depth.

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