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Article

Measuring Information Asymmetry Without Insider-Trading Statistics: Market Microstructure Evidence From a State-Dominated Frontier Market

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Abstract: *Information asymmetry is usually inferred from enforcement records of insider trading, yet in most frontier markets such records do not exist. This paper develops and applies a framework for measuring information asymmetry when the regulator has never prosecuted a single insider-trading case, using Uzbekistan – a market whose capitalisation grew 14-fold in 2018–2025 while its free float stayed at 1.5% – as a laboratory. We hand-collect a microstructure dataset for 72 listed equities on the Tashkent Stock Exchange (July–September 2026) and estimate Roll and quoted spreads, Amihud illiquidity, zero-volume days and Lee–Ready order imbalance, complemented by a market-adjusted event study of material-fact disclosures and a ten-year (2016–2025) time-series model of market activity. Three results stand out. First, the market is highly asymmetric by any international benchmark: the median Roll effective spread is 3.4% (58% of securities exceed 2%), the median Amihud ratio is 35.9 and one quarter of securities have zero-volume days. Second, we document a "state-insider" channel: controlling for trading value, sector and share class, state-controlled issuers exhibit 2.4 times higher illiquidity ($\beta = 0.883$, $p < 0.01$) and twice the daily volatility of private issuers, while the median lag between a corporate event and its official disclosure is 12 days and abnormal returns of −9.4% to +29.1% accumulate before disclosure. Third, a two-equation model shows that each additional regulatory act raised investor activity by 63% on average, and scenario forecasts indicate that without enforcement reform the median spread will remain above 3% through 2030, whereas the proposed disclosure-and-surveillance package reduces it to 2.0–2.4% and lifts turnover from 6% to 25–31%. The paper contributes a replicable measurement toolkit for markets without enforcement data, provides the first firm-level microstructure estimates for Uzbekistan, and derives surveillance thresholds and a regulatory roadmap that are directly usable by frontier-market regulators.*

Keywords: *information asymmetry; insider trading; market microstructure; bid–ask spread; state ownership; disclosure; frontier markets; Uzbekistan.*

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1. Introduction

Since Akerlof Spence and Grossman and Stiglitz information asymmetry has been understood as an intrinsic property of financial markets that can be reduced but never eliminated. In equity markets its most visible manifestation is insider trading – trading on material non-public information – and the empirical literature has therefore relied heavily on insider-trading statistics to gauge the degree of asymmetry: the number of prosecuted cases mandatory reports of insiders' transactions or documented illegal trades. This approach has an obvious limitation [1]. In a large group of emerging and frontier markets the regulator has never opened a single insider-trading case, insiders are not required to report their transactions and insider lists are not maintained. In such markets the absence of insider-trading statistics is not evidence of low asymmetry; as Bhattacharya and Daouk

showed, a law that exists but is not enforced can be worse than no law at all, because it lulls uninformed investors into a false sense of protection [2].

Uzbekistan is an almost ideal setting in which to study this problem. Between 2016 and 2025 the capitalisation of the Tashkent Stock Exchange (TSE) rose from roughly USD 2 billion to USD 23.7 billion (15.4% of GDP), the number of trades increased 142-fold and trading value 59-fold; the country created an independent capital-market regulator (the National Agency of Perspective Projects, NAPP), a single corporate-disclosure portal and, in 2024, an automated market-surveillance system. At the same time, the state still controls more than 80% of the share capital registered in the Central Securities Depository, the free float is 1.5% of capitalisation, insider trading is prohibited only declaratively (no specific administrative or criminal offence exists), and between 2016 and 2025 not one investigation was opened [3]. A draft Capital Market Law adopted in first reading in July 2026 introduces graduated financial sanctions and gives the regulator access to bank-secrecy data, which makes the question of how large the asymmetry actually is – and which channels generate it – a matter of immediate policy relevance.

This paper makes four contributions. First, it proposes a measurement framework that replaces missing enforcement statistics with a battery of market-microstructure proxies – effective and quoted spreads, Amihud illiquidity, zero-volume days and order imbalance – combined with an event study of the lag between corporate events and their official disclosure. The framework is deliberately parsimonious in its data requirements (daily closing prices, trade prints and the public disclosure portal) so that it can be replicated by regulators and researchers in comparable markets. Second, it provides the first firm-level microstructure estimates for the Uzbek market, based on a hand-collected sample of 72 quoted equities. Third, it identifies and quantifies a "state-insider" channel of information asymmetry that is specific to state-dominated markets: conditional on trading activity, sector and share class, state-controlled issuers are markedly less liquid, more volatile and slower to disclose than private issuers [4]. Fourth, it links the cross-sectional estimates to a ten-year time-series model of market development in order to produce scenario forecasts of asymmetry indicators to 2030, and derives from the event-study evidence a set of calibrated surveillance thresholds and a phased regulatory roadmap.

Our findings relate to three strands of literature. The market-microstructure literature provides the theoretical mapping from asymmetric information to spreads, price impact and order flow that underpins our proxies; we follow the low-frequency estimation tradition of Roll Corwin and Schultz, Lesmond et al. and Fong et al.. The law-and-finance literature on insider trading documents the effects of enforcement on the cost of capital and price informativeness; we add evidence on the pre-enforcement state of a market in which enforcement has not yet begun [5]. Finally, the literature on state ownership and stock-market quality has examined price synchronicity and investor protection; we extend it by showing that state control has a direct microstructure footprint in the form of wider spreads and slower disclosure. The remainder of the paper is organised as follows. Section 2 describes the institutional setting. Section 3 reviews the literature and states the hypotheses. Section 4 presents the data and methodology. Section 5 reports the results, Section 6 discusses policy implications and Section 7 concludes.

Institutional setting: a fast-growing, state-dominated frontier market

Table 1 summarises the development of the Uzbek equity market between 2016 and 2025. Growth in size has been spectacular: capitalisation increased from UZS 19.7 trillion in 2018 to UZS 284.6 trillion in 2025, the number of exchange trades from 3,080 in 2016 to about 438,000 in 2025 (annualised), and trading value from UZS 0.3 trillion to UZS 17.7 trillion [6]. Growth in *quality*, however, has lagged. The turnover ratio – trading value divided by capitalisation – fluctuated between 0.8% and 9.1% (Fig. 1), an order of magnitude below the 10–50% typical of emerging markets. Free float fell from 5.8% of capitalisation in 2020 to roughly 1.4% in 2025 as the capitalisation of large state-controlled

companies was recognised without a corresponding public offering. Ten securities account for 79% of trading value; retail investors generate over 70% of trades but a small share of value; and domestic institutional investors, including pension funds, are effectively absent [7].

Table 1

Development of the Uzbek equity market, 2016–2025

Indicator	2016	2018	2020	2022	2024	2025
Market capitalisation, UZS trn	≈6.8[a]	19.7	54.8	92.5	242.4	284.6
Market capitalisation, % of GDP	<3	4.8	8.2	9.3	16.7	15.4
Exchange trading value, UZS bn	299.8	687.9	578.2	4,800	21,950	17,700[b]
Number of trades, thousand	3.1	14.0	36.1	80.7	498.3	437.8[b]
Turnover ratio, %	n/a	3.5	1.1	5.2	9.1	6.2
Free float / capitalisation, %	n/a	n/a	5.8	n/a	n/a	≈1.4
Share of 10 largest securities in trading value, %	n/a	n/a	78.2	≈40[c]	n/a	78.7
Joint-stock companies registered in the CSD	n/a	n/a	599	625	680	717
Insider-trading / manipulation cases opened	0	0	0	0	0	0
Cumulative index of regulatory acts (IRI)[d]	4	4	6	7	10	12

Notes: [a] Author estimate from a USD 2.1 bn valuation at the end-2016 exchange rate. [b] 2025 trades annualised from nine-month data; trading value is a preliminary estimate. [c] Dominated by a single block trade. [d] Number of laws, decrees and agency regulations governing disclosure and insider trading in force at year-end (see Section 4.4). Sources: Tashkent Stock Exchange annual reviews; Central Securities Depository; NAPP; Central Bank of Uzbekistan; authors' calculations.

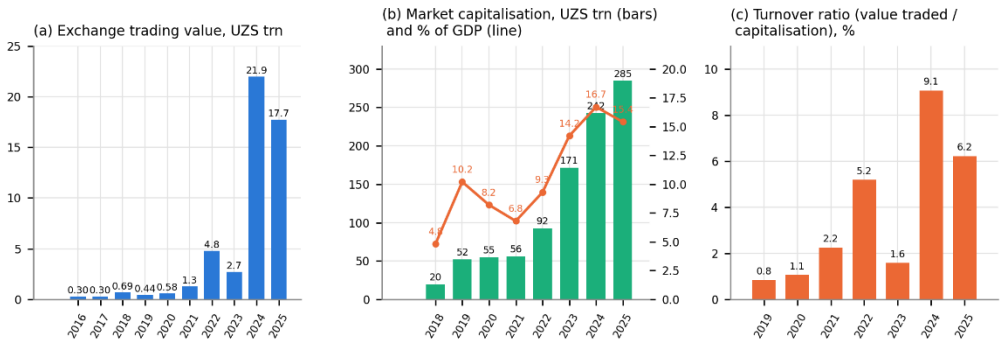


Fig. 1. Size versus quality of the Uzbek equity market, 2016–2025. Panel (a) exchange trading value; panel (b) market capitalisation and its ratio to GDP; panel (c) turnover ratio. Sources: Tashkent Stock Exchange; Central Bank of Uzbekistan; authors' calculations.

The regulatory architecture has changed repeatedly. The supervisory function moved from a centre within the anti-monopoly committee to an independent Capital Market Development Agency then to a department of the Ministry of Finance and finally to NAPP, an agency reporting directly to the President (since September 2023). Disclosure obligations are set by the 2015 Securities Market Law and the 2012 Rules on the provision and publication of information (Regulation No. 2383), which require issuers to publish any of 46 types of "material facts" within two business days on the single portal openinfo.uz. Insider trading is prohibited by Article 54 of the Securities Market Law, but the Administrative Liability Code contains only a generic offence ("violation of securities-market legislation", Article 174-1) with fines of a few dozen basic calculation units, roughly EUR 200, and the Criminal Code contains no insider-trading offence at all. Insider lists, personal reporting of insiders' transactions and closed periods – the three pillars of the EU

Market Abuse Regulation (Articles 18–19) and of the US Section 16(a) regime – are absent. The regulator is not a signatory of Appendix A of the IOSCO Multilateral Memorandum of Understanding, chiefly because it lacks the power to obtain bank-secrecy records. Table 2 maps the resulting gaps onto the IOSCO Principles [8].

Table 2

Compliance of Uzbek securities regulation with IOSCO Principles and identified gaps (as of September 2026)

IOSCO principle group	Status	Main gap	Assessment
A. Regulator (1–8)	NAPP: independent, presidentially accountable, off-budget	22 staff in supervision; three changes of regulator in 2019–2023	Broadly implemented
B. Enforcement (10–12)	Generic administrative offence; fines via court	No specific insider-trading/manipulation offence; no criminal liability; no out-of-court sanctions	Partly implemented
C. Cooperation (13–15)	IOSCO ordinary member; MMoU commitment in presidential decrees	Appendix B (not A) of MMoU; no access to bank-secrecy data; no CBU–NAPP MoU	Partly implemented
D. Issuers (16–18)	46 material-fact types; 2-business-day rule; single portal	76 late disclosures in 17 months; median actual lag 12 days; retroactive re-publication possible	Broadly implemented
E. Auditors & accounting (19–23)	IFRS mandatory since 2021	IFRS reports published without notes by 7 of 10 largest issuers	Broadly implemented
G. Secondary markets (33–37)	Surveillance system since 2024; Art. 54 prohibition	No insider lists, transaction reporting or closed periods; 0 cases in 2016–2025	Partly implemented
H. Clearing & settlement (38)	CSD under the Central Bank; unified registry	Central counterparty in formation	Broadly implemented

Sources: IOSCO (2017); World Bank (2025); IMF (2025); EBRD (2020); NAPP; authors' assessment.

Related literature and hypotheses

Measuring information asymmetry

Market-microstructure theory links private information to observable trading outcomes. In Kyle the informed trader's order flow is impounded into prices through the market maker's pricing rule, so that price impact per unit of volume rises with the share of informed trading; in Glosten and Milgrom the bid–ask spread contains an adverse-selection component that compensates liquidity suppliers for trading against better-informed counterparties; in Easley et al. the probability of informed trading (PIN) is estimated from the arrival rates of buyer- and seller-initiated orders. Because high-frequency quote data are rarely available in frontier markets, an extensive literature has developed low-frequency proxies: the Roll effective spread estimated from the serial covariance of price changes, the Corwin–Schultz high–low estimator, the Lesmond et al. zero-return measure and the Amihud illiquidity ratio [9]. Fong et al. show that Amihud-type measures and the Corwin–Schultz estimator are the best monthly proxies of price impact and spreads for global research, which motivates our choice of measures. Trade direction, needed for order-imbalance measures, is inferred with the Lee and Ready tick test [10].

Insider trading, enforcement and market quality

Manne argued that insider trading accelerates the incorporation of information into prices, whereas Bainbridge and most regulators regard it as a breach of fairness that raises

the cost of capital. Empirically, Meulbroek found that illegal insider trades move prices and account for roughly half of the pre-announcement run-up, and Bhattacharya et al. documented the "event that is not an event" in an emerging market where prices react before, not at, the official announcement – precisely because insiders trade on the news first. Bhattacharya and Daouk showed for 103 countries that the cost of equity falls by about 5% after the *first* prosecution, not after the enactment of the law; Bris found that enforcement reduces the profitability of insider trading only when it is credible; Fernandes and Ferreira showed that enforcement improves price informativeness in developed markets but not in emerging ones [11]. These findings imply that in a market with a law but no enforcement, indirect microstructure measures should reveal a high level of asymmetry irrespective of the absence of recorded cases.

State ownership and the "state-insider" channel

Morck et al. attribute the high price synchronicity of emerging markets to weak property rights and poor investor protection, and La Porta et al. link ownership concentration to the legal environment [12]. In markets where the state is the dominant shareholder, a further channel arises: decisions that constitute inside information – privatisation schedules, dividend instructions, mergers of state enterprises – are taken by government bodies whose officials are not formally classified as insiders, and state-controlled issuers typically have weaker disclosure incentives. We refer to this as the state-insider channel and expect it to manifest as wider spreads, higher illiquidity and longer disclosure lags among state-controlled issuers, conditional on their trading activity [13].

Hypotheses

H1. The Uzbek market exhibits a high degree of information asymmetry by international benchmarks: median effective spreads exceed 2% and a substantial fraction of securities have zero-volume days.

H2. Prices and volumes react to material corporate events before their official disclosure: pre-announcement cumulative abnormal returns differ from zero, whereas the announcement-day reaction is weak, and the lag between event and disclosure exceeds the statutory two business days.

H3. Information asymmetry is stronger for state-controlled issuers: conditional on trading value, sector and share class, state control is associated with higher illiquidity and volatility.

H4. Institutional reforms raise market activity, so that scenario differences in the regulatory path translate into materially different trajectories of asymmetry indicators.

2. Materials And Methods

Sample and data sources

The cross-sectional sample comprises all 72 equities (49 ordinary and 23 preferred shares of 55 issuers) that were quoted on the main board of the Tashkent Stock Exchange with at least one trade in the observation window. Daily closing prices, trading volumes and values were collected from the exchange's security pages for the twenty trading days from 19 August to 17 September 2026; for 46 securities we also obtained the intraday trade prints (up to 250 most recent trades per security), and for 33 securities the best bid and ask quotes and depth of the order book at the end of the window. Corporate events were collected from the single disclosure portal (openinfo.uz) and from the CorpInfo news channel, which republishes material facts with time stamps, allowing us to date both the event (T0) and its public disclosure (Tp). Ownership (state-controlled if the state or a state entity holds a controlling stake), sector and share class were obtained from issuer disclosures and the Central Securities Depository. The time-series sample consists of annual observations for 2016–2025 on trading value, number of trades, the exchange rate, the central-bank policy rate and a regulatory-intensity index. Table 3 defines the variables.

Table 3
Variable definitions

Variable	Definition	Source
Roll spread (daily), %	$2\sqrt{(-\mathrm{Cov}(\Delta p_t, \Delta p_{t-1}))} / \bar{p}$ from daily closing prices; set to zero when covariance is positive (Roll, 1984)	TSE daily history
Roll spread (intraday), %	Same estimator applied to consecutive trade prints	TSE trade prints
Quoted spread, %	(ask − bid) / midpoint at end of window	TSE order book
Amihud ILLIQ	Mean of $\lvert r_t \rvert / V_t$ over trading days, with $\lvert r_t \rvert$ in % and V_t in UZS bn (Amihud, 2002)	TSE daily history
Zero-volume days, %	Share of trading days in the window with no trades	TSE daily history
Order imbalance	$\lvert B - S \rvert / (B + S)$, B and S = buyer-/seller-initiated trades by the Lee–Ready (1991) tick test	TSE trade prints
Volatility, %	Standard deviation of daily log returns	TSE daily history
ln(VOL)	Log of average daily trading value, UZS mn	TSE daily history
STATE	1 if the issuer is state-controlled	CSD; issuer disclosures
PREF; BANK	1 for preferred shares; 1 for banks	TSE
CAR[a;b]	Cumulative market-adjusted abnormal return over days a…b relative to T0 or Tp, market = equal-weighted index of sample securities	Authors' calculations
Abnormal volume	Mean volume in the event window / mean volume in the estimation window [−25; −6]	Authors' calculations
N, V (annual)	Number of exchange trades; exchange trading value, UZS bn	TSE annual reviews
IRI	Cumulative number of laws, decrees and agency regulations governing disclosure and insider trading in force at year-end	lex.uz; NAPP
FX; R	UZS/USD exchange rate, year-end; central-bank policy rate, year-end, %	Central Bank of Uzbekistan

Microstructure measures

For each security we compute the Roll (1984) effective spread from daily closing prices, $S = 2\sqrt{(-\mathrm{Cov}(\Delta p_t, \Delta p_{t-1}))}/\bar{p}$, and, where trade prints are available, the same estimator from consecutive transaction prices, which is less affected by non-trading. The Amihud ratio, $\mathrm{ILLIQ} = (1/D)\Sigma\,|r_t|/V_t$, measures price impact per unit of trading value and is the most widely used low-frequency proxy for Kyle's λ. The share of zero-volume days follows Lesmond et al. as an indicator of non-trading induced by transaction costs. Order imbalance, $|B - S|/(B + S)$, is computed from trades signed with the tick test and is interpreted, following Easley et al. as a coarse proxy for the intensity of informed (one-sided) trading. Quoted spreads and depth are taken from the closing order book. Because the daily history covers only twenty trading days, we complement the daily Roll estimate with the intraday estimate and treat securities with fewer than ten trading days as unreliable for volatility-based measures.

Event study

We follow Brown and Warner and MacKinlay and compute market-adjusted abnormal returns, $\mathrm{AR}_{it} = r_{it} - r_{mt}$, where the market return is the equal-weighted average return of the sample securities with a valid price on day t; a market-model specification is not feasible with a twenty-day estimation window. Cumulative abnormal returns are computed over the pre-event window [−5; −1], the event window [0; +1] and the post-event window [+2; +5], separately around the event date T0 and the disclosure date Tp. Abnormal volume is the ratio of mean volume in [−3; −1] and [0; +1] to mean volume in the estimation window. The event sample consists of seven observations from the window: the presidential decree on the public sale of state stakes (PF-177 of 28 August 2026, affecting Turonbank ordinary and preferred shares, disclosed on 9 September), a set of large and related-party transactions of Uzbekneftegaz (concluded 3–24 August, disclosed 30 August), the corporate-governance rating event of Almalyk Mining and Metallurgical

Complex (2 September, disclosed 7 September) and two market-wide events on the day of the composite-index peak (9 September). Two further disclosure lags (a reorganisation and a delisting) are used only for the delay distribution. The small event sample is an inherent limitation of a market with a handful of liquid securities and is discussed in Section 7.

Cross-sectional and time-series models

To test H3 we estimate, for each asymmetry measure Y_i, the cross-sectional regression

$$Y_i = \alpha + \beta_1 \text{STATE}_i + \beta_2 \text{PREF}_i + \beta_3 \text{BANK}_i + \beta_4 \ln(\text{VOL})_i + \varepsilon_i, \quad (1)$$

with heteroskedasticity-robust (HC1) standard errors. ln(VOL) controls for the mechanical relation between trading activity and liquidity, PREF captures the systematically lower liquidity of preferred shares and BANK the sector with the largest number of listings. The coefficient of interest, β_1, measures the state-insider premium conditional on activity.

To test H4 we estimate a recursive two-equation model on annual data for 2016–2025:

$$\ln N_t = \alpha_0 + \alpha_1 \text{IRI}_t + \alpha_2 \ln \text{FX}_t + \varepsilon_{1t}, \quad (2)$$

$$\ln V_t = \beta_0 + \beta_1 \ln N_t + \beta_2 R_t + \varepsilon_{2t}, \quad (3)$$

where N is the number of trades (investor activity), V trading value, IRI the cumulative regulatory-intensity index constructed from the sequence of laws, presidential decrees and agency regulations (4 acts in 2016, 12 in 2025), FX the year-end exchange rate (a proxy for the 2017 currency liberalisation that opened the market to foreign investors) and R the central-bank policy rate. Each equation is estimated by OLS and subjected to four diagnostic checks: overall significance (F), coefficient significance (t), residual autocorrelation (Durbin–Watson) and residual homoskedasticity, normality and multicollinearity (Breusch–Pagan, Jarque–Bera, VIF). Forecasts for 2026–2030 are produced for a baseline scenario (reform pace of 2016–2025, one act every 1.25 years) and a reform scenario (the disclosure and surveillance package of Section 6, one act per year, with the policy rate declining to 9%). The aggregate forecasts are mapped into asymmetry indicators by applying the elasticities from Eq. (1): half of the aggregate growth in trading value is assumed to accrue to per-security trading value, and the share of state-controlled securities is assumed to fall from 68% to 60% (baseline) or 42% (reform, via the public sale of 62 state stakes announced in decree PF-177).

3. Results and Discussion

The level of information asymmetry (H1)

Table 4 reports descriptive statistics for the microstructure measures for the full sample and by ownership. The median Roll effective spread computed from daily closes is 3.40% (mean 4.38%), and 58% of securities have spreads above 2%; the intraday Roll estimate, available for the more liquid half of the sample, has a median of 1.29%, and the median quoted spread is 1.55% (mean 2.98%). For comparison, effective spreads in developed markets are typically 0.1–0.5% and in emerging markets 0.5–2.0% (Fong et al., 2017). The median Amihud ratio is 35.9 – a 1% price move per UZS 28 million (about USD 2,300) of trading value – and the mean is 189 because of a tail of practically untraded securities [14]. One quarter of the securities have at least one zero-volume day in the window and 13.5% of security-days on average are zero-volume days. Median daily volatility is 4.5%, two to four times the level of developed markets, and the composite index lost 39% in five trading days in September 2026. The median order imbalance of 0.22 (mean 0.25) indicates that one-sided order flow is common; it is highest for insurance companies (0.37) and preferred shares [15]. Every indicator therefore places the market in the "high asymmetry" range, supporting H1.

Table 4

Descriptive statistics of information-asymmetry measures, Tashkent Stock Exchange, 19 August – 17 September 2026

Measure	N	Mean	Median	SD	State: median (N)	Private: median (N)	MW p-value
Roll spread (daily), %	63	4.38	3.40	4.45	3.58 (37)	2.30 (16)	0.48
Roll spread (intraday), %	46	2.92	1.29	4.03	1.22 (29)	1.32 (14)	0.85
Quoted spread, %	33	2.98	1.55	3.61	1.55 (21)	1.26 (11)	0.97
Amihud ILLIQ	59	188.9	35.9	508.9	36.4 (36)	9.5 (14)	0.13
Zero-volume days, %	63	13.5	0.0	28.0	0.0 (37)	0.0 (16)	0.57
Daily volatility, %	63	6.06	4.54	4.46	5.02 (37)	2.45 (16)	0.01
Order imbalance	45	0.25	0.22	0.20	0.21 (29)	0.25 (13)	0.18
Avg. daily trading value, UZS mn	63	14.9	1.98	41.2	2.72 (37)	2.91 (16)	0.98

Notes: N varies because some measures require trade prints or order-book data. State/private classification available for 62 securities. MW p-value refers to the two-sided Mann–Whitney test of equality of distributions between state-controlled and private securities. Source: authors' calculations.

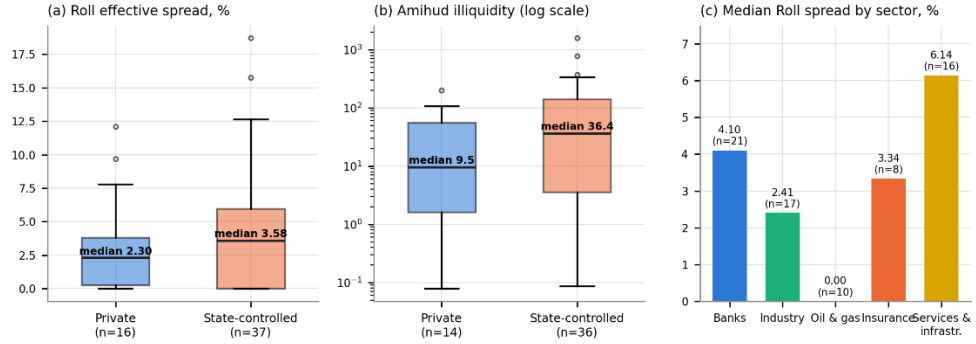


Fig. 2. Distribution of asymmetry measures by ownership and sector. Panels (a) and (b): box plots of the Roll effective spread and the Amihud illiquidity ratio for private and state-controlled securities; panel (c): median Roll spread by sector. Source: authors' calculations.

Fig. 2 shows that the sector pattern is polarised. Banks – the most numerous group – combine a handful of very liquid, tightly priced securities (spreads of 0.2–0.3%) with a majority of wide-spread, thinly traded ones, so that their median spread (4.1%) is above the sample median. Industrial companies have the narrowest median spread (2.4%), while services and infrastructure issuers – dominated by state-owned utilities and transport companies – are the least liquid group (median spread 6.1%, median Amihud 111, zero-volume days 10%). Oil-and-gas securities show a zero daily Roll estimate because their closing prices are essentially frozen, but the highest quoted spread (4.3%) and volatility (9.4%), a typical signature of illiquidity rather than of efficient pricing [16].

The state-insider channel (H3)

The univariate comparison in Table 4 already suggests that state-controlled securities are less liquid – the median Amihud ratio is 3.8 times higher (36.4 versus 9.5) and volatility twice as high (5.0% versus 2.5%, Mann–Whitney $p = 0.01$) – but only the volatility difference is statistically significant in the raw data because state-controlled securities also include the largest and most traded issuers. The multivariate estimates in Table 5 isolate the ownership effect. Conditional on trading value, share class and sector, the state-control dummy raises log illiquidity by 0.883 ($p < 0.01$), i.e. state-controlled securities have a 2.4 times ($e^{0.883}$) higher price impact than private securities with the same trading value; the model explains 80% of the cross-sectional variation in illiquidity. The elasticity of illiquidity with respect to trading value is −1.14, close to the −1 implied by the construction of the measure. State control is also associated with a lower share of zero-volume days (−12.2 pp, $p < 0.10$) and a lower order imbalance (−0.148, $p < 0.05$): state-controlled securities trade more regularly but with larger price impact, consistent with a market in which

uninformed (retail) trading in state companies is frequent while informed trading is concentrated around specific events. For the Roll spread the state coefficient is positive (+1.2 pp) but imprecisely estimated, reflecting the noisiness of the twenty-day daily estimator; the bank dummy adds 2.2 pp ($p < 0.10$). Preferred shares have a significantly higher order imbalance (+0.19, $p < 0.01$), consistent with their retail-dominated, one-sided trading. Fig. 3 visualises the illiquidity–activity relation: the state and private fitted lines are almost parallel, with the state line shifted upward by roughly 0.9 log points across the entire range of trading activity.

Table 5

Cross-sectional determinants of information-asymmetry measures (OLS, HC1 standard errors)

Variable	(1) Roll spread, %	(2) ln Amihud	(3) Zero-volume days, %	(4) Quoted spread, %	(5) Order imbalance
STATE	1.218 (1.086)	0.883*** (0.333)	−12.18* (6.88)	−2.097* (1.239)	−0.148** (0.069)
PREF	0.772 (1.212)	−0.172 (0.299)	5.90 (5.32)	1.517 (1.192)	0.186*** (0.065)
BANK	2.213* (1.163)	−0.622** (0.262)	−5.04 (5.01)	−0.617 (1.301)	−0.085 (0.062)
ln(VOL)	−0.542 (0.336)	−1.142*** (0.084)	−7.11*** (1.66)	−1.137*** (0.433)	−0.047** (0.022)
Constant	2.766** (1.095)	4.207*** (0.319)	25.35*** (6.34)	6.430*** (1.742)	0.412*** (0.071)
Observations	53	50	53	28	34
R^2	0.150	0.804	0.498	0.390	0.420
F-statistic	2.11	48.4	11.9	3.68	5.26

Notes: Robust standard errors in parentheses. , *and* **denote significance at the 10%, 5% and 1% levels. Column (2) implies that state-controlled securities have $e^{0.883} = 2.4$ times higher illiquidity than private securities with the same trading value. Source: authors' calculation**

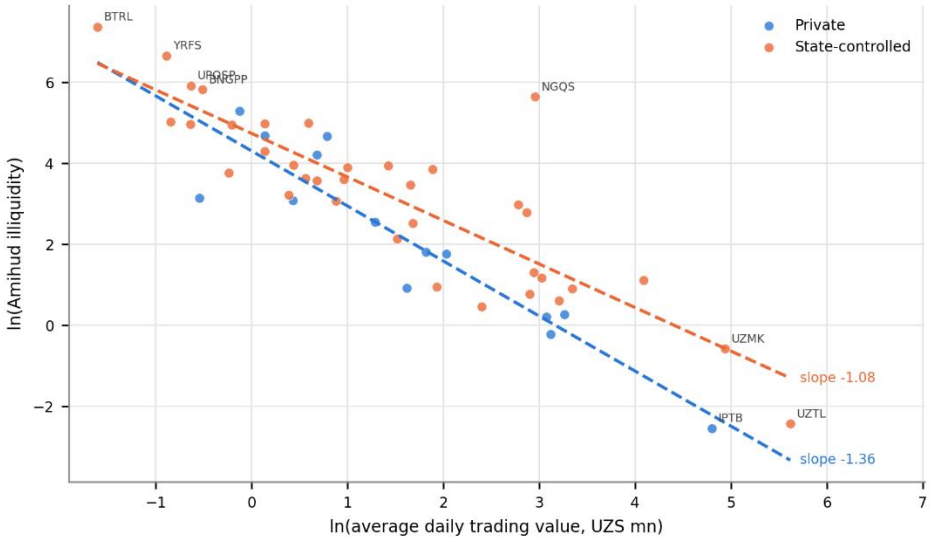


Fig. 3. Illiquidity and trading activity by ownership. Scatter of log Amihud illiquidity against log average daily trading value with separate OLS fits for private and state-controlled securities. Source: authors' calculations.

Disclosure lags and pre-announcement price behaviour (H2)

Table 6 and Fig. 4 present the event-study evidence. The median lag between the corporate event and its official disclosure is 12 calendar days (range 0–64), against a statutory limit of two business days: the presidential decree on the sale of state stakes in

Turonbank was published in the legal database on 28 August but disclosed by the issuer only on 9 September; the Uzbekneftegaz transactions concluded between 3 and 24 August were disclosed on 30 August; a reorganisation decided on 11 June became public on 14 August [17]. Around the event dates we observe the pattern described by Bhattacharya et al. (2000). For Almalyk MMC preferred shares the pre-event CAR is +29.1% with abnormal volume of 1.73 in the three days before the event, followed by a negative reaction at disclosure (−8.7%); for Turonbank preferred shares the pre-event CAR is −4.8% (volume 1.34) and the pre-disclosure CAR −9.4% (volume 1.89), with a +7.1% correction at disclosure. In every case with sufficient data the absolute pre-window CAR exceeds the disclosure-day reaction, and abnormal volume at disclosure (1.9–4.4) indicates that uninformed investors trade on the news only when it becomes official. The two market-wide observations on the index-peak day show pre-window CARs of −12.7% and −6.5% for the two most liquid private securities, i.e. informed selling ahead of a broad correction. Taken together with the 12-day median lag, the evidence supports H2: the disclosure regime leaves a window of one to two weeks in which prices move on information that has not been made public [18].

Table 6

Market-adjusted abnormal returns, abnormal volume and disclosure lag around material corporate events, August–September 2026

Event (issuer, security)	T0	Tp	Lag, days	CAR[−5;−1], %	CAR[0;+1], %	CAR[+2;+5], %	Abn. volume [−3;−1] / [0;+1]
Decree PF-177, sale of state stake – Turonbank ord. (TNBN), around T0	28 Aug	9 Sep	12	+0.1	−3.5	−6.7	0.65 / 0.42
— same event, around Tp	28 Aug	9 Sep	12	−0.6	−10.0	+7.4	1.10 / 3.27
Decree PF-177 – Turonbank pref. (TNBNP), around T0	28 Aug	9 Sep	12	−4.8	−10.3	−1.0	1.34 / 1.87
— same event, around Tp	28 Aug	9 Sep	12	−9.4	+7.1	−12.3	1.89 / 4.36
Uzbekneftegaz: large and related-party transactions (UZNGP), around Tp	3–24 Aug	30 Aug	6–27	n/a	+16.5	+42.8	n/a
Corporate-governance rating – Almalyk MMC pref. (AGMKP), around T0	2 Sep	7 Sep	5	+29.1	−8.7	−16.7	1.73 / 1.86
— same event, around Tp	2 Sep	7 Sep	5	−5.8	−11.9	+8.5	1.28 / 1.86
Market event: index peak – Kvarts (KVTS)	9 Sep	9 Sep	0	−12.7	−0.9	+6.2	—
Market event: index peak – Uzbektelecom pref. (UZTLP)	9 Sep	9 Sep	0	−6.5	−2.3	n/a	—
Additional lag observations: Kattakurgan Oil (reorganisation) 11 Jun → 14 Aug; Taminotchi-Paxta (delisting) 10 Aug → 15 Aug			64; 5				
Median disclosure lag (7 observations)			12				

Notes: T0 = date of the corporate event; Tp = date of official disclosure on openinfo.uz. Market return is the equal-weighted return of sample securities. n/a: insufficient trading

days in the window. Source: authors' calculations from TSE, openinfo.uz and CorpInfo data.

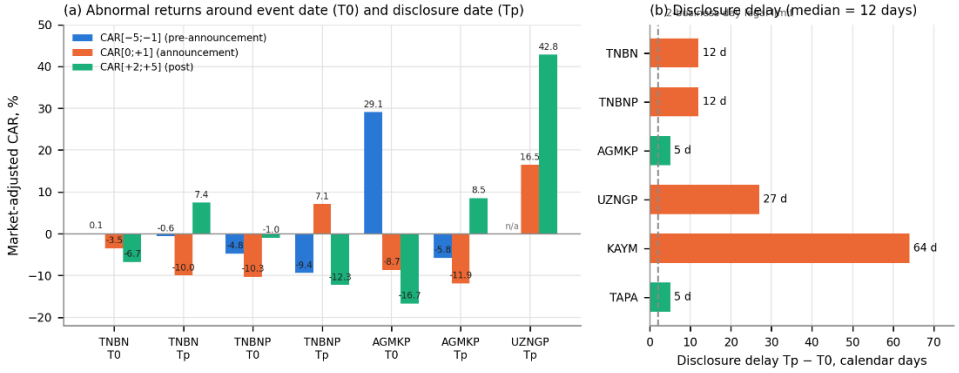


Fig. 4. Pre-announcement price behaviour and disclosure lags. Panel (a): market-adjusted cumulative abnormal returns around the event date (T0) and the disclosure date (Tp); panel (b): lag between event and disclosure for six events against the statutory two-business-day limit. Source: authors' calculations.

Institutional reforms, market activity and scenarios to 2030 (H4)

Table 7 reports the time-series estimates. Investor activity responds strongly to regulatory intensity: each additional act in the IRI raises the number of trades by $e^{0.488} - 1 = 63\%$ ($p < 0.01$), and the elasticity with respect to the exchange rate is 1.55 ($p < 0.10$), capturing the entry of foreign investors after the 2017 liberalisation; the equation explains 90% of the variation in log trades. Trading value in turn has an elasticity of 0.76 with respect to the number of trades ($p < 0.01$) – new trades are predominantly small retail orders – and falls by about 10% per percentage point of the policy rate, although the latter effect is imprecisely estimated. Both equations pass the four diagnostic checks: the *F*-statistics (32.6 and 12.8) exceed the 5% critical value of 4.74; Durbin–Watson statistics of 2.18 and 2.19 lie inside the no-autocorrelation band (1.64; 2.36); Breusch–Pagan and Jarque–Bera tests do not reject homoskedasticity and normality; and variance-inflation factors are below 2. Alternative specifications that regress trading value directly on the regulatory index have a higher R^2 but a Durbin–Watson statistic of 3.0, indicating negative autocorrelation, and were discarded.

Table 7

Two-equation model of market activity, 2016–2025 (OLS) and diagnostic checks

	Eq. (2): ln N	**Eq. (3): ln V**
IRI (regulatory-intensity index)	0.488*** (0.107)	—
ln FX (year-end exchange rate)	1.548* (0.736)	—
ln N (number of trades)	—	0.765*** (0.153)
R (policy rate, %)	—	−0.107 (0.151)
Constant	−6.683 (6.279)	0.614 (2.280)
R^2 / adjusted R^2	0.903 / 0.875	0.785 / 0.724
F-statistic (p-value); critical F(2;7) = 4.74	32.57 (0.0003)	12.78 (0.0046)
Durbin–Watson; band (dU; 4 − dU) = (1.64; 2.36)	2.18	2.19
Breusch–Pagan LM (p-value)	0.31 (0.86)	5.15 (0.08)
Jarque–Bera (p-value)	3.01 (0.22)	1.11 (0.58)
Max. VIF; mean absolute percentage error	1.73; 4.3%	1.09; 8.8%

Notes: n = 10 annual observations. Standard errors in parentheses; , *and* **denote significance at the 10%, 5% and 1% levels. Source: authors' calculation**

Table 8 and Fig. 5 translate the model into scenarios. Under the baseline, the number of trades reaches 1.9 million and trading value UZS 33 trillion by 2030, but because capitalisation grows at a similar pace the turnover ratio stays at 5–7%; applying the elasticities of Table 5, the median Roll spread falls only from 3.40% to 3.14% and the

median Amihud ratio from 35.9 to 23.5. Under the reform scenario the number of trades reaches 13.6 million and trading value UZS 201 trillion (11 times the 2025 level), the turnover ratio rises to 31% – in the middle of the emerging-market range – the median spread falls to 2.43%, the Amihud ratio to 7.1 (a five-fold decline) and the share of zero-volume days from 13.5% to 8%. These projections capture only the liquidity and ownership channels embedded in Eq. (1). The information channel of the reform package – the closing of the pre-disclosure window and the increase in the probability of detection – is not identified in the 2026 cross-section because no such mechanisms existed; a conservative estimate, obtained by assuming that the reform eliminates the state–private spread differential (1.2 pp) for the remaining 42% of state-controlled securities, lowers the 2030 median spread to about 1.9–2.0%. The 90% prediction intervals are wide, as expected with ten annual observations, so the point forecasts should be read as directions rather than targets [19].

Table 8

Scenario forecasts of market activity and information-asymmetry indicators, 2025–2030

Indicator	2025 (actual)	2027 baseline / reform	2030 baseline / reform	2030 policy target
Number of trades, million	0.44	1.00 / 2.66	1.94 / 13.6	—
Trading value, UZS trn	17.7	16.0 / 41.9	32.9 / 201.5	—
Turnover ratio, %	6.2	4.5 / 10.6	6.6 / 30.9	≥ 25
Roll effective spread, % (median)	3.40	3.41 / 3.05	3.14 / 2.43	≤ 2.0
Amihud ILLIQ (median)	35.9	37.4 / 20.1	23.5 / 7.1	≤ 7
Quoted spread, % (median)	1.55	1.64 / 1.26	1.36 / 0.71	≤ 0.8
Zero-volume days, % (mean)	13.5	14.1 / 11.6	12.2 / 8.0	≤ 8
Free float / capitalisation, %	1.4	2.0 / 4.0	2.5 / 10.0	≥ 10
Median disclosure lag, days	12	8 / 3	5 / 1	≤ 1
Insider-trading investigations per year	0	0 / 5–10	0 / 15–20	≥ 15

Notes: Baseline = regulatory intensity grows at the 2016–2025 pace and the policy rate stays at 12–14%; reform = one regulatory act per year (Section 6), policy rate declining to 9%, sale of 62 state stakes. Rows 4–7 are obtained by applying the elasticities of Table 5 to the aggregate forecasts; rows 8–10 are policy assumptions of the reform package. Source: authors' calculations.

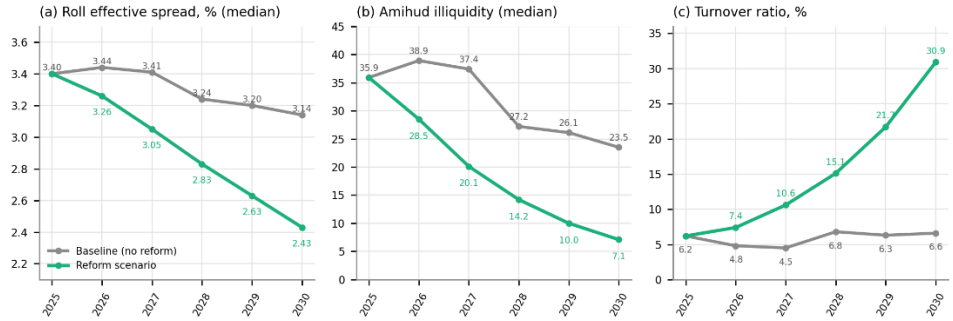


Fig. 5. Scenario forecasts of asymmetry indicators, 2025–2030. Baseline (no enforcement reform) versus the reform scenario for the median Roll spread (a), the median Amihud illiquidity ratio (b) and the turnover ratio (c). Source: authors' calculations.

Robustness

Several checks confirm the main results. (i) Replacing the daily Roll estimate with the intraday estimate as the dependent variable leaves the sign of the state coefficient unchanged but, as in column (1), it is insignificant; the illiquidity result is robust to using intraday trading value. (ii) Excluding preferred shares reduces the sample to 35 securities but the state coefficient in the illiquidity equation remains at 0.81 ($p < 0.05$). (iii) Winsorising the Amihud ratio at the 5th and 95th percentiles or dropping the two securities with fewer

than five trading days does not change the inference. (iv) Using ln(market capitalisation) instead of ln(VOL) as the activity control yields a state coefficient of 1.02 with a lower R^2 (0.61), since capitalisation is a poor proxy for activity in a market where the largest companies have a negligible float. (v) In the event study, using the median rather than the mean of sample returns as the market benchmark changes individual CARs by less than one percentage point. (vi) The time-series results hold when trading value is deflated by consumer prices or expressed in US dollars, with lower R^2 and identical diagnostic conclusions.

4. Discussion

Our results have a straightforward interpretation within the Becker framework of optimal deterrence. An insider trades when the expected gain exceeds the product of the probability of detection and the sanction. In Uzbekistan both terms of the product are close to zero: the sanction is a generic administrative fine of about EUR 200, and detection is virtually impossible because the surveillance system introduced in 2024 cannot link suspicious trades to identified persons in the absence of insider lists and transaction reporting. The draft Capital Market Law raises the sanction to twice the illicit gain and 100% of annual remuneration, but a simple calculation shows that sanctions alone are insufficient: for an insider gain of UZS 500 million, an expected cost equal to the gain requires a detection probability of 35–50%, which can be achieved only if identification mechanisms and investigative powers are introduced at the same time [20]. This is the central lesson of Bhattacharya and Daouk: the market responds to the first credible enforcement, not to the text of the law.

The state-insider channel documented in Section 5.2 implies that the reform must be tailored to a state-dominated ownership structure. Three measures follow directly from the evidence. First, the disclosure deadline for material facts should be shortened from two business days to "as soon as possible but no later than 24 hours" (the principle of Article 17 of the EU Market Abuse Regulation), with time-stamped recording of the decision date and a trading halt until disclosure; the median 12-day lag shows that the current deadline is neither binding nor enforced. Second, a specific insider regime for state-controlled issuers should classify government representatives on boards and the officials of asset-management bodies as insiders, define the event date for state decisions and impose OECD-type disclosure standards; the public sale of state stakes should include a minimum public tranche of 10–15% so that the free float reaches the 10–15% listing thresholds used, for example, by the Kazakhstan Stock Exchange [21]. Third, the identification regime should combine EU-style insider lists and 30-day closed periods with US-style personal reporting of insiders' transactions within two business days into a machine-readable register on the existing disclosure portal – a "mixed" model that fits a market in which insider information originates as much in ministries as in issuers.

The event-study evidence also allows the surveillance system to be calibrated on domestic rather than imported thresholds. Fig. 6 presents the resulting three-filter algorithm. The first filter flags securities whose pre-event volume exceeds 1.5 times the estimation-window mean or whose five-day CAR exceeds 5% in absolute value – thresholds that would have captured four of the seven observations in Table 6 (pre-event volume of 1.34–1.73 and CARs of −4.8% to +29.1%); a "red" level (2.5 times and 10%) prioritises investigative resources [22]. The second filter confirms the signal with order imbalance above 0.6, a spread jump above twice its estimation-window mean or a disclosure lag above one day. The third filter – the one that cannot operate today – matches counterparties from depository records against the insider register, affiliation data and the closed-period calendar. Applying the algorithm retrospectively to the August–September 2026 events shows that it would have escalated the Turonbank and Almalyk cases to the identification stage, where the current system stops. Because the volume and return filters are prone to false positives in illiquid securities, we recommend that in the first year only

red-level signals be investigated and that thresholds be recalibrated on the basis of the false-positive rate [23].

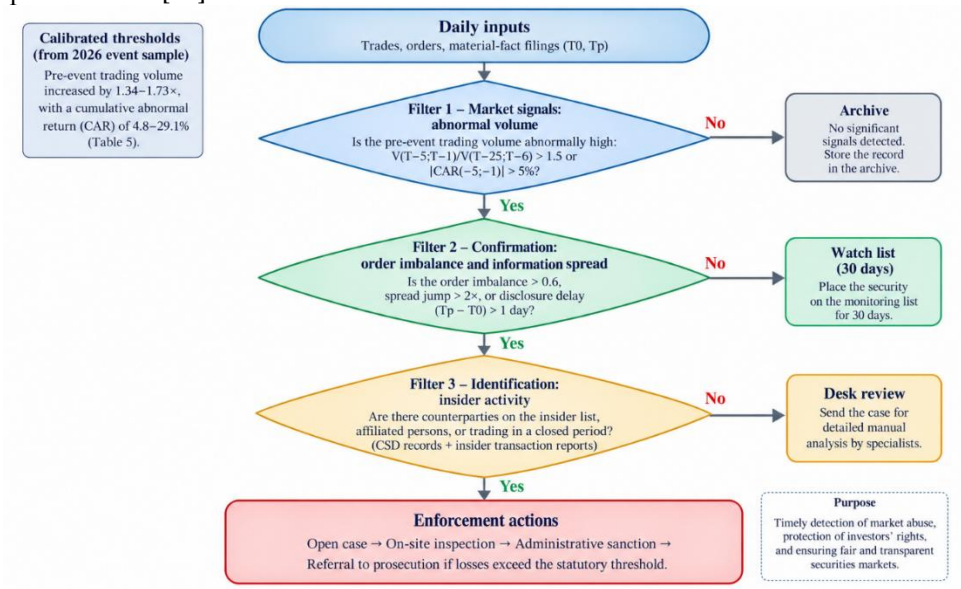


Fig. 6. Proposed three-filter surveillance algorithm with thresholds calibrated on the event-study evidence. Source: authors' design.

Table 9 summarises the regulatory package as a mapping from the five institutional gaps identified in Section 2 to concrete amendments, and the scenario analysis of Section 5.4 suggests a sequencing: statutory amendments (the Capital Market Law, the Administrative Liability and Criminal Codes, and the Bank Secrecy Law, which must be amended together because the sanctions of the new law cannot be applied without the codes and bank-secrecy access cannot be exercised without the fifth article of that law) in 2026–2027; the insider register, transaction reporting and closed periods, which can be introduced at the agency-regulation level without waiting for the law, in 2027; the first enforcement actions, publication of enforcement statistics and accession to Appendix A of the IOSCO MMoU in 2028; and the extension of the regime to the over-the-counter market and recalibration of thresholds in 2029–2030. Each phase is tied to measurable targets – disclosure lag, median spread, turnover, free float – that can be recomputed annually with the toolkit of Section 4, so that the framework proposed here doubles as the regulator's monitoring instrument [24].

Table 9

Institutional gaps and the proposed regulatory package

Gap	Evidence (this paper)	Proposed measure	Instrument	Phase
Sanction gap	0 cases in 2016–2025; generic fine ≈ EUR 200; expected cost ≈ 0.1% of gain	Three-tier liability: procedural breaches 10–50 BCU; insider dealing – 2× gain, ≥ 100 BCU, 3-year ban; criminal offence for large losses (3–5 years)	Administrative Liability Code (new Arts. 174-2, 174-3); Criminal Code; Capital Market Law	2026–2027
Detection gap	No insider lists, reporting or closed periods; pre-event CAR up to 29%; 12-day lag	Insider register on openinfo.uz; personal reporting within 2 business days; 30-day closed periods and T0–Tp blackout; three-filter surveillance	Agency Regulation No. 3625 (anti-fraud rules); Regulation No. 2383	2026–2027
Power gap	MMoU Appendix B; no bank-secrecy access; court-only fines; ≤ 10-day licence suspension	NAPP added to Art. 5 of Bank Secrecy Law; CBU–NAPP MoU and real-time CSD access; on-site inspections; out-of-court sanctions with due-process	Bank Secrecy Law; Capital Market Law; Regulation No. 3655 (sanction procedure)	2027–2028

		safeguards; MMoU Appendix A by 2028		
State-insider gap	Illiquidity 2.4× and volatility 2× higher for state issuers; state decisions disclosed with 12-day lag	Special insider regime for state-controlled issuers; government representatives as insiders; ≥ 10–15% public tranche in state-stake sales; free-float listing thresholds (A ≥ 15%, B ≥ 10%)	Decree PF-177; Corporate Governance Code; TSE listing rules	2027–2028
Disclosure gap	76 late disclosures in 17 months; 2-business-day rule not binding; retroactive corrections	"As soon as possible, ≤ 24 h" with T0/Tp time stamps; pre-disclosure trading halt; immutable filings with correction log; IFRS notes and iXBRL	Regulation No. 2383; TSE rules	2026–2029

Notes: BCU = basic calculation unit (UZS 412,000 in 2025). Source: authors.

5. Conclusion

This paper asks how information asymmetry can be measured in a market where the conventional yardstick – insider-trading enforcement statistics – does not exist, and applies the answer to Uzbekistan, a rapidly growing but state-dominated frontier market. Using a hand-collected microstructure dataset for 72 securities, an event study of disclosure lags and a ten-year model of market activity, we find that the market is highly asymmetric by every measure (median effective spread 3.4%, median Amihud ratio 35.9, one quarter of securities with zero-volume days); that prices move on corporate information one to two weeks before it is officially disclosed; and that, conditional on trading activity, state-controlled issuers are 2.4 times less liquid and twice as volatile as private issuers – a state-insider channel that standard cross-country studies of insider-trading law do not capture. Scenario forecasts indicate that market growth alone will not remove the asymmetry by 2030, whereas a package combining a 24-hour disclosure rule, an identification regime for insiders (including state representatives), graduated sanctions, expanded investigative powers and a calibrated surveillance algorithm could reduce the median spread to about 2% and raise turnover to the emerging-market range. The study has limitations that define an agenda for further research. The daily price history available to us covers twenty trading days and the event sample seven observations, so the cross-sectional and event-study estimates should be regarded as a first pilot; the framework is designed to be re-estimated as the exchange releases longer histories and as the disclosure portal begins to publish time-stamped filings. The probability of informed trading (PIN) could not be estimated with the available trade prints and remains a natural extension once intraday data become accessible. The time-series model rests on ten annual observations and a constructed regulatory index, and its forecasts carry wide prediction intervals. Finally, the information channel of the proposed reforms cannot be identified before the reforms are enacted; the first enforcement actions expected in 2028 will provide the natural experiment with which to test the predictions of this paper. Beyond Uzbekistan, the measurement framework and the state-insider hypothesis are directly applicable to other frontier markets in Central Asia, the Caucasus and Africa in which the state remains the dominant shareholder and enforcement statistics are absent.

Declaration of competing interest. The authors declare no competing interests.

Data availability. The security-level dataset (72 securities, July–September 2026), the event file and the annual time series are available from the corresponding author on request and will be deposited in a public repository upon acceptance.

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