

“Institutional complements or substitutes? Digital government, the rule of law, and investment in post-Soviet economies”

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INSTITUTIONAL COMPLEMENTS OR SUBSTITUTES? DIGITAL GOVERNMENT, THE RULE OF LAW, AND INVESTMENT IN POST-SOVIET ECONOMIES

Abstract

Digital government is advancing worldwide while foreign investment contracts and becomes more selective, making it a first-order policy question whether e-government can attract capital without strong formal institutions. The study aims to establish whether the investment payoff of digital government depends on the rule of law in 15 post-Soviet economies, separating the within-country and between-country dimensions of this relationship over 2008–2024. A biennial panel aligned to the nine UN E-Government Survey waves (135 country-wave cells; baseline $N = 120$) is estimated with two-way fixed effects, a within-between specification that tests each dimension separately, an EGDI $\times$ Rule of Law interaction, wild cluster bootstrap inference, and a robustness battery of seventeen alternative specifications. Within countries, no complementarity is found. The interaction equals -0.191 ($SE = 0.447$, bootstrap $p = 0.690$, bootstrap 95% CI from -1.616 to 0.742), and the marginal effect of a one-standard-deviation EGDI increase is insignificant at every rule-of-law level (-0.979 to -1.481 percentage points of GDP). Between countries, the level association is null as well; the between-country slope equals -1.083 (bootstrap $p = 0.692$). The only conditional structure is exploratory and substitution-signed, an interaction of -2.619 outside the EU members (bootstrap $p = 0.013$) that does not survive correction for multiple specifications (Holm-adjusted $p = 0.226$). Digital government offers no detectable investment premium at either level.

Keywords

digital government, e-government, institutional quality, foreign investment, post-Soviet economies

JEL Classification

F21, O38, O17, P33

INTRODUCTION

Digital government is a visible element of national competitiveness: the 2024 United Nations E-Government Survey puts the global average E-Government Development Index at 0.6382, with 71.5 percent of member states at high or very high levels (United Nations, 2024). Investment moves the other way. Foreign direct investment excluding conduit transactions fell 11 percent in 2024, a second consecutive decline, while headline flows rose 4 percent on conduit transactions and greenfield digital projects in the Global South concentrated in ten economies (UNCTAD, 2025). Whether digital government helps countries attract this scarce and selective capital is a first-order policy question.

The post-Soviet region is an unusually sharp setting. From 2008 to 2024, its 15 economies digitalized far faster than their institutions changed: the within-country standard deviation of the EGDI is about two-thirds of its overall value, compared with less than one-fifth for the rule of law, whose within-country movement is no larger than its

reported measurement error. The region spans the full institutional-digital space, from Estonia, among the top three worldwide in 2024 (United Nations, 2024), to Central Asian economies in the lower tercile, and three economies illustrate it: Ukraine, upper-middle income and digitalizing under wartime conditions (World Bank, 2025a), Kazakhstan, with a high EGDI and a middle-tercile rule of law, and Latvia, with strong institutions and advanced digital government.

What remains unresolved is whether the two act as complements, courts being required before digital transparency earns investor confidence, or as substitutes, online services bypassing weak administration. Existing evidence rarely separates them: it pools level differences with changes within countries, leaves between-country associations untested, and seldom confronts few-cluster inference or the measurement error of perception-based indices. The study aims to establish whether the investment payoff of digital government depends on the rule of law in 15 post-Soviet economies, separating the within-country and between-country dimensions of this relationship over 2008–2024.

1. LITERATURE REVIEW

A first strand links digital technology to macro-economic and investment outcomes. Internet and mobile diffusion are associated with faster growth (Kusairi et al., 2023), although information technology can contribute negatively once it interacts with foreign capital (Asongu & Odhiambo, 2020). Within Europe, digital transformation is uneven but converging (Pakhnenko et al., 2025); the digital divide has grown into a large research field (Kovac et al., 2024), and digital readiness follows research investment, connectivity, and income (Valaskova et al., 2025). Work on investment finds the relationship conditional rather than uniform: digitalization attracts foreign direct investment in Chinese cities with effects differing across income groups (Zhang et al., 2024) and raises it only up to a threshold beyond which cyber-risk deters capital (Ho et al., 2025), while digital government shows non-monotone returns, with initial inefficiency before maturity (Hrytsenko et al., 2026). Decomposed, electronic government is the component most consistently associated with bilateral investment (Mai, 2025), and bibliometric work extends the logic to disclosure in insurance (Kuzior et al., 2023). At the firm and sector level the returns are better documented, from efficiency and organizational change in shipping and telecommunications (Khalifa et al., 2025; Sahnouni & Kadri, 2025) to customer outcomes in banking and healthcare retail (Thach et al., 2025; Conley, 2026), and from productivity in publishing and virtual work (Olszewski & Krawczyk, 2026; Quisenberry & Burrell, 2026) to firm value under fintech (Noor et al., 2024). The macro studies share a positive

but conditional reading estimated almost entirely from cross-sectional or pooled variation, and the micro evidence says nothing about whether such gains aggregate into cross-border flows.

A second, older strand treats institutions as determinants of where capital locates. Governance infrastructure attracts foreign direct investment, most strongly in developing and transition economies (Globerman & Shapiro, 2002); regulatory quality and legal predictability are among the most powerful location factors (Daude & Stein, 2007), and legal and administrative institutions promote inflows largely independently of development level (Bénassy-Quéré et al., 2007). Recent panels qualify this: institutional dimensions are not uniformly investment-promoting, and the rule of law can enter negatively once corruption control is held constant (Bhujabal et al., 2024), while institutional quality raises growth directly and through the FDI channel (Hayat, 2019). In the post-Soviet and Central European settings, the relationship is heterogeneous: the growth payoff of institutions is non-linear and weakened by resource abundance (Gasimov et al., 2023), catching-up growth has been capital-driven with institutional improvement lagging (Ciolek et al., 2025), and the rule of law is itself a historically contingent principle rather than a fixed endowment (Crowley & Mujtaba, 2026). Within the Union, institutional maturity and digital competence jointly raise ethical-leadership standards (Kyzenko et al., 2026), and Ukrainian evidence shows digital maturity translating into recovery and investment only through institutional trust and government effectiveness (Topazly et al., 2026).

A third strand places investment within broader structural conditions. It advances sustainable-development outcomes only under supportive institutional frameworks (Mursalov et al., 2025), drives public expenditure in the Baltic states (Filipova et al., 2025), and is one dimension of macro-financial resilience in shock-exposed economies (Gondauri, 2026). Broader accounts find human development a more robust growth correlate than foreign investment (Soussou & Salem, 2026), treat dual higher education as a channel of human-capital reform (Davlikanova, 2025), and show digital platforms delivering direct returns in low-income settings (Mshana & Postrzednik-Lotko, 2026).

A fourth strand concerns the transition context. Armed conflict slowed technological progress in Ukraine and Russia (Prokopenko et al., 2021), the electricity-price shocks of the invasion passed through to European inflation (Vasylieva et al., 2025), Ukrainian energy poverty tracks household income more closely than efficiency or renewables (Smiech et al., 2025), the effects of migration depend on the welfare architecture receiving it (Yeremenko et al., 2025), and demographic strain weighs on public governance (Zahorodnia et al., 2026). Digitalization has nonetheless advanced: trust-building accompanied the move to online public services (Litovtseva et al., 2022), digital-CSR integration shaped trust and performance in transitional banking (Zakharkina et al., 2025), and responsible production in Kazakhstan follows environmental, operational, and social drivers (Zhidebekkyzy et al., 2025).

A fifth strand, closest to this study, examines the interaction between digital government and institutions. Digital governance is expected to raise integrity by reducing discretion, and high-technology capacity is indeed associated with corruption control and regulatory quality (Yefimenko et al., 2025), with anti-corruption audit conceptualized as a distinct control instrument (Bezverkhyy et al., 2024). Sector evidence, however, finds no direct effect of digital transformation on banking-risk control once law enforcement and governance are accounted for (Dinh & Thanh, 2024), and trust and standardized metrics are prerequisites for it to deliver (Melnik et al., 2025). Whether such systems earn trust depends on their governance: on process understandability and managed technical debt (Hayes,

2026; Thibodeau, 2026), on data sovereignty and consent (Sidii, 2025), and on transparency, without which diversification does not pay off and digital environments erode trust (Sharov et al., 2026; Burrell, 2026). Disclosure institutions complete the channel, from sustainability-reporting audits and digital financial information (Bezverkhyy et al., 2025; Shygun et al., 2023) to corporate-social-responsibility policy and ethical reporting (Taliouris & Trihas, 2026; Bappayo et al., 2026). The two readings correspond to the complementarity and substitution hypotheses, under which courts are either required before digital transparency earns investor confidence or bypassed by automated procedures. This conditional relationship is usually assumed rather than tested with an explicit interaction term.

Three limitations recur. First, designs seldom separate the within-country evolution of digital government from between-country differences in development, so a standing endowment is mistaken for the marginal effect of reform, and the between-country association is rarely tested with few-cluster inference. Second, institutional quality enters most panels through perception-based indices whose within-country movements match their reported measurement error. Third, long-run panels integrating digital government and the rule of law for post-Soviet economies remain scarce. This study confronts all three, separating the two dimensions, testing each with few-cluster inference, and quantifying the reliability of the institutional measure.

2. DATA AND METHODOLOGY

2.1. Data and sample

The study covers 15 post-Soviet economies (Appendix A) over the nine United Nations E-Government Survey waves from 2008 to 2024, that is, 135 country-wave cells. Digital-government indicators enter at survey-wave values, while all annual variables are entered as biennium means over the wave year and the year before. Ukraine, Kazakhstan, and Latvia are illustrative economies (Figure 4), not a case-study design.

Investment and macroeconomic variables come from the World Bank WDI, digital government from the UN E-Government Survey, and the rule

of law from the WGI estimate, whose reported standard error is retained. Because the key regressors are lagged one wave, the panel starts in 2010, and the baseline, whose four controls are complete for every cell, is balanced at $N = 120$ from 15 economies over eight waves. CPI inflation is missing for Turkmenistan throughout and for several Tajik and Uzbek waves, and the cells it would remove differ systematically from the rest (Results, Table 2), so it enters only as a sensitivity column ($N = 107$), as do internet penetration and resource rents.

2.2. Variables

Table 1 defines and sources every variable. The EGDI, the OSI, and the rule of law are z-standardized over the full 135-cell panel, and the same scaling is held fixed in every specification, including the subsamples and the annual panel, so that interaction coefficients are comparable across the robustness battery. The centered interaction has negligible collinearity ($VIF = 2.03$).

2.3. Empirical strategy

The baseline is the two-way fixed-effects model specified in Eq. (1). Key regressors are lagged one wave, that is, two calendar years.

$$\begin{aligned} \overline{FDI}_{it} = & \alpha_i + \delta_t + \beta_1 zEGDI_{i,t-1} \\ & + \beta_2 zRoL_{i,t-1} + \beta_3 (zEGDI \cdot zRoL)_{i,t-1} \\ & + \gamma' \bar{X}_{it} + \varepsilon_{it}, \end{aligned} \quad (1)$$

where the overline denotes a biennium mean over the wave year and the year before, i indexes countries and t survey waves; FDI_{it} is net FDI inflows as a share of GDP; $zEGDI$ and $zRoL$ are the standardized E-Government Development Index and the rule of law; α_i are country effects and δ_t wave effects; β_1 , β_2 , and β_3 are the coefficients on the $EGDI$, the rule of law, and their interaction; X_{it} is the vector of biennium-mean controls with coefficient vector γ ; and ε_{it} is the idiosyncratic error. Equation (1) compares investment inflows within the same country across survey waves, net of the

Table 1. Variable definitions and sources

Variable	Definition and construction	Source
FDI inflows (dependent)	Net FDI inflows, % of GDP; biennium mean over (t-1, t)	WDI, BX.KLT.DINV.WD.GD.ZS
FDI per capita (alternative dependent)	Inverse hyperbolic sine of net FDI inflows per capita, constant 2015 USD, computed as the FDI-to-GDP ratio times GDP per capita; robustness	WDI, own construction
GFCF (alternative outcome)	Gross fixed capital formation, % of GDP; biennium mean; a domestic-investment outcome, not a proxy for foreign investment	WDI, NE.GDI.FTOT.ZS
EGDI	E-Government Development Index, survey-wave value; z-standardized over the full panel; lagged one wave in the baseline	UN E-Government Survey, 2008–2024
OSI	Online Service Index, survey-wave value; z-standardized over the full panel (robustness)	UN E-Government Survey, 2008–2024
Rule of Law	WGI estimate (-2.5 to 2.5); biennium mean; z-standardized over the full panel; reported standard error retained; lagged one wave	WGI, World Bank
EGDI × Rule of Law	Product of the standardized variables; lagged one wave in the baseline	Own construction
ln GDP per capita	Log of GDP per capita, constant 2015 USD; biennium mean	WDI, NY.GDP.PCAP.KD
GDP growth	Annual GDP growth, %; biennium mean	WDI, NY.GDP.MKTP.KD.ZG
Trade openness	Exports plus imports, % of GDP; biennium mean	WDI, NE.TRD.GNFS.ZS
ln population	Log of total population; biennium mean	WDI, SP.POP.TOTL
Inflation	$\ln(1 + \text{CPI inflation}/100)$; biennium mean; sensitivity column	WDI, FP.CPI.TOTL.ZG
Internet users	% of population; biennium mean; sensitivity column	WDI, IT.NET.USER.ZS
Resource rents	Total natural resource rents, % of GDP; sensitivity column	WDI, NY.GDP.TOTL.RT.ZS
Non-EU indicator	1 for the twelve non-EU economies, 0 for Estonia, Latvia, and Lithuania; enters only in interactions	Own construction
Conflict intensity	$\ln(1 + \text{battle-related deaths})$, biennium sum of best estimates	UCDP GED v25.1
Alternative rule of law	WJP Rule of Law Index (overall); Freedom House rule of law; z-standardized over the available cells	QoG Standard Dataset, Jan 2026

Note: t indexes survey waves, so a one-wave lag corresponds to two calendar years. The four baseline controls also enter lagged one wave in a robustness column, and country-specific linear trends in another.

common shocks absorbed by the wave effects and of the time-invariant differences absorbed by the country effects, so that β_3 is the parameter that answers the question of the paper. Country and wave effects absorb level differences between countries and common trends, while the controls capture time-varying macroeconomic conditions within countries that may move with both digitalization and inflows; because income, growth, and trade can respond to investment within a biennium, a robustness column enters all four controls lagged one wave, and a column with no controls shows the unconditional pattern.

Following Brambor et al. (2006), complementarity ($\beta_3 > 0$) versus substitution ($\beta_3 < 0$) is assessed through the marginal effect in Eq. (2), evaluated at the 10th, 50th, and 90th percentiles of the lagged rule of law, with delta-method standard errors and t critical values on $(G - 1)$ degrees of freedom, where G is the number of countries.

$$\frac{\partial \overline{FDI}_{it}}{\partial zEGDI_{i,t-1}} = \beta_1 + \beta_3 zRoL_{i,t-1}. \quad (2)$$

Equation (2) states how much an additional standard deviation of digital government is associated with FDI inflows at a given institutional level, which is the quantity the complementarity hypothesis is about.

With 15 clusters, CRV1 standard errors are reported with p -values on $t_{(G-1)}$ and, as the headline inference, wild cluster bootstrap p -values (Cameron et al., 2008; Rademacher weights, null imposed, 9,999 replications). Because a null interaction is informative only to the extent that it is precise, the baseline reports the 95% confidence interval for β_3 both on $t_{(G-1)}$ and by inverting the wild cluster bootstrap test over a grid of null values, together with the minimum detectable interaction at 80% power, computed as the sum of the 97.5th and 80th percentiles of $t_{(G-1)}$ times the clustered standard error.

Between-country information is recovered with the within-between specification in Eq. (3) (Bell & Jones, 2015), a reparameterization of the correlated-random-effects model (Mundlak, 1978). Each regressor and each control enters as its deviation from the country mean and as the country mean

itself; the model is estimated by pooled OLS with wave dummies and country-clustered errors. The coefficients β on the deviations replicate the fixed-effects estimates exactly, and the coefficients δ on the means are the between-country slopes themselves. In the Mundlak parameterization, the coefficient on a country mean is the difference $(\delta - \beta)$, whose significance is not that of the between slope; the reparameterization makes δ a single coefficient that is tested directly with clustered and bootstrap inference. Equation (3) is estimated without the interaction, to answer the level question, and with it, in which case the within coefficients reproduce Eq. (1); a regression of the 15 country means on the country means of the regressors, with HC3 standard errors on $(N - k)$ degrees of freedom, provides the same slopes outside the panel framework. Fixed against random effects is tested with the regression-based Hausman test of Wooldridge (2010), the cluster-robust joint Wald test that $(\delta = \beta)$ for every regressor in Eq. (3), because the classical Hausman (1978) statistic requires random-effects variance components that are not identified when the between regression has 15 country means on 15 regressors.

$$\begin{aligned} \overline{FDI}_{it} = & \theta_0 + \beta' (w_{it} - \bar{w}_i) + \delta' \bar{w}_i \\ & + \kappa' (\bar{X}_{it} - \bar{X}_i) + \eta' \bar{X}_i + \delta_i + \varepsilon_{it}, \end{aligned} \quad (3)$$

where w_{it} collects the three key regressors, $\bar{w}_i$ is the country mean of w_{it} over the estimation sample, the dot in the subscript marking an average over waves, $\bar{X}_i$ is the country mean of the controls, θ_0 is the intercept, β and κ are the within-country coefficients, δ and η are the between-country slopes, and δ_i the wave effects. Equation (3) estimates the within-country and between-country associations jointly, so that δ answers whether countries with more digital government also receive more investment in levels, while β answers whether a country receives more investment in waves when its own digital government is higher.

Because the interaction of two variables that each have within and between components is itself a mixture, Eq. (4) decomposes it into four terms (Schunck & Perales, 2017), where w^E and w^R denote deviations from country means, and $\bar{E}$ and $\bar{R}$ denote the country means. The within-between term captures whether within-country digitalization pays

off differently at different institutional levels, the operative form of the conditional hypothesis; the within-within term requires institutional change within countries. Results are in Appendix D.

$$\begin{aligned} \overline{FDI}_{it} = & \theta_0 + \beta_1 w_{it}^E + \beta_2 w_{it}^R + \beta_{ww} w_{it}^E w_{it}^R \\ & + \beta_{wb} w_{it}^E \bar{R}_i + \beta_{bw} \bar{E}_i w_{it}^R + \delta_1 \bar{E}_i + \delta_2 \bar{R}_i \\ & + \delta_{bb} \bar{E}_i \bar{R}_i + \kappa'(\bar{X}_{it} - \bar{X}_i) + \eta' \bar{X}_i + \delta_i + \varepsilon_{it}, \end{aligned} \quad (4)$$

where w_{it}^E and w_{it}^R are the within-country deviations of the EGDI and the rule of law, and $\bar{E}_i$ and $\bar{R}_i$ are their country means, so that β_{ww} , β_{wb} , β_{bw} , and δ_{bb} are the within-within, within-between, between-within, and between-between components of the interaction. Equation (4) separates the conditional effect that is identified by institutional change within countries from the one identified by institutional differences between them.

Whether the rule of law carries enough within-country signal to identify that term is quantified rather than assumed. The WGI reports a standard error for every estimate (Kaufmann et al., 2011), so the reliability of the within-country variation is given by Eq. (5),

$$\lambda_w = 1 - \frac{\text{mean}(s_{it}^2)}{\text{Varw}(RoL)}, \quad (5)$$

with the within variance corrected for the 15 country means, and each biennial change is tested against the standard error of the two adjacent estimates, $\sqrt{(s_{it}^2 + s_{i,t-1}^2)}$, at the 10% level.

As a more flexible check in the spirit of the binning approach (Hainmueller et al., 2019), Eq. (6) replaces the interaction with separate lagged-EGDI slopes across terciles T_{ik} of the period-average rule of law. The slopes are parameterized as the lower-tercile slope ϕ_1 plus the contrasts $\Delta_2 = \phi_2 - \phi_1$ and $\Delta_3 = \phi_3 - \phi_1$, so that each difference is a single coefficient to which the wild cluster bootstrap applies directly; a joint Wald test of $\Delta_2 = \Delta_3 = 0$ is also reported.

$$\begin{aligned} \overline{FDI}_{it} = & \alpha_i + \delta_i + \phi_1 zEGDI_{i,t-1} \\ & + \Delta_2 (zEGDI_{i,t-1} \cdot T_{i2}) + \Delta_3 (zEGDI_{i,t-1} \cdot T_{i3}) \\ & + \beta_2 zRoL_{i,t-1} + \gamma' \bar{X}_{it} + \varepsilon_{it}, \end{aligned} \quad (6)$$

where T_{i2} and T_{i3} are indicators for the middle and upper terciles of the period-average rule of law, ϕ_1 is the lower-tercile slope, and Δ_2 and Δ_3 are the differences from it. Equation (6) allows the association between digital government and investment to differ freely across three institutional groups instead of imposing the linear interaction of Eq. (1).

Heterogeneity by EU membership is tested formally in Eq. (7), which interacts the three lagged key terms with a non-EU indicator in the full sample rather than by exclusion; the indicator alone is absorbed by the country effects. The coefficient β_6 is the difference between the non-EU and EU interactions, and the non-EU interaction is the linear combination $\beta_3 + \beta_6$. Because the EU side rests on three clusters, the bootstrap p-value of β_6 is the appropriate benchmark (MacKinnon & Webb, 2018).

$$\begin{aligned} \overline{FDI}_{it} = & \alpha_i + \delta_i + \beta_1 zEGDI_{i,t-1} \\ & + \beta_2 zRoL_{i,t-1} + \beta_3 (zEGDI \cdot zRoL)_{i,t-1} \\ & + \beta_4 zEGDI_{i,t-1} N_i + \beta_5 zRoL_{i,t-1} N_i \\ & + \beta_6 (zEGDI \cdot zRoL)_{i,t-1} N_i + \gamma' \bar{X}_{it} + \varepsilon_{it}, \end{aligned} \quad (7)$$

where N_i equals one for the twelve non-EU economies and zero for the three Baltic members, and β_4 , β_5 , and β_6 are the differences in the EGDI, rule-of-law, and interaction coefficients between the two groups. Equation (7) tests the EU contrast inside the full sample rather than by re-estimating the model on a subsample.

The robustness battery re-estimates Eq. (1) in seventeen alternative specifications (Appendix C) that vary the control set and its timing, add country-specific linear trends, drop the lag, transform or replace the dependent variable, restrict the sample by country or period, substitute the digital and institutional measures, add a conflict control, and move to an annual panel. Because seventeen tests of one coefficient inflate the chance of a nominally significant departure, Appendix C also reports bootstrap p-values adjusted by the Holm (1979) step-down procedure. Diagnostics include the Breusch-Pagan test (Breusch & Pagan, 1979), the Pesaran CD test (Pesaran, 2015), and variance inflation factors. All computations use Python 3.12 with a fixed random seed; fixed-effects estimates and clus-

tered standard errors are cross-checked against pyfixest, and the bootstrap uses a purpose-written implementation.

3. LIMITATIONS

Five limitations apply. First, 15 clusters are few, which the wild cluster bootstrap addresses; the EU contrast rests on three, and the CD test finds no residual dependence. Second, the WGI rule of law is perception-based, and its within-country variation is indistinguishable from its measurement error, so the conditional hypothesis is identified by digitalization at different institutional levels rather than by institutional change, with the World Justice Project and Freedom House measures as checks. Third, the design is not causal: investment may finance digitalization or stimulate legal reform, and with no credible instrument and system GMM unreliable at $N = 15$ (Roodman, 2009), estimates are conditional associations. Fourth, FDI net inflows as a share of GDP include round-tripping and conduit flows, which averaging and winsorizing mitigate but do not remove, and the ratio scales with economy size, which the per-capita specification addresses; EGDI revisions limit cross-wave comparability, addressed via the OSI. Fifth, null results are only as informative as their precision, so the interaction is reported with bootstrap confidence intervals and a minimum detectable effect, and modest conditional effects cannot be excluded.

4. RESULTS

4.1. Descriptive statistics and sample structure

Table 2 reports descriptive statistics for the 135 country-wave cells of the biennial panel. The core variables and the four baseline controls are complete, so the lagged baseline sample is the full balanced panel of $N = 120$, 15 countries over the eight waves from 2010 to 2024. CPI inflation is missing for Turkmenistan (all waves), Tajikistan (2018–2024), and Uzbekistan (2008–2010), and requiring it would drop 13 cells and one country. Those cells are not missing at random: they carry higher FDI inflows (5.35 against 3.81% of GDP), a far lower EGDI (0.424 against 0.673), a lower rule of law (−1.37 against −0.26), and more than twice the resource rents (15.8 against 6.6% of GDP), so inflation enters only as a sensitivity column. FDI inflows average 4.43% of GDP and range from −4.40 to 19.30%, tails heavy enough to motivate a winsorized check, and the EGDI spans 0.32 to 0.97, its maximum reached by Estonia in 2024.

The variance decomposition shapes the estimation strategy. The ratio of within-country to overall standard deviation is 0.675 for the EGDI but 0.187 for the rule of law. Because the WGI reports a standard error for every estimate, that noise can be quantified: the reliability of the within-country component is negative (−0.09) against 0.96 for the overall variation, and none of the 120 biennial changes is distinguishable from zero at the 10%

Table 2. Descriptive statistics, biennial panel of 15 post-Soviet economies, 2008–2024

Variable	N	Mean	SD	Min	Median	Max
FDI net inflows (% of GDP)	135	4.426	3.518	−4.396	3.133	19.304
Gross fixed capital formation (% of GDP)	135	24.866	6.661	12.537	23.109	47.123
E-Government Development Index (EGDI)	135	0.629	0.162	0.315	0.630	0.973
Online Service Index (OSI)	135	0.556	0.243	0.029	0.594	1.000
Rule of Law (WGI estimate)	135	−0.393	0.801	−1.563	−0.655	1.505
ln GDP per capita (constant 2015 USD)	135	8.480	0.879	6.560	8.560	9.966
GDP growth (%)	135	3.735	4.355	−12.656	4.172	18.027
Trade openness (% of GDP)	135	95.131	34.431	29.974	91.564	168.080
CPI inflation (%)	120	7.746	6.747	−0.172	6.421	56.224
ln(1 + inflation/100)	120	0.073	0.057	−0.002	0.062	0.446
ln population	135	15.876	1.241	14.090	15.744	18.795
Internet users (% of population)	131	56.676	27.877	1.578	66.495	93.305
Natural resource rents (% of GDP)	119	8.101	10.147	0.111	2.311	53.112

Note: Annual variables are biennium means over $(t-1, t)$; EGDI and its components are survey-wave values. Data come from the World Bank WDI, the Worldwide Governance Indicators, and the UN E-Government Survey (2008–2024 waves).

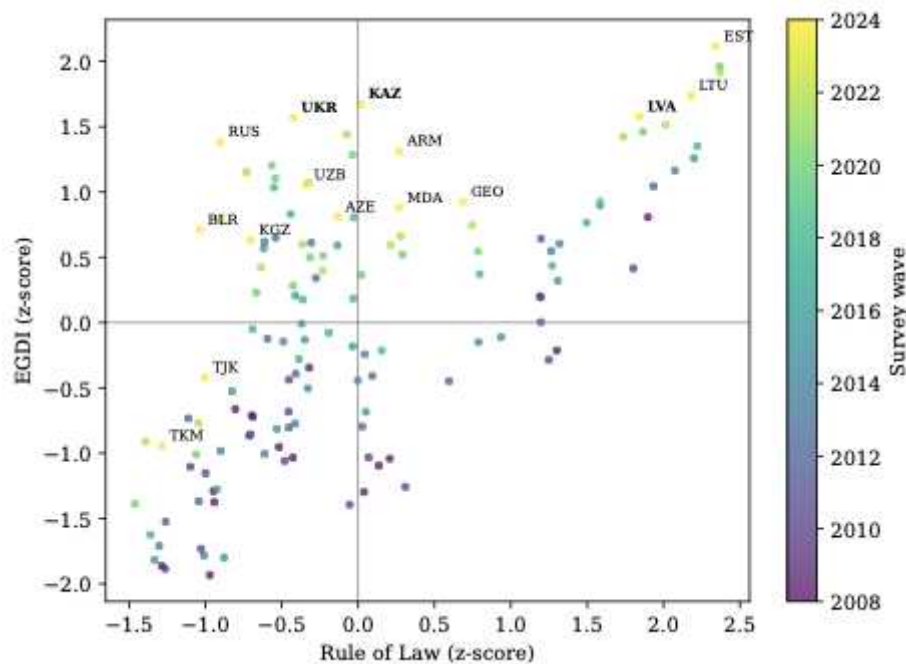


Figure 1. Joint distribution of digital government and the rule of law, 2008–2024 (standardized values; labels mark the 2024 wave; color indicates the survey wave)

level. The conditional hypothesis is therefore identified by within-country digitalization at different institutional levels, not by institutional change, and the fixed-effects estimates are accompanied by a within-between specification. Correlations are in Appendix B; variance inflation factors stay below 10 (maximum 9.55 for the EGDI, driven by its 0.92 correlation with internet users) and the centered interaction is unproblematic ($VIF = 2.03$). Figure 1 shows common support: all four quadrants are populated, the Baltic members occupy the high-high cell, Turkmenistan and Tajikistan the low-low cell, and observations move predominantly vertically, digitalization advancing at nearly fixed institutional positions.

4.2. Baseline estimates

Table 3 builds the specification across columns (1) to (6). With only the lagged key terms, the interaction is marginally positive (0.892; bootstrap $p = 0.110$). Once controls enter the baseline column (2), it collapses to -0.191 and stays near zero in columns (3) to (6), between -0.375 and 0.184 . A single variable is responsible. With $\ln$ population alone added to column (1), the interaction falls to 0.026 , whereas $\ln$ GDP per capita, growth, or trade openness added alone leave it between 0.58 and 0.86 .

Since country and wave effects already remove level differences and common trends, the unconditional interaction reflects the co-movement of population with the denominator of the FDI-to-GDP ratio within countries, a scaling effect rather than a within-country complementarity.

Column (2) is the baseline; wild cluster bootstrap p -values (Rademacher, imposed null, 9,999 replications) for the EGDI, the rule of law, and the interaction equal 0.240 , 0.058 , and 0.690 , respectively. Column (3) adds inflation and loses Turkmenistan; column (4) lags all four controls by one wave.

In the baseline column (2), the interaction equals -0.191 (bootstrap $p = 0.690$). Its precision bounds what the null can claim: the 95% interval runs from -1.144 to 0.761 on $t(14)$ and from -1.616 to 0.742 by inverting the bootstrap test, and the minimum detectable interaction at 80% power is 1.34 percentage points of GDP, about 0.45 of the within-country standard deviation of inflows (2.96). This is an absence of evidence for a complementarity of detectable size, not evidence of a zero. The EGDI main effect is negative and insignificant (-1.178 ; bootstrap $p = 0.240$), and the rule of law is positive (4.046 ; bootstrap $p = 0.058$); the latter

Table 3. Digital government, the rule of law, and FDI inflows, estimated by two-way fixed effects

Variable	(1)	(2)	(3)	(4)	(5)	(6)
EGDI (z, lagged one wave)	0.483 (1.444)	-1.178 (0.993)	-1.426 (0.893)	-0.615 (1.023)	-1.129 (0.785)	-1.255 (1.085)
Rule of Law (z, lagged one wave)	2.973 (2.443)	4.046* (1.747)	3.760 (2.081)	4.864 (2.605)	3.748 (1.855)	4.513* (2.053)
EGDI × Rule of Law (lagged)	0.892 (0.456)	-0.191 (0.444)	-0.062 (0.447)	-0.271 (0.640)	-0.375 (0.673)	0.184 (0.860)
ln GDP per capita		3.096 (3.675)	5.004 (3.242)	2.247 (4.674)	4.313 (4.048)	3.439 (5.052)
GDP growth		-0.016 (0.091)	-0.029 (0.095)	0.003 (0.064)	-0.029 (0.094)	-0.070 (0.117)
Trade openness		0.043 (0.025)	0.022 (0.034)	-0.030 (0.033)	0.030 (0.031)	0.057* (0.026)
ln population		-13.547* (4.630)	-14.450 (4.286)	-22.874 (7.514)	-12.397* (4.553)	-12.685 (8.043)
ln(1 + inflation)			-0.416 (4.168)			
Internet users					-0.037 (0.061)	
Resource rents						-0.085 (0.109)
Controls timing		t	t	t-1	t	t
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Wave fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120	120	107	120	116	104
Countries	15	15	14	15	15	15
R ²	0.504	0.580	0.536	0.573	0.593	0.604
Within-R ²	0.102	0.241	0.209	0.227	0.179	0.246

Note: The dependent variable is FDI net inflows (% of GDP), biennium mean. Country-clustered (CRV1) standard errors in parentheses, with p-values on the t-distribution with G-1 degrees of freedom; * p < 0.05, ** p < 0.01, *** p < 0.001.

should be read with caution given the reliability result. Population is large and negative (-13.547), reflecting the economy-size scaling of the ratio, and column (4) shows that lagging the controls leaves the key coefficients unchanged.

Figure 2 translates these estimates into marginal effects. A one-standard-deviation EGDI increase is associated with -0.979 percentage points of GDP at the 10th percentile of the lagged rule of law (95% CI [-2.955; 0.998]), -1.115 at the me-

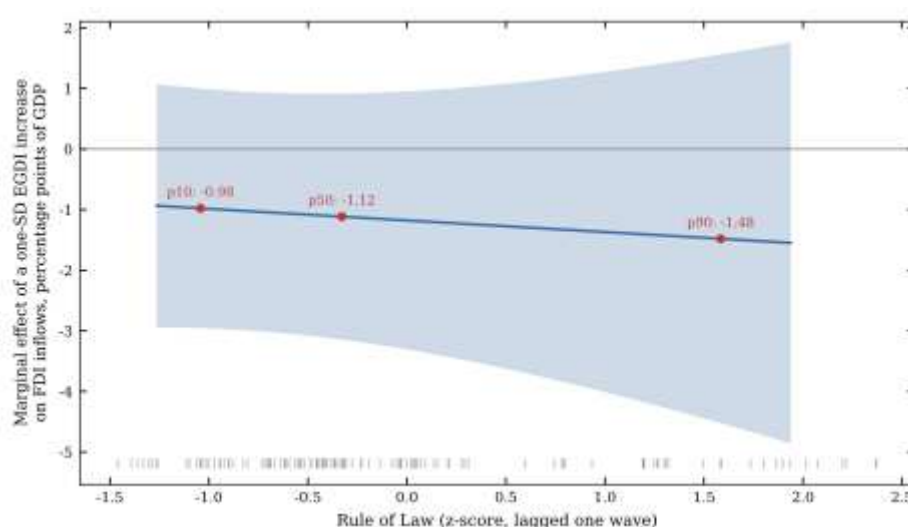


Figure 2. Marginal effect of a one-standard-deviation increase in the lagged EGDI on FDI inflows across the lagged rule-of-law distribution

dian $([-3.145; 0.915])$, and -1.481 at the 90th $([-4.524; 1.562])$. The profile is flat and nowhere significant, and every interval admits both a sizeable negative and a moderate positive association, so the within-country dimension does not support complementarity.

4.3. Within- versus between-country variation

Table 4 reports the within-between estimates of Eq. (3). Panel A, without the interaction, answers the level question: the within coefficients replicate fixed effects (-1.019 for the EGDI, 3.675 for the rule of law), while the between-country slope of the EGDI is -1.083 (bootstrap $p = 0.692$) and that of the rule of law is 0.511 ($p = 0.753$). Panel B adds the interaction, and the three between-country slopes remain far from significance (bootstrap $p = 0.821, 0.943, 0.865$). A regression on the 15 country means confirms this outside the panel framework: the bivariate slope is -0.174 , the slope with the full control set is -1.083 (HC3 $p = 0.839$), and the raw correlation of period averages is -0.07 . The slope is also sample-sensitive: on the 14-country sample that inflation imposes it equals $+2.54$ but remains insignificant (bootstrap $p = 0.297$), the difference driven by Turkmenistan, which combines the lowest period-average EGDI with the second-highest FDI-to-GDP ratio. There is no positive association between digital government and FDI inflows at the between-country level either.

In Panel B, the within coefficients are identical to Table 3, column (2), and the standard errors differ only because the between terms replace the country effects.

Appendix D decomposes the interaction into its four within and between components (Schunck & Perales, 2017). None is significant, jointly ($\chi^2(4) = 4.04, p = 0.400$) or individually. The within-within component is essentially unidentified given the reliability result, and the within-between component, which is the operative part of the conditional hypothesis, equals -0.794 (bootstrap $p = 0.266$).

4.4. Robustness and heterogeneity

Figure 3 summarizes the interaction across seventeen specifications; Appendix C lists each variant and reports all eighteen rows with Holm-adjusted bootstrap p -values. The within-country null is stable: the coefficient stays between -0.68 and $+0.96$ with bootstrap p -values of 0.32 or higher, apart from the FE-only column ($p = 0.11$) and the EU departures below. Neither the subsample ending in 2020 nor the direct conflict control revives the interaction, so wartime disruption does not explain the null result.

Two departures arise, both tied to EU membership. When the three EU members are excluded, the interaction within the twelve non-EU economies is negative and, taken on its own, significant

Table 4. Within- and between-country slopes from the within-between (REWB) specification

Variable	Coef.	SE	p (CRV1)	p (WCB)
Panel A. Without the interaction				
Within: EGDI (z, lagged)	-1.019	(0.955)	0.304	0.282
Within: Rule of Law (z, lagged)	3.675	(1.567)	0.034	0.042
Between: country mean of EGDI (z, lagged)	-1.083	(1.620)	0.515	0.692
Between: country mean of Rule of Law (z, lagged)	0.511	(1.329)	0.706	0.753
Mundlak-Wooldridge test, H0 within = between (6 restrictions)	$\chi^2(6) = 12.35, p = 0.055; F(6, 14) = 2.06, p = 0.125$			
Panel B. With the interaction				
Within: EGDI (z, lagged)	-1.178	(1.027)	0.271	
Within: Rule of Law (z, lagged)	4.046	(1.809)	0.042	
Within: EGDI $\times$ Rule of Law (lagged)	-0.191	(0.460)	0.684	
Between: country mean of EGDI (z, lagged)	-0.757	(2.170)	0.732	0.821
Between: country mean of Rule of Law (z, lagged)	0.303	(1.930)	0.877	0.943
Between: country mean of EGDI $\times$ Rule of Law (lagged)	0.250	(1.024)	0.811	0.865
Mundlak-Wooldridge test, H0 within = between (7 restrictions)	$\chi^2(7) = 11.24, p = 0.129; F(7, 14) = 1.61, p = 0.213$			

Note: The dependent variable is FDI net inflows (% of GDP); $N = 120$, 15 countries. Each regressor enters as its deviation from the country mean (within) and as its country mean (between); the controls enter the same way; wave dummies and a constant are included; standard errors are clustered by country with p -values on $t(14)$, and WCB p -values use Rademacher weights, an imposed null, and 9,999 replications.

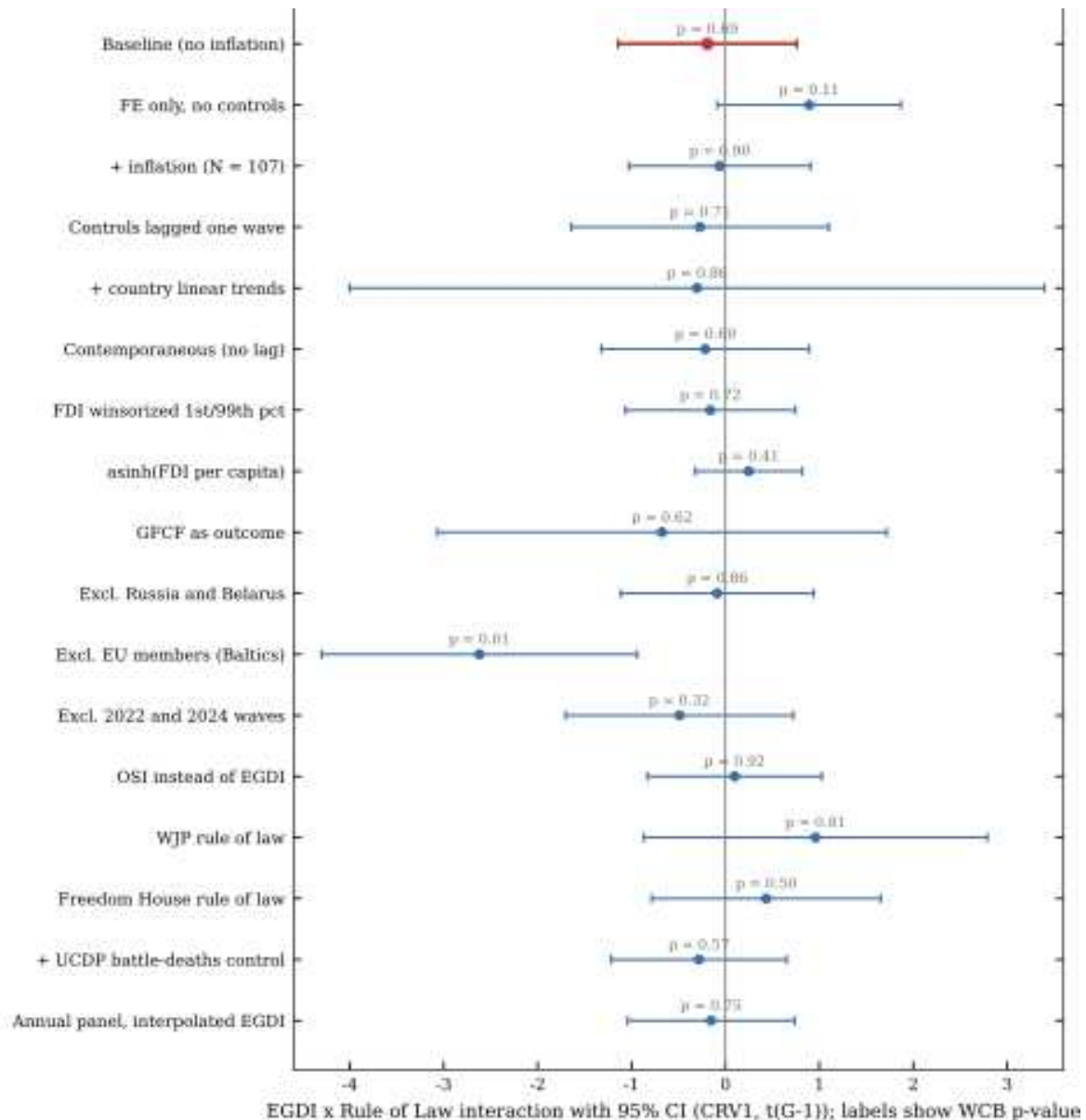


Figure 3. Interaction coefficient across seventeen specifications

(-2.619; bootstrap $p = 0.013$; $N = 96$, 12 countries). It is, however, one estimate among the seventeen alternatives of Appendix C: the Holm correction raises its bootstrap p -value to 0.226, and under independent true nulls the probability of at least one nominally significant result among seventeen tests would be 0.58. Within this subsample, the marginal effect falls from +1.663 percentage points of GDP at the 10th percentile of the non-EU rule of law to -1.713 at the 90th ($[-3.363; -0.064]$). Table 5 tests the EU difference formally, through a triple interaction of the lagged key terms with a non-EU indicator in the full sample. The interaction is 1.892 in the three EU members and -2.977 in the

twelve non-EU economies, and the difference of -4.869 is significant with cluster-robust errors ($p = 0.003$) but only marginally so under the bootstrap ($p = 0.062$), the appropriate benchmark when one side rests on three clusters. Both results are therefore treated as heterogeneity evidence rather than as headline findings.

Table 6 provides a more flexible view of the same gradient. With countries grouped into terciles by their period-average rule of law, the lagged EGDI slopes decline monotonically, from 0.113 in the lower tercile to -1.372 in the middle and -2.317 in the upper. The upper-lower difference equals

Table 5. EU heterogeneity of the interaction, triple-interaction specification

Group	EGDI × Rule of Law (lagged)	SE	p (CRV1)	p (WCB)
EU members (EST, LTU, LVA)	1.892	(0.888)	0.051	
Non-EU economies (12)	−2.977	(0.691)	0.001	
Difference (EGDI × Rule of Law × non-EU)	−4.869	(1.335)	0.003	0.062

Note: Two-way fixed-effects estimation on the baseline sample (N = 120, 15 countries) with the three lagged key terms, their products with a non-EU indicator, and the controls of Table 3, column (2); the non-EU indicator itself is absorbed by the country effects. The non-EU coefficient is the linear combination of the EU coefficient and the difference, with its delta-method standard error. p-values on t(14); the WCB p-value refers to the triple-interaction coefficient.

Table 6. Within-country EGDI slopes by rule-of-law terciles, exploratory

Slope of EGDI (z, lagged)	Coefficient	SE	p (CRV1)	p (WCB)
Lower tercile (T1)	0.113	1.183	0.925	
Middle tercile (T2)	−1.372	0.907	0.153	
Upper tercile (T3)	−2.317	1.389	0.117	
Difference T2 – T1	−1.485	0.891	0.118	0.145
Difference T3 – T1	−2.430	1.009	0.030	0.098
Joint test T1 = T2 = T3	$\chi^2(2) = 6.15$		0.046	

Note: Two-way fixed-effects estimation on the baseline sample (N = 120); the three slopes replace the EGDI main effect and the interaction; controls as in Table 3, column (2). Terciles by period-average rule of law are T1 = {BLR, KGZ, TJK, TKM, UZB}, T2 = {AZE, KAZ, MDA, RUS, UKR}, and T3 = {ARM, EST, GEO, LTU, LVA}. Differences are estimated directly by reparameterizing the slopes as T1 plus contrasts, so that the WCB applies to a single coefficient; p-values are on t(14).

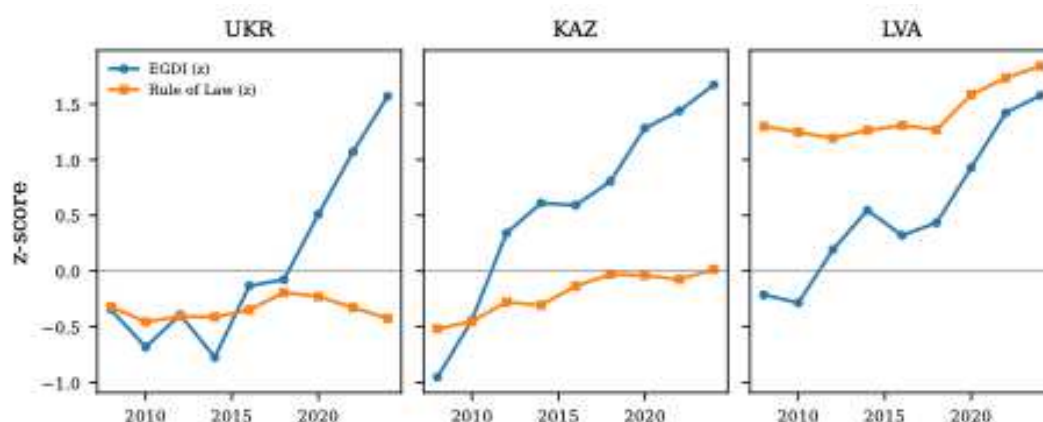
−2.430 (bootstrap p = 0.098), the middle–lower difference −1.485 (p = 0.145), and the joint test of equal slopes gives p = 0.046 with cluster-robust errors. With five countries per group and a bootstrap p-value above 0.05, this is exploratory evidence, and where the cross-partial is detectable at all, it carries the substitution sign.

4.5. Diagnostics and summary

The Breusch-Pagan test rejects homoskedasticity (LM = 14.38, p = 0.045), which cluster-robust and bootstrap inference already accommodates,

and the Pesaran CD test finds no residual cross-sectional dependence once wave effects are included (CD = −1.35, p = 0.177, on 105 country pairs). Digital government and the rule of law therefore operate neither as complements nor as detectable substitutes: the association is null within countries at every institutional level and null between them, and the only conditional structure is exploratory.

The three illustrative economies show the mechanics (Figure 4). Kazakhstan pairs the third-highest period-average EGDI (0.726) with a middle-tercile rule of law and 5.31% of GDP in

**Figure 4.** Digitalization and rule-of-law trajectories in the illustrative economies Ukraine, Kazakhstan, and Latvia (standardized values, 2008–2024)

inflows, while Turkmenistan, lowest on both indices, records 7.35%, the pairing that removes any between-country gradient. Ukraine digitalized rapidly from the middle tercile (EGDI 0.642, FDI 3.15% of GDP), its 2022–2024 waves showing why wartime shocks are controlled for rather than interpreted, and Latvia combines upper-tercile institutions with a high EGDI (0.718) yet moderate inflows (3.76% of GDP).

5. DISCUSSION

Institutions were established as determinants of foreign direct investment from level differences across countries (Globerman & Shapiro, 2002; Daude & Stein, 2007), and the digital-investment studies identify the same way (Mai, 2025; Zhang et al., 2024). The present results are contrary to that strand at both levels, for two regional reasons. First, inflows relative to GDP are governed here by economy size and resource endowment rather than administrative quality, so a single resource exporter reverses the sign of the between-country slope, consistent with resource abundance weakening the payoff of institutions in the region (Gasimov et al., 2023). Second, the between-country slope of a pooled or Mundlak design is not the coefficient on the country mean but its sum with the within coefficient, and on fifteen countries that sum is too imprecise to carry a level claim. The positive cross-country association is therefore less contradicted here than unidentifiable once levels and changes are separated.

The within-country null runs against both hypotheses: complementarity requires the returns to digitalization to rise with the rule of law, as institutional preconditions do for investment in general (Daude & Stein, 2007), substitution re-

quires them to fall, and neither is detectable. The only conditional structure, steeper negative EGDI slopes at higher institutional levels outside the EU, is directional but has analogs: rule-of-law dimensions can enter FDI panels negatively (Bhujabal et al., 2024), and the returns to digital exposure vary with context and reverse beyond a threshold (Zhang et al., 2024; Ho et al., 2025), as the most digitalized economies of the region would. After correction for multiple specifications and under inference suited to three EU clusters, however, the gradient invites a test elsewhere rather than evidence against complementarity. It also explains why within-country designs are unlikely to settle the question with the WGI, whose within-country movement is indistinguishable from its reported error, so that such coefficients estimate noise as much as signal.

Why digital government fails to convert into investor confidence is suggested by Ukrainian evidence that its effect on recovery and investment runs entirely through institutional trust and government effectiveness (Topazly et al., 2026); where these mediators barely move, as here, index gains do not move either, and inflows relative to GDP also fall mechanically as economies grow. For the literature, the positive findings are level phenomena that fixed-effects designs on small regional panels do not reproduce (Mai, 2025); for policy, e-government cannot be justified by expected foreign investment within a policy horizon, whether Ukraine's wartime acceleration or Kazakhstan's index gains. Two caveats bound this reading: the relationships are conditional rather than causal, so the finding is what does not appear rather than an identified null mechanism, and the intervals exclude only a large conditional effect.

CONCLUSION

This study asked whether the rule of law conditions the investment payoff of digital government in the post-Soviet region, and whether that payoff exists within countries, between them, or at neither level. Evidence comes from a biennial panel of 15 economies over nine E-Government Survey waves, 2008–2024 (135 cells; baseline $N = 120$), estimated with two-way fixed effects, a within-between specification, and wild cluster bootstrap inference.

Within countries, no complementarity was found; the interaction equaled -0.191 (bootstrap $p = 0.690$, bootstrap 95% CI from -1.616 to 0.742), and the marginal effect of a one-standard-deviation EGDI increase was insignificant at every rule-of-law level (-0.979 to -1.481 percentage points of GDP). Between

countries, the level association is null as well, with a slope of -1.083 (bootstrap $p = 0.692$) and a raw correlation of period averages of -0.07 , and the positive slope of a 14-country sample is insignificant and rests on Turkmenistan. The only conditional structure is exploratory and substitution-signed, an interaction of -2.619 outside the EU members (bootstrap $p = 0.013$, Holm-adjusted $p = 0.226$) and a tercile difference of -2.430 (bootstrap $p = 0.098$). The within-country variation of the WGI rule of law is statistically indistinguishable from its measurement error (reliability -0.09 ; none of 120 biennial changes significant), and the Mundlak-Wooldridge test of within against between slopes gives $p = 0.055$.

For the region's governments, e-government should not be justified by expected foreign investment at any level of judicial quality, whether Ukraine's wartime digital leap or Kazakhstan's index gains. Inflows relative to GDP track economy size and resource endowment, not digital or institutional rankings, and digitalization is better argued by direct returns in service quality, transparency, and administrative cost.

Institutional reform stands on its own terms. Because index-level improvements in the rule of law are too small and too noisy to move investment measurably within a policy horizon, discretion-reducing tools such as electronic procurement and registries should be pursued for their governance value and evaluated by service outcomes rather than by capital inflows.

For evaluators of digital programs, within-country movements of perception-based governance indices carry no usable signal at this frequency, and level associations should be tested as between-country slopes with inference suited to a handful of countries before they enter policy advice.

DATA AVAILABILITY

The data that support the findings of this study are openly available from public sources, and no new primary data were generated. Foreign direct investment and the macroeconomic control variables were obtained from the World Bank World Development Indicators (World Bank, 2025b). The E-Government Development Index and its subindices come from the United Nations E-Government Survey (United Nations, 2024), and rule-of-law and the other governance dimensions come from the Worldwide Governance Indicators (Kaufmann et al., 2011). The income-group classification used in Appendix A follows the World Bank (2025a). The robustness analysis additionally draws on the World Justice Project and Freedom House rule-of-law measures compiled in the Quality of Government Standard Dataset (Teorell et al., 2025) and on battle-related deaths from the UCDP Georeferenced Event Dataset, version 25.1 (Sundberg & Melander, 2013).

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APPENDIX A. Sample composition: countries, income groups, and rule-of-law terciles

Table A1. Sample composition: countries, income groups, and rule-of-law terciles

Country	ISO3	Income group (WB FY2026)	RoL tercile	Mean EGDI	Mean RoL	Mean FDI, % GDP	Waves
Armenia	ARM	Upper middle income	T3 (high)	0.590	−0.296	3.810	9
Azerbaijan	AZE	Upper middle income	T2 (mid)	0.601	−0.669	4.691	9
Belarus	BLR	Upper middle income	T1 (low)	0.663	−0.920	2.846	9
Estonia	EST	High income	T3 (high)	0.846	1.316	7.223	9
Georgia	GEO	Upper middle income	T3 (high)	0.621	0.127	8.564	9
Kazakhstan	KAZ	Upper middle income	T2 (mid)	0.726	−0.554	5.308	9
Kyrgyz Republic	KGZ	Lower middle income	T1 (low)	0.555	−0.923	4.926	9
Lithuania	LTU	High income	T3 (high)	0.770	0.856	3.485	9
Latvia	LVA	High income	T3 (high)	0.718	0.741	3.760	9
Moldova	MDA	Upper middle income	T2 (mid)	0.608	−0.328	4.026	9
Russian Federation	RUS	High income	T2 (mid)	0.722	−0.919	1.732	9
Tajikistan	TJK	Lower middle income	T1 (low)	0.411	−1.190	3.333	9
Turkmenistan	TKM	Upper middle income	T1 (low)	0.382	−1.456	7.352	9
Ukraine	UKR	Upper middle income	T2 (mid)	0.642	−0.670	3.154	9
Uzbekistan	UZB	Lower middle income	T1 (low)	0.577	−1.011	2.176	9

Note: Income groups follow the World Bank classification for FY2026 (July 1, 2025 to June 30, 2026), based on 2024 Atlas GNI per capita. Terciles are formed on the period-average WGI Rule of Law estimate, 2008–2024. Means are computed over the nine biennial waves. The non-EU indicator and the “excluding EU members” subsample are defined by EU membership, not by income group.

APPENDIX B. Pairwise correlation matrix

Table B1. Pairwise correlation matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) FDI inflows	1.00												
(2) GFCF	0.42	1.00											
(3) EGDI	−0.28	−0.38	1.00										
(4) OSI	−0.28	−0.40	0.94	1.00									
(5) Rule of Law	0.13	−0.19	0.63	0.57	1.00								
(6) EGDI × RoL	0.29	0.25	0.03	−0.04	0.39	1.00							
(7) ln GDP pc	0.02	−0.13	0.64	0.54	0.64	0.26	1.00						
(8) GDP growth	0.21	0.30	−0.33	−0.27	−0.28	0.15	−0.21	1.00					
(9) Trade openness	0.24	0.04	0.34	0.23	0.65	0.40	0.28	−0.11	1.00				
(10) ln(1+inflation)	0.06	0.18	−0.16	−0.17	−0.37	−0.12	−0.21	0.12	−0.03	1.00			
(11) ln population	−0.30	−0.17	−0.07	−0.02	−0.62	−0.45	−0.19	−0.04	−0.63	0.33	1.00		
(12) Internet users	−0.40	−0.41	0.92	0.85	0.53	−0.05	0.60	−0.37	0.23	−0.25	−0.10	1.00	
(13) Resource rents	0.10	0.06	−0.24	−0.18	−0.47	0.01	0.02	0.35	−0.43	0.14	0.41	−0.22	1.00

Note. Pairwise Pearson correlations over available country-wave cells of the biennial panel (135 cells; 120 for inflation-based cells, 119 for resource rents). Lower triangle shown; the interaction is the product of standardized EGDI and Rule of Law.

APPENDIX C. Robustness battery: full estimates

Table C1. Robustness battery: full estimates

Specification	N	Countries	EGDI × RoL	SE	p (CRV1)	p (WCB)	p (WCB, Holm)	EGDI	Rule of Law
Baseline (Table 3, column 2)	120	15	−0.191	0.444	0.673	0.690		−1.178	4.046
FE only, no controls (Table 3, column 1)	120	15	0.892	0.456	0.071	0.110	1.000	0.484	2.974
Inflation added (Table 3, column 3)	107	14	−0.062	0.447	0.892	0.896	1.000	−1.426	3.760
Controls lagged one wave (Table 3, column 4)	120	15	−0.271	0.640	0.678	0.715	1.000	−0.615	4.864
Country-specific linear trends added	120	15	−0.302	1.725	0.864	0.862	1.000	−0.354	2.345
Contemporaneous (no lag)	135	15	−0.214	0.516	0.684	0.689	1.000	−1.008	3.166
FDI winsorized at 1st/99th percentiles	120	15	−0.161	0.422	0.709	0.725	1.000	−1.189	3.697
asinh(FDI per capita) as dependent variable	120	15	0.248	0.266	0.366	0.411	1.000	−0.039	0.733
GFCF as outcome (domestic investment)	120	15	−0.675	1.116	0.555	0.616	1.000	−2.505	14.081
Excl. Russia and Belarus	104	13	−0.086	0.471	0.858	0.856	1.000	−1.468	5.008
Excl. EU members (Estonia, Latvia, Lithuania)	96	12	−2.619	0.764	0.006	0.013	0.226	−1.165	2.878
Excl. 2022 and 2024 waves	90	15	−0.489	0.566	0.402	0.317	1.000	−1.319	4.638
OSI instead of EGDI	120	15	0.098	0.434	0.825	0.919	1.000	−0.432	3.266
EGDI × RoL × non-EU (difference, Table 5)	120	15	−4.869	1.335	0.003	0.062	0.994	−4.191	2.993
WJP rule of law	56	11	0.960	0.821	0.269	0.806	1.000	0.287	3.190
Freedom House rule of law	120	15	0.435	0.568	0.457	0.502	1.000	−0.641	1.635
UCDP battle-deaths control added	120	15	−0.282	0.436	0.529	0.573	1.000	−1.601	4.031
Annual panel, EGDI interpolated	224	15	−0.153	0.414	0.718	0.746	1.000	−0.880	3.205

Note: Each row re-estimates Eq. (1) under the stated variant with two-way fixed effects, country-clustered (CRV1) standard errors with p-values on $t(G - 1)$, and wild cluster bootstrap p-values with Rademacher weights, the null imposed, 9,999 replications, and a fixed seed. The Holm column adjusts the seventeen non-baseline bootstrap p-values by the step-down procedure over this family. Standardization of the EGDI, the OSI, and the rule of law is fixed on the full 135-cell panel in every row, including the annual panel, which uses two-year lags. In the triple-interaction row the reported coefficient is the difference between the non-EU and EU interactions, and the EGDI and rule-of-law columns are the EU-group main effects. Alternative-measure rows replace the digital or institutional variable and the interaction accordingly.

APPENDIX D. Within and between components of the interaction

Table D1. Four-component decomposition of the EGDI × Rule of Law interaction, within-between specification

Component	Coef.	SE	p (CRV1)	p (WCB)
Within: EGDI (z, lagged)	−1.432	1.094	0.212	0.182
Within: Rule of Law (z, lagged)	4.597	2.128	0.048	0.087
Within EGDI × within Rule of Law	−0.809	2.786	0.776	0.786
Within EGDI × between Rule of Law	−0.794	0.705	0.279	0.266
Between EGDI × within Rule of Law	2.816	1.627	0.105	0.118
Between: EGDI (country mean)	−0.768	2.188	0.731	0.818
Between: Rule of Law (country mean)	0.386	1.966	0.847	0.922
Between EGDI × between Rule of Law	0.194	1.011	0.851	0.889
Joint test, four interaction components = 0	$\chi^2(4) = 4.04$		0.400	
Joint test, three components with a within factor = 0	$\chi^2(3) = 3.68$		0.299	

Note: Eq. (4) estimated by pooled OLS on the baseline sample (N = 120, 15 countries) with wave dummies, a constant, the four baseline controls entered as within deviations and country means, and country-clustered standard errors with p-values on $t(14)$; WCB p-values as in Table C1. “Within” denotes deviation from the country mean over the estimation sample and “between” the country mean itself. The within-within component is identified only by within-country movements of the rule of law, which are statistically indistinguishable from measurement error (Results); the within-between component is the identified counterpart of the conditional hypothesis. Joint tests use the cluster-robust Wald statistic; the corresponding F versions give $p = 0.435$ and $p = 0.337$.