

Article

Improving the Effectiveness of Financial Control in Public Procurement: Risk-Based Digital Monitoring and Preventive Control

Uchkun Yunusovich Urokov

1. PhD in Economics, Professor, Tashkent State University of Economics

* Correspondence: uuroqov@tsue.uz

Abstract: This article examines the determinants of procurement control performance in a transition economy and develops an integrated reform architecture that shifts control from detection towards prevention. The study combines an institutional analysis of the Uzbek procurement control system with an econometric investigation of a balanced regional panel covering fourteen administrative territories over 2018–2023 ($n = 84$). Two dependent variables are modelled: the price reduction coefficient, capturing the economy dimension of value for money, and violation density, capturing the legality dimension. Pooled OLS, region fixed-effects and two-way fixed-effects specifications are estimated, supported by multicollinearity, heteroskedasticity and autocorrelation diagnostics. The article proposes a six-pillar reform architecture – strategic planning, risk-based digital control organised around the «stop-or-explain» principle, the systematic contraction of direct awards, professional certification, the redesign of remedies, and evaluation on a total cost of ownership basis – and quantifies its expected effects using the estimated model coefficients.

Keywords: public procurement; financial control; risk-based supervision; value for money; e-procurement; corruption risk indicators; Uzbekistan; transition economies

Citation: Urokov, U. Y. Improving the Effectiveness of Financial Control in Public Procurement: Risk-Based Digital Monitoring and Preventive Control. Academic Journal of Digital Economics and Stability 2025, 38(3), 1699-1714

Received: 13th Apr 2025Revised: 28th May 2025Accepted: 15th Jun 2025Published: 21st Jul 2025

Copyright: © 2025 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license

(<https://creativecommons.org/licenses/by/4.0/>)

1. Introduction

Public procurement is simultaneously the largest single channel of discretionary public spending and the point at which budgetary resources are converted into physical goods, works and services. In OECD member states it accounts for roughly 12–13 per cent of gross domestic product and for close to one third of total general government expenditure. In developing and transition economies the share is frequently higher, while the institutional safeguards surrounding it are weaker. This combination of fiscal magnitude and institutional fragility makes procurement the single most consequential object of public financial control. [1]

The conversion point itself explains much of the risk. Up to the moment of contract award, budget resources exist as accounting entries subject to well-established treasury discipline; after award they become obligations towards private counterparties whose performance is costly to verify. Estimates cited in policy documents suggest that procurement-related corruption absorbs up to 10 per cent of allocations in advanced economies and up to 25 per cent in developing ones, equivalent to as much as 2 per cent of GDP. Even a conservative reading of these figures implies that investment in control technology is economically justified by a wide margin.

Nevertheless, the dominant model of procurement control in transition economies remains poorly matched to the nature of the risk it addresses. Three features recur. First, control is predominantly ex post: irregularities are identified after the contract has been

signed and often after payment, when the only available remedy is recovery of damages through litigation. Second, control is document-centred: the question asked is whether the required file exists, not whether the justification it contains corresponds to economic reality. Third, control performance is measured by detection volume – the number of violations found and the sums recovered – which systematically discourages prevention, because a violation successfully deterred leaves no trace in any performance indicator.

Uzbekistan offers an instructive setting in which to study these problems. Since 2018 the country has adopted a dedicated procurement law, migrated the overwhelming majority of procedures to electronic platforms, restructured the mandate of its supreme audit institution and approved successive medium-term procurement development strategies. The e-procurement infrastructure now generates a near-complete structured record of every competitive procedure. Yet the share of non-competitive awards has remained close to half of total procurement value, and the number of anti-competitive practices detected annually runs into the tens of thousands. The country thus combines an advanced data infrastructure with a control model that does not yet exploit it – a configuration shared by a number of post-Soviet and other transition economies. [2]

This paper addresses three questions. What are the measurable determinants of procurement control performance in such a setting? Does digitalisation, by itself, improve either the economy or the legality dimension of procurement outcomes? And what institutional architecture would convert an existing data infrastructure into an effective preventive control system?

The contribution is threefold. Empirically, the paper estimates a two-outcome panel model that separates the economy and legality dimensions of control performance and shows that the determinants of the two differ in policy-relevant ways. Theoretically, it links the results to the agency-theoretic and behavioural literature on control, and in particular to the Goodhart-type distortions that single-indicator performance regimes generate. Prescriptively, it develops an integrated six-pillar reform architecture whose components are specified at the level of concrete legal and technical mechanisms rather than general recommendations, and estimates the magnitude of the effects that their implementation could be expected to produce.

The remainder of the paper is organised as follows. Section 2 develops the theoretical framework and situates the study in the literature. Section 3 describes the institutional setting. Section 4 presents the data and the empirical strategy. Section 5 reports the results. Section 6 develops the proposed reform architecture. Section 7 simulates its expected effects. Section 8 discusses implications and Section 9 concludes.

1.1 Theoretical framework and related literature

1.1.1 Financial control as an institutional response to agency problems

The theoretical case for financial control in procurement rests on the divergence of interest between the citizen-taxpayer as ultimate principal and the contracting authority as agent. In the canonical formulation of Jensen and Meckling, the residual loss arising from this divergence can be reduced through monitoring, but only at a cost that must itself be counted against the benefit. Laffont and Tirole extended the argument specifically to procurement and regulation, showing that the optimal intensity of monitoring is jointly determined with the power of the incentive scheme under which the agent operates: strong incentives substitute for monitoring, and vice versa. [3] [4]

Public choice theory supplies the behavioural micro-foundation. Buchanan and Tullock model the public official as a rational maximiser of personal utility rather than as a neutral executor of collective preferences, implying that the alignment of official and public interest must be constructed institutionally rather than assumed. Transaction cost economics adds the observation that procurement is a contracting problem characterised by incomplete specification and costly ex post verification, so that a substantial share of the resources devoted to a procurement transaction is absorbed by search, negotiation, monitoring and dispute resolution rather than by production. [5] [6]

Two empirical strands qualify this framework in ways that matter for control design. Bandiera, Prat and Valletti, exploiting a policy experiment in Italian public purchasing, decompose excess spending into active waste, which benefits the decision-maker, and

passive waste, which arises from administrative burden and limited capacity. Their finding that passive waste accounts for the greater part of observed inefficiency implies that a control regime built exclusively around sanctioning will address only a minority of the loss. Fazekas, Tóth and King demonstrate that objective corruption risk can be measured directly from administrative procurement data using observable indicators such as single-bidding, short advertisement periods and repeated winners, establishing the feasibility of data-driven risk scoring at scale. [7] [8]

1.1.2. The limits of control and the measurement problem

A second literature identifies the boundaries beyond which additional control ceases to be productive. Goodhart's law, as generalised by Strathern, holds that a quantitative measure loses its validity as an indicator once it is adopted as a target. Campbell reached an equivalent conclusion for social programme evaluation. Applied to procurement supervision, the implication is concrete: if supervisory agencies are appraised by the number of violations detected, they will rationally concentrate on formally detectable and easily documented irregularities; if contracting authorities are appraised by «savings» measured against the estimated price, they will rationally inflate the estimate. Power describes the wider institutional consequence of this dynamic as the transformation of verification into ritual, in which the production of auditable records displaces the substantive outcome that auditing was intended to protect. [9] [10] [11] [12]

These arguments converge on a design principle that is central to the present paper. A control regime should not be evaluated by the volume of what it detects, but by the joint behaviour of a balanced set of indicators covering coverage, precision, economic return and prevention. A single-dimensional performance regime is not merely incomplete; it is actively distorting.

1.1.3. Risk-based supervision and preventive design

The migration of regulatory supervision from universal inspection towards risk-based targeting is now well established across financial regulation, tax administration and customs. Its procurement application is more recent but institutionally consolidated in several jurisdictions. The European Union's remedies regime introduced a mandatory standstill period between award and contract conclusion, an arrangement whose principal economic function is to relocate the point of intervention to a moment at which no financial obligation has yet arisen. The European Commission's ARACHNE tool applies risk scoring to beneficiaries and contractors of EU-funded projects. In Ukraine, automated risk indicators embedded in the ProZorro platform and the civic monitoring layer built around it illustrate both the potential of open procurement data and the characteristic failure mode of such systems: indicators that are not periodically recalibrated degrade into the detection of immaterial formal defects, and monitoring that is triggered after contract signature forfeits its preventive value. [13] [14] [15]

The Korean Online E-Procurement System provides the clearest evidence on the economics of embedding control within the transaction platform itself. Evaluations attribute annual savings of approximately KRW 8 trillion to the system, of which roughly 83 per cent accrues to suppliers through the elimination of transaction costs rather than to the public sector through price effects. This distribution is theoretically significant: it confirms the transaction-cost channel identified by Williamson and implies that simplification of procedural burdens is itself a source of fiscal saving, since supplier costs are ultimately reflected in bid prices. [16] [17]

1.1.4. Research gap

Three gaps motivate this study. First, the empirical literature on procurement control in transition economies has largely treated economy and legality outcomes interchangeably, although there is no a priori reason why the same institutional factors should drive both. Second, the effect of digitalisation is frequently asserted rather than estimated, and rarely separated from the effect of the analytical capacity that digitalisation makes possible. Third, and most importantly, the normative literature stops at the level of general recommendations – «strengthen internal control», «use risk-based approaches» – without specifying the legal and technical mechanisms through which such prescriptions would operate. This paper addresses all three.

1.2. Institutional setting

Uzbekistan's procurement regime is governed by a dedicated law adopted in 2018 and re-enacted in 2021, which establishes six statutory principles: rational, economical and effective use of financial resources; openness and transparency; competition and impartiality; proportionality; sustainability; and the unity and integrity of the procurement system. Procedures are conducted through a special information portal and a set of licensed electronic trading platform operators. Treasury registration of contractual obligations links procurement contracts to budget appropriations and constitutes the principal preventive control instrument currently in operation. [18] [19]

Supervisory competence is distributed across several institutions. The supreme audit institution conducts financial, compliance and performance audits; the ministry responsible for finance and its treasury service exercise preventive and concurrent control over budget execution; the competition authority reviews restrictive practices and complaints; a dedicated agency administers the procurement system itself; and internal audit units operate within some, but by no means all, contracting authorities. This configuration provides breadth of coverage but produces overlapping mandates and, critically, leaves the boundary between monitoring and formal control undefined in normative terms. [20] [21]

Two features of the setting are particularly relevant for the empirical analysis. First, the share of procurement conducted outside competitive procedures – through direct contracting and single-source awards – has remained persistently high, at close to half of total value throughout the observation period. Second, the coverage of analytical monitoring has consistently lagged behind the coverage of electronic procedure execution. The resulting divergence between data availability and data use is, in our reading, the central operational weakness of the system and the point at which the reform architecture proposed in Section 6 intervenes.

2. Materials and Methods

2.1. Data and variables

The empirical analysis uses a balanced panel of the fourteen administrative territories of Uzbekistan – the Republic of Karakalpakstan, twelve regions and the city of Tashkent – observed annually over 2018–2023, yielding 84 observations. The panel was assembled from procurement portal records, treasury execution data, supervisory body reporting and official statistical publications. Territory-level aggregation is appropriate for this research question because the institutional variables of interest – monitoring coverage, internal audit deployment and the intensity of direct contracting – are administered at that level, whereas transaction-level data would introduce heterogeneity in procurement object that the available covariates cannot control.

Two dependent variables are used in order to separate the two dimensions of control performance identified in Section 2. The price reduction coefficient (SAV), defined as the percentage difference between the aggregate estimated price and the aggregate contract price of competitively awarded procedures, captures the economy dimension of value for money. Violation density (VIOL), defined as the number of confirmed procedural and competition violations per thousand procedures, captures the legality dimension. Using both avoids the single-indicator distortion discussed in Section 2.2 and permits a direct test of whether the same institutional factors drive both outcomes. [22]

Five explanatory variables and one control are employed. Competition intensity (COMP) is the average number of admitted bids per lot. The direct award share (DIRECT) is the value share of procurement conducted through direct contracts and single-source awards. Digitalisation (EPROC) is the value share of procurement executed through electronic procedures. Risk-based control coverage (RBC) is the share of procurement value subject to analytical monitoring based on risk indicators, as distinct from routine procedural checking. Internal audit coverage (IAC) is the share of contracting authorities operating a functioning internal audit unit. The natural logarithm of procurement volume (LNVOL) controls for market scale. Full definitions are reported in the Appendix.

Table 1. Definition of variables

Variable	Definition	Unit	Expected sign (SAV / VIOL)
SAV	Price reduction coefficient: (estimated price – contract price) / estimated price for competitive procedures	per cent	– / –
VIOL	Violation density: confirmed procedural and competition violations per 1,000 procedures	count	– / –
COMP	Competition intensity: average number of admitted bids per lot	count	+ / –
DIRECT	Value share of direct contracts and single-source awards	per cent	– / +
EPROC	Value share of procurement executed through electronic procedures	per cent	+ / –
RBC	Share of procurement value subject to risk-indicator-based analytical monitoring	per cent	+ / –
IAC	Share of contracting authorities with a functioning internal audit unit	per cent	+ / –
LNVOL	Natural logarithm of annual procurement volume	log units	ambiguous

2.2. Model specification

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

$$SAV_{it} = \beta_0 + \beta_1 COMP_{it} + \beta_2 DIRECT_{it} + \beta_3 EPROC_{it} + \beta_4 RBC_{it} + \beta_5 IAC_{it} + \beta_6 LNVOL_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad [23]$$

where i indexes territories, t indexes years, μ_i denotes unobserved territory effects, λ_t denotes year effects and ε_{it} is the idiosyncratic error. The legality specification replaces SAV with VIOL and omits LNVOL, since violation density is already normalised by the number of procedures. Three estimators are reported for the economy model: pooled OLS, a one-way region fixed-effects specification and a two-way specification including year effects. Comparison across the three permits assessment of how much of the apparent effect of each variable is attributable to persistent territorial heterogeneity and to common temporal trends.

Two identification concerns require acknowledgement. Risk-based control coverage may be endogenous to control performance, since territories with better outcomes may find it administratively easier to extend monitoring. The fixed-effects specifications absorb the time-invariant component of this problem but not its time-varying component; results for RBC are therefore interpreted as conditional associations rather than causal effects. Competition intensity may likewise be jointly determined with the direct award share, and the correlation between the two (–0.800) is substantial, though the variance inflation factors reported below remain within conventional bounds.

3. Results

3.1. Descriptive statistics and dynamics

Table 2 reports descriptive statistics. Competition intensity averages 1.76 bids per lot over the observation period, well below the three-to-five range conventionally regarded as indicative of a competitive procurement market. The direct award share averages 54.12 per cent, and violation density varies by a factor of more than three across observations,

indicating substantial heterogeneity in institutional performance across territories and years.

Table 2. Descriptive statistics (14 territories, 2018–2023, n = 84)

Variable	Mean	Std. dev.	Minimum	Maximum
SAV (per cent)	4.26	2.68	–0.46	9.44
VIOL (per 1,000 procedures)	73.99	18.44	33.52	107.15
COMP (bids per lot)	1.76	0.55	1.02	2.91
DIRECT (per cent)	54.12	6.59	36.96	69.32
EPROC (per cent)	62.97	11.04	41.18	86.76
RBC (per cent)	32.40	14.05	7.27	58.95
IAC (per cent)	31.17	14.85	3.04	57.72
VOL (trillion UZS)	7.54	4.40	2.03	28.04

Table 3 reports annual means. All indicators move in the expected direction over the period: competition intensity rises from 1.17 to 2.45 bids per lot, the price reduction coefficient from 1.02 to 7.89 per cent, while the direct award share falls from 61.35 to 46.27 per cent and violation density from 98.16 to 49.16. Two features of this trajectory deserve emphasis. First, digitalisation advances considerably faster than risk-based monitoring throughout the period: by 2023 electronic execution covers 77.30 per cent of procurement value while analytical monitoring covers 51.70 per cent, a gap of 25.6 percentage points. Second, the reduction in the direct award share decelerates markedly in the final two years, from an average annual decline of 3.5 percentage points in 2019–2021 to 2.4 points thereafter, suggesting that the reserve of easily reversible exemptions has been exhausted.

Table 3. Annual means of the panel variables

Variable	2018	2019	2020	2021	2022	2023
SAV (per cent)	1.02	1.61	3.46	4.95	6.61	7.89
VIOL (per 1,000)	98.16	91.69	78.94	67.46	58.54	49.16
COMP (bids per lot)	1.17	1.23	1.60	1.88	2.22	2.45
DIRECT (per cent)	61.35	61.00	55.48	52.00	48.64	46.27
EPROC (per cent)	47.25	53.67	61.13	66.39	72.07	77.30
RBC (per cent)	12.68	21.52	28.10	35.36	45.02	51.70
IAC (per cent)	10.12	18.61	28.52	36.91	41.28	51.58
VOL (trillion UZS)	3.66	4.99	6.48	8.29	9.69	12.12

3.2. Determinants of the economy dimension

Table 4 reports estimates of the price reduction model. Competition intensity is positive and significant at the 1 per cent level in all three specifications, with a pooled coefficient of 2.0815: one additional admitted bid per lot is associated with a 2.08 percentage-point increase in the price reduction coefficient. The coefficient declines to 1.8870 under region fixed effects and to 1.5500 under two-way fixed effects, indicating that roughly a quarter of the pooled association reflects persistent territorial characteristics and common time trends rather than the competition mechanism itself. The magnitude nonetheless remains economically substantial and statistically robust.

The direct award share is negative and significant at the 1 per cent level throughout, with coefficients clustered tightly between –0.0967 and –0.0989: a ten-percentage-point increase in the direct award share is associated with a reduction of approximately one percentage point in realised savings. The stability of this coefficient across specifications is notable, since it indicates that the effect is not driven by territorial heterogeneity.

Risk-based control coverage carries a positive and significant coefficient in the pooled and region fixed-effects specifications (0.0460 and 0.0389 respectively) but loses significance under two-way fixed effects. Digitalisation is significant only in the pooled specification. Internal audit coverage is insignificant in every specification of the economy

model – a result that appears counter-intuitive but is explained below by the legality results.

Table 4. Determinants of the price reduction coefficient (SAV)

Variable	(1) Pooled OLS	(2) Region FE	(3) Two-way FE
COMP	2.0815*** (8.40)	1.8870*** (4.34)	1.5500*** (3.13)
DIRECT	-0.0967*** (-4.41)	-0.0989*** (-3.67)	-0.0969*** (-3.39)
EPROC	0.0409*** (2.96)	0.0397 (1.60)	0.0304 (0.91)
RBC	0.0460*** (3.58)	0.0389** (2.18)	0.0296 (1.42)
IAC	0.0059 (0.49)	0.0007 (0.05)	-0.0020 (-0.11)
LN VOL	-0.4455** (-2.29)	0.2174 (0.37)	0.2096 (0.26)
Constant	2.4184 (1.31)	2.1216 (0.94)	3.1754 (1.05)
Region effects	No	Yes	Yes
Year effects	No	No	Yes
R ²	0.9533	0.9576	0.9595
Adjusted R ²	0.9497	0.9450	0.9430
F-statistic	262.23***	–	–
Observations	84	84	84

Note: t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

3.3. Determinants of the legality dimension

Table 5 reports the violation density model, and its results diverge from the economy model in two respects that are central to the argument of this paper.

First, internal audit coverage, insignificant for savings, is negative and significant at the 5 per cent level for violations (-0.2160). Internal audit therefore operates on legality rather than on price: it detects and deters procedural irregularity without measurably improving commercial outcomes. This is consistent with its institutional design, which is oriented towards compliance assurance rather than commercial evaluation, and it implies that internal audit and competition policy are complements rather than substitutes.

Second, and more consequentially, the direct award share is statistically insignificant in the violation model (coefficient 0.0952, $p = 0.545$) despite being strongly significant in the savings model. The asymmetry admits a single coherent interpretation: direct awards generate substantial economic loss that the existing control apparatus does not record as violation. Because non-competitive procedures are, by construction, subject to fewer procedural requirements, they present fewer opportunities for formal non-compliance and therefore generate fewer detectable violations, while simultaneously removing the market mechanism through which price discipline is enforced. Direct contracting thus constitutes a systematic blind spot rather than a well-controlled exception – a finding with direct implications for the reform architecture developed below.

Risk-based control coverage carries the largest standardised effect in the violation model (-0.4915, significant at 1 per cent). Digitalisation is negative and significant (-0.2407), indicating that electronic execution does reduce recorded violations, in contrast to its weak performance in the savings model. Competition intensity again dominates in magnitude, with a coefficient of -10.2435.

Table 5. Determinants of violation density (VIOL), pooled OLS

Variable	Coefficient	Std. error	t-statistic	p-value
COMP	-10.2435	1.7509	-5.85	0.000
DIRECT	0.0952	0.1565	0.61	0.545
EPROC	-0.2407	0.1006	-2.39	0.019
RBC	-0.4915	0.0936	-5.25	0.000
IAC	-0.2160	0.0848	-2.55	0.013
Constant	124.6502	12.9275	9.64	0.000

Variable	Coefficient	Std. error	t-statistic	p-value
$R^2 = 0.9469$; adjusted $R^2 =$ 0.9435 ; $F =$ 278.08 $(p < 0.001)$; n $= 84$				

3.4. Diagnostics and robustness

Table 6 reports the diagnostic tests. All variance inflation factors lie below the conventional threshold of ten, with the highest values attaching to risk-based control coverage (7.524) and internal audit coverage (7.612), reflecting their common institutional driver. The Breusch–Pagan test does not reject homoskedasticity ($LM = 7.064$, $p = 0.315$) and the Durbin–Watson statistic of 2.087 indicates no material first-order autocorrelation. The explanatory power of both models is high, which is expected given that the specifications include the principal institutional determinants of aggregate territorial outcomes; it also implies that the residual variation available for identification is limited, and coefficient magnitudes should be read with that caveat.

Table 6. Diagnostic tests

Test / statistic	Value	Threshold	Interpretation
VIF – COMP	4.328	< 10	Acceptable
VIF – DIRECT	4.806	< 10	Acceptable
VIF – EPROC	5.360	< 10	Acceptable
VIF – RBC	7.524	< 10	Acceptable; near upper range
VIF – IAC	7.612	< 10	Acceptable; near upper range
VIF – LNVOL	2.467	< 10	Acceptable
Breusch–Pagan LM	.064 ($p = 0.315$)	$p > 0.05$	Homoskedasticity not rejected
Durbin–Watson	2.087	1.5 – 2.5	No material autocorrelation

The central empirical conclusion is that digitalisation and control are analytically distinct. Electronic execution renders procurement activity observable; it does not, by itself, make it economical. The variable that consistently carries explanatory power across both outcome dimensions is not the extent of electronic execution but the extent to which the resulting data are subjected to risk-based analysis, alongside the level of competition that the procedural design actually generates. This distinction structures the reform architecture proposed in the following section.

3.5. A proposed reform architecture

The empirical results identify three leverage points: competition intensity, the direct award share and the depth of analytical monitoring. They also identify a blind spot – the absence of any detection mechanism calibrated to non-competitive awards. This section develops an integrated reform architecture addressed to these findings. The architecture is organised in five technical layers (Figure 1) and six policy pillars (Table 7). Its design principle is that control instruments should be embedded in the transaction platform rather than applied to it from outside, and that intervention should occur before a financial obligation arises rather than after it.

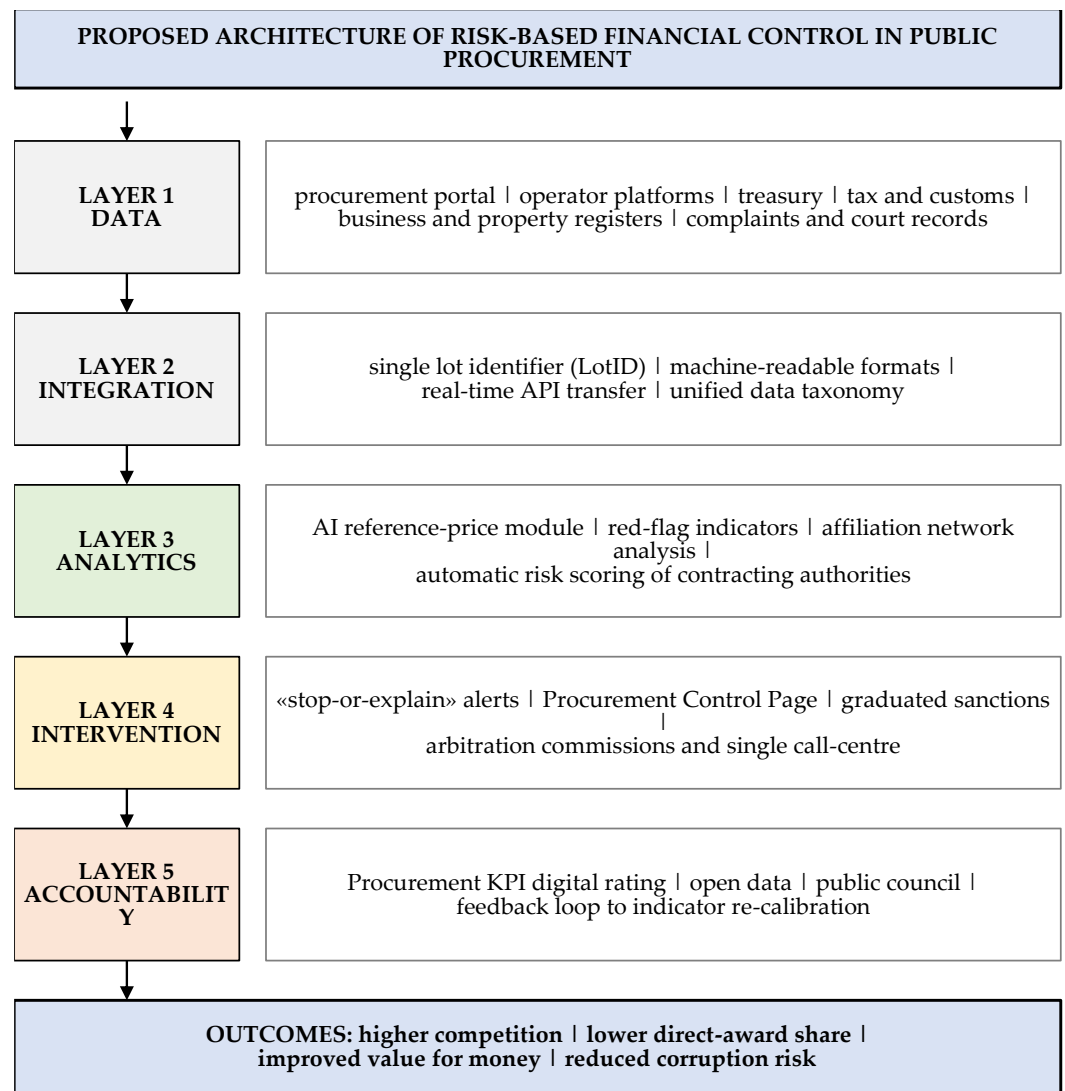


Figure 1. Proposed five-layer architecture of risk-based financial control in public procurement

Source: authors' elaboration.

3.6 Pillar I: Strategic planning and category management [24]

Control exercised at the level of individual procedures cannot address inefficiency that originates in the fragmentation of demand. We propose that contracting authorities above a defined threshold be required to prepare and publish rolling three-year procurement plans, and that expenditure estimates be constructed in the breakdown of goods, works and services that the procurement schedule will subsequently use. For major state-participated investment projects, a dedicated project procurement plan should be generated in a standardised machine-readable form. The control significance of this requirement is that it establishes a documented ex ante benchmark against which subsequent deviations become automatically detectable; in its absence, the need itself is unverifiable and every downstream control is reduced to procedural checking.

For technically complex goods with service lives exceeding three years, we propose that suppliers be required to assume a minimum three-year warranty, maintenance and spare-parts obligation, and that evaluation criteria incorporate warranty duration, service coverage, energy efficiency and maintenance cost alongside acquisition price. This converts the procurement decision from a price comparison into a cost-of-ownership comparison and is developed further in Pillar VI.

3.7. Pillar II: Risk-based digital control and the «stop-or-explain» principle

The core of the proposed architecture is the relocation of the control intervention point. Under the prevailing model, supervisory attention is triggered by a complaint or

by a scheduled inspection, in both cases after contract conclusion. We propose instead that the e-procurement system compute a composite risk index for every procedure at the moment of publication, using twelve weighted indicators covering affiliation between the winner and other participants, single-bidding, absence of price reduction, repeat-winner frequency, deviation of the estimated price from an algorithmically generated market reference, uniqueness of technical parameters, evidence of contract splitting, minimal advertisement periods, contract value escalation through addenda, the contracting authority's violation history, temporal clustering of bid submissions and performance delays.

Where the index exceeds a defined threshold, the system should suspend progression to the next procedural stage and issue an automated request for justification, specifying the risk detected and its probable determinants. The contracting authority may either provide a reasoned explanation or make a correction; both are recorded in the audit trail and become available to supervisory bodies for subsequent monitoring. This «stop-or-explain» mechanism is set out in Figure 2.

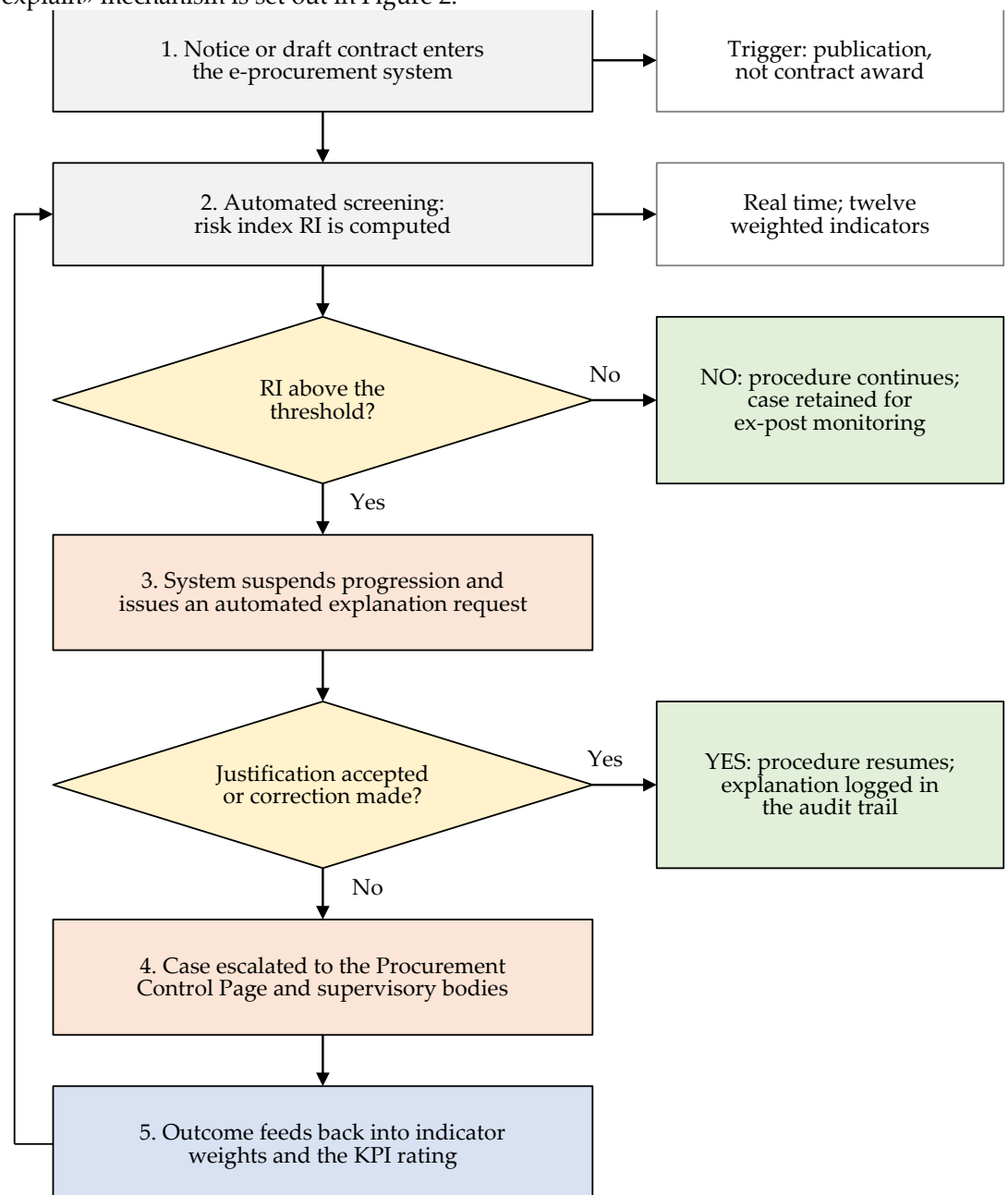


Figure 2. The «stop-or-explain» control algorithm

Source: authors' elaboration.

Three design features of this mechanism warrant emphasis. First, the initial response to a detected risk is a request for explanation rather than a sanction. This is a direct application of the active–passive waste distinction: where the underlying cause is limited capacity rather than intent, an explanation request corrects the outcome at a fraction of the cost of an inspection. Second, the mechanism operates before any financial obligation is created, which eliminates the recovery problem entirely. Third, explanations are logged rather than merely accepted, so that patterns of justification themselves become an analytical input – a contracting authority that repeatedly invokes the same exemption becomes visible in the aggregate data even when each individual justification is formally adequate.

The mechanism requires a supporting institutional layer. We propose a consolidated Procurement Control Page within the procurement portal, on which the results of all supervisory activity – inspection outcomes, instructions, notifications, administrative protocols and their execution status – are published in a single structured register. This addresses the fragmentation of supervisory information across agencies, which at present prevents any single body from observing the full risk profile of a contracting authority. The same register should support automatic risk classification of contracting authorities and the maintenance of a Procurement KPI digital rating, converting supervisory output into a forward-looking allocation instrument rather than a retrospective record.

3.8. Pillar III: Contraction and regulation of direct awards

The finding that direct awards depress savings without generating detectable violations implies that this segment cannot be addressed through improved detection. It must be addressed structurally. We propose four measures.

First, a single electronic register of all legal instruments permitting direct contracting should be established, recording for each instrument its legal basis, validity period, scope of application, value ceiling and reporting requirements, with direct contracting on any basis not entered in the register prohibited. An inventory conducted for the purposes of this study identified more than 180 normative acts conferring such permissions, a number that makes systematic supervision impossible and effectively converts the exception into a parallel regime.

Second, draft legislation containing direct-contracting permissions should be automatically flagged as high-risk within the electronic legislative drafting system and blocked from advancing to the next approval stage until the competition authority has assessed its effect on the competitive environment. This introduces a competition impact assessment at the point where exemptions are created rather than after they have entered into force.

Third, intended direct contracts should be subject to mandatory public pre-notification during which other economic operators may submit lower price offers. The contracting authority should be obliged to consider such offers and to publish a reasoned decision on their acceptance or rejection. This mechanism introduces contestability into a segment from which competition has been procedurally excluded, at negligible administrative cost.

Fourth, all exceptional direct contracts should be automatically classified as high-risk procurement on the Procurement Control Page and designated as the first-priority object of supervisory attention. This directly implements the empirical finding that supervisory resources are currently allocated to the segment where violations are easiest to detect rather than to the segment where losses are largest.

3.9. Pillar IV: Professionalisation of the procurement workforce

The insignificance of internal audit coverage in the savings model, combined with its significance in the violation model, indicates a capacity constraint: existing control staff are equipped to assess compliance but not commercial quality. We propose a three-tier certification system – procurement officer, procurement manager and professional procurer – delivered through a dedicated training platform, with the highest tier accredited against international professional standards. Certification should become a condition for participation in procurement commissions above defined value thresholds,

and gross or systematic violation of procurement legislation should trigger revocation of certification with temporary disqualification.

This pillar is the least technologically demanding and the most frequently neglected component of procurement reform. Its economic rationale follows directly from the passive waste literature: where the majority of excess spending originates in limited capability rather than in intent, investment in capability dominates investment in enforcement on cost-effectiveness grounds. [25]

3.10. Pillar V: Remedies and dispute resolution

An effective preventive regime requires a remedies system capable of operating within the procurement timetable. We propose three elements. Arbitration commissions should be established at each platform operator to resolve disputes concerning procedures and contract performance below a defined value threshold, with mandatory participation of a non-governmental sector representative. A single call centre should provide real-time registration and routing of all procurement-related enquiries and complaints in a unified electronic register, with artificial intelligence applied to the identification of recurrent systemic problems. The review period for complaints requiring additional examination should be extendable, with corresponding suspension of the procedure, so that substantive review does not require the contract to be concluded first.

Complementing these, we propose that participants in competitive electronic procedures receive an automatically generated electronic evaluation statement disclosing the scoring outcome against each published criterion. Evaluation conducted on criteria not specified in the procurement documents, in breach of published relative weights, with differential treatment of participants in identical situations, or without documented justification should be formally defined as unjustified evaluation and constitute grounds for annulment. Conversely, defects that demonstrably did not affect equality of participants, the competitive environment, price offers or the identification of the winner should not, by themselves, constitute grounds for annulment – a rule that protects completed transactions from destabilisation on purely formal grounds while preserving intervention where the substantive outcome was affected.

3.11. Pillar VI: Total cost of ownership, offtake and offset mechanisms

The final pillar addresses the economy criterion directly. We propose that evaluation on a total cost of ownership basis – incorporating acquisition, delivery, installation, energy and resource consumption, maintenance, repair, spare parts and disposal over the asset's service life – be introduced on an experimental basis for a defined list of goods, with staged extension following evaluation of results. In parallel, offtake contracts should be available for products where domestic production exists but does not meet internal demand, and offset obligations – technology transfer, local cooperation, establishment of service and repair capacity, workforce training – should be applicable to major state-participated investment projects and strategically significant imports. [26]

Table 7. The six pillars of the proposed architecture and their transmission channels

Pillar	Principal mechanisms	Transmission channel	Target variable
I. Strategic planning	Rolling three-year plans; project procurement plans; life-cycle warranty requirements	Establishes an ex ante benchmark making deviation detectable	DIRECT, SAV
II. Risk-based digital control	Composite risk index; «stop-or-explain» suspension; Procurement Control Page; KPI rating	Relocates intervention to the pre-obligation stage	RBC, VIOL

Pillar	Principal mechanisms	Transmission channel	Target variable
III. Contraction of direct awards	Register of legal grounds; competition impact screening of draft acts; public pre-notification with counter-offers	Restores contestability in the non-competitive segment	DIRECT, COMP
IV. Professionalisation	Three-tier certification; mandatory qualification for commission membership; certification revocation	Reduces passive waste arising from limited capability	SAV, VIOL
V. Remedies	Arbitration commissions; single call centre; extended review with suspension; electronic evaluation statements	Makes substantive review feasible within the procurement timetable	VIOL, COMP
VI. Total cost of ownership	TCO evaluation pilot; offtake contracts; offset obligations	Shifts the award criterion from price to life-cycle cost	SAV

Source: authors' elaboration.

3.11 Simulated effects of the proposed architecture

The estimated coefficients permit an approximate quantification of the effects that implementation of the architecture could be expected to produce. Three individual scenarios and one combined scenario are considered, each expressed as a change in the relevant explanatory variable from its 2023 mean. The exercise is illustrative rather than predictive: it assumes linearity over the relevant range, treats the estimated associations as though they were causal, and abstracts from implementation lags and interaction effects. Its purpose is to establish the relative magnitude of the available policy levers, not to forecast outcomes.

Table 8. Simulated effects of the proposed measures (pooled OLS coefficients, 2023 baseline)

Scenario	Change in the explanatory variable	Expected change in SAV (p.p.)	Expected change in VIOL (units)
S1. Competition (Pillars III and V)	COMP from 2.45 to 3.00 (+0.55)	+1.15	-5.63
S2. Risk-based monitoring (Pillar II)	RBC from 51.7 to 80.0 (+28.3 p.p.)	+1.30	-13.91
S3. Direct awards (Pillar III)	DIRECT from 46.3 to 30.0 (-16.3 p.p.)	+1.58	not significant
S4. Internal audit and capability (Pillar IV)	IAC from 51.6 to 80.0 (+28.4 p.p.)	not significant	-6.13
Combined scenario (S1-S4)	All four simultaneously	+4.03	-25.67

Source: authors' calculations. Effects reported only where the underlying coefficient is significant at conventional levels.

Three observations follow. First, contraction of direct awards yields the largest single effect on the economy dimension (+1.58 percentage points) but no measurable effect on recorded violations – precisely the asymmetry identified in Section 5.3, and a further indication that the loss occurring in this segment is invisible to the existing detection apparatus. Second, risk-based monitoring is the dominant instrument for the legality dimension (–13.91 units), more than twice the effect of internal audit expansion. Third, the combined scenario yields an increase of approximately four percentage points in the price reduction coefficient. Applied to the 2023 procurement volume, an effect of this magnitude corresponds to a substantial fiscal saving, which provides the benchmark against which the implementation cost of the architecture should be assessed.

4. Discussion

The principal analytical result of this study is the separation of digitalisation from control. Electronic procurement systems generate a structured record of every transaction and thereby make irregularity observable; the empirical results indicate that they do not, by themselves, reduce it. The variable that consistently predicts both economy and legality outcomes is the extent to which the resulting data are analytically processed. In the terminology developed in Section 2, digitalisation removes the informational constraint on control but does not remove the analytical one. Where the second constraint binds – as the 25.6-percentage-point gap between electronic execution and analytical monitoring coverage indicates that it does in the setting studied – additional investment in digitalisation yields diminishing returns relative to investment in analytical capacity.

This finding qualifies a widespread assumption in the procurement reform literature and in the operational practice of development institutions, where platform deployment is frequently treated as the principal reform deliverable. The Korean evidence points in the same direction from a different angle: the greater part of the savings attributed to KONEPS arises from the elimination of supplier transaction costs rather than from improved price discipline, which suggests that the fiscal return to e-procurement operates substantially through a channel other than control. [27]

The second result with wider implications is the asymmetry of the direct award coefficient. A control system that measures its own performance by detected violations will systematically under-attend to the segment in which violations are structurally hardest to commit and losses are largest. This is a Goodhart problem in its most direct institutional form, and it cannot be resolved by improving detection technology; it requires either the structural contraction of the segment or the introduction of a fundamentally different evaluation criterion for it – in practice, a reference-price standard rather than a procedural-compliance standard. Both are incorporated in Pillar III.

The third result concerns the division of labour between control instruments. Internal audit reduces violations but not prices; competition affects both; risk-based monitoring affects both but with markedly greater force on violations. These instruments are therefore complements with distinct functional specialisations, and a reform programme that expands one while neglecting the others will produce partial and possibly misleading improvements in headline indicators. This is the empirical basis for the insistence, in Section 6, that the six pillars constitute an architecture rather than a menu.

Several limitations qualify these conclusions. The panel is small, and the high explanatory power of the models reflects aggregation as well as specification quality. The identification strategy is associational: fixed effects absorb time-invariant territorial heterogeneity but not time-varying confounders, and the potential endogeneity of monitoring coverage is acknowledged rather than resolved. An instrumental variables strategy exploiting administratively determined variation in monitoring rollout would strengthen inference and is the natural extension of this work. Finally, territorial aggregation conceals sectoral heterogeneity: construction and pharmaceutical procurement exhibit risk profiles markedly different from those of standardised goods,

and transaction-level analysis by procurement category would refine the indicator weights proposed in Pillar II.

5. Conclusion

This paper has examined the determinants of financial control performance in public procurement in a transition economy and developed an integrated reform architecture addressed to them. Using a regional panel covering fourteen territories over 2018–2023, it finds that competition intensity is the dominant determinant of both the economy and the legality dimensions of procurement outcomes; that the direct award share significantly depresses realised savings while generating no measurable increase in recorded violations; that risk-based analytical monitoring predicts both outcomes robustly; and that digitalisation alone does not survive the introduction of fixed effects in the economy model.

The policy implication is that the reform frontier in systems of this type has moved beyond platform deployment. The binding constraint is no longer the availability of procurement data but the institutional capacity to convert it into timely intervention. The architecture proposed here addresses that constraint through five technical layers and six policy pillars, of which the central innovation is the «stop-or-explain» mechanism: an automated, pre-obligation intervention that requests justification rather than imposing sanction, logs the justification as an analytical input, and escalates only where justification fails. Simulation using the estimated coefficients suggests that full implementation could raise the price reduction coefficient by approximately four percentage points and reduce violation density by roughly a quarter of its 2023 level.

Three directions for further research follow. First, the indicator weights proposed for the composite risk index require empirical calibration against confirmed violations once a sufficient observation history exists; the weights offered here are expert-assigned priors, not estimates. Second, the interaction between certification coverage and control outcomes deserves separate treatment, since the capability channel is theoretically central but empirically under-identified in the present data. Third, comparative application of the framework to other transition economies operating centralised e-procurement platforms would establish the extent to which the digitalisation–control divergence documented here is a general feature of such systems rather than a national particularity.

REFERENCES

- [1] OECD, Government at a glance 2023. Paris: OECD Publishing.
- [2] Law of the Republic of Uzbekistan No. ZRU-684 of 22 April 2021 'On Public Procurement'. Tashkent, 2021.
- [3] Jensen, M.C. and Meckling, W.H., 'Theory of the firm: managerial behavior, agency costs and ownership structure', *Journal of Financial Economics*, 3(4), pp. 305–360, 1976.
- [4] Laffont, J.-J. and Tirole, J., *A theory of incentives in procurement and regulation*. Cambridge, MA: MIT Press, 1993.
- [5] Buchanan, J.M. and Tullock, G., *The calculus of consent: logical foundations of constitutional democracy*. Ann Arbor: University of Michigan Press, 1962.
- [6] World Bank, *The Korea online e-procurement system (KONEPS): development case study*. Washington, DC: World Bank Group, 2020.
- [7] Bandiera, O., Prat, A. and Valletti, T., 'Active and passive waste in government spending: evidence from a policy experiment', *American Economic Review*, 99(4), pp. 1278–1308, 2009.
- [8] Fazekas, M., Tóth, I.J. and King, L.P., 'An objective corruption risk index using public procurement data', *European Journal on Criminal Policy and Research*, 22(3), pp. 369–397, 2016.
- [9] Goodhart, C.A.E., 'Problems of monetary management: the U.K. experience', in *Papers in monetary economics*, vol. 1. Sydney: Reserve Bank of Australia, pp. 91–121, 1975.
- [10] Strathern, M., 'Improving ratings: audit in the British university system', *European Review*, 5(3), pp. 305–321, 1997.
- [11] Campbell, D.T., 'Assessing the impact of planned social change', *Evaluation and Program Planning*, 2(1), pp. 67–90, 1979.
- [12] Power, M., *The audit society: rituals of verification*. Oxford: Oxford University Press, 1997.

- [13] European Parliament and Council, Directive 2007/66/EC amending Council Directives 89/665/EEC and 92/13/EEC with regard to improving the effectiveness of review procedures concerning the award of public contracts. Official Journal of the European Union, L 335, pp. 31–46.
- [14] Transparency International Ukraine, DOZORRO artificial intelligence to find violations in ProZorro: how it works. Kyiv: Transparency International Ukraine, 2018.
- [15] Transparency International Ukraine, Analytics for procurement: DOZORRO project. Kyiv: Transparency International Ukraine, 2024.
- [16] OECD, Korea on-line e-procurement system (KONEPS): infrastructure toolkit case. Paris: OECD Publishing, 2022.
- [17] INTOSAI, The Lima declaration of guidelines on auditing precepts (ISSAI 1). Vienna: International Organisation of Supreme Audit Institutions, 1977.
- [18] OECD and World Bank, Methodology for assessing procurement systems (MAPS). Paris and Washington, DC, 2018.
- [19] UNCITRAL, UNCITRAL model law on public procurement (2011). Vienna: United Nations Commission on International Trade Law, 2014.
- [20] INTOSAI, ISSAI 3000: Standard for performance auditing. Vienna: International Organisation of Supreme Audit Institutions, 2016.
- [21] COSO, Internal control – integrated framework. Durham: Committee of Sponsoring Organizations of the Treadway Commission, 2013.
- [22] PEFA Secretariat, Framework for assessing public financial management. Washington, DC: PEFA Secretariat, 2016.
- [23] Milgrom, P., Putting auction theory to work. Cambridge: Cambridge University Press, 2004.
- [24] European Parliament and Council, Directive 2014/24/EU on public procurement and repealing Directive 2004/18/EC. Official Journal of the European Union, L 94, pp. 65–242.
- [25] Becker, G.S., 'Crime and punishment: an economic approach', *Journal of Political Economy*, 76(2), pp. 169–217, 1968.
- [26] Williamson, O.E., *The economic institutions of capitalism: firms, markets, relational contracting*. New York: The Free Press, 1985.
- [27] O'roqov, U.Yu., *Public procurement. Textbook*. Tashkent: Nihol Print. 200 p, 2022.

Appendix. Construction of the panel variables

SAV is computed for each territory-year as the aggregate estimated price of competitively awarded lots less the aggregate contract price, divided by the aggregate estimated price, expressed in per cent. Lots awarded through direct contracting and single-source procedures are excluded from the numerator and denominator, since no estimated-to-contract price comparison is meaningful for them.

VIOL is computed as the number of confirmed procedural and competition violations recorded by supervisory bodies in a territory-year, divided by the number of procurement procedures conducted in that territory-year, multiplied by one thousand. Confirmation is defined as a finding sustained after administrative review; allegations subsequently dismissed are excluded.

COMP is the number of bids admitted to evaluation, averaged across all lots in the territory-year. Bids rejected at the admission stage are excluded, so that the variable measures effective rather than nominal competition.

DIRECT is the value of contracts concluded through direct contracting and single-source procedures as a percentage of total procurement value. EPROC is the value of procurement executed through electronic procedures as a percentage of total procurement value. RBC is the value of procurement subjected to analytical monitoring based on risk indicators as a percentage of total procurement value; routine procedural verification that does not involve indicator computation is excluded. IAC is the number of contracting authorities operating a functioning internal audit unit as a percentage of all contracting authorities in the territory.