

INNOVATION SCIENCE AND TECHNOLOGY

ISSUE 9, PART 2 / SEPTEMBER 2026

 Acceptance of papers



**Acceptance of
papers**

Published monthly



Topics

economics,
technology, social
sciences



EDITOR-IN-CHIEF:

Mirzaliyev Sanjar Makhamatjon ugli

DEPUTY EDITOR-IN-CHIEF:

Makhmudov Nosir Makhmudovich
DSc., Prof., Academician

DEPUTY EDITOR-IN-CHIEF:

Ochilov Bobur Bakhtiyor ugli – Senior
lecturer at TSUI

THE SCIENTIFIC-POPULAR ELECTRONIC
JOURNAL **"INNOVATION SCIENCE AND
TECHNOLOGY"** HAS BEEN REGISTERED
UNDER THE NUMBER **C-5669633** BY THE
AGENCY FOR INFORMATION AND MASS
COMMUNICATIONS (AOKA) OF THE
REPUBLIC OF UZBEKISTAN, EFFECTIVE
FROM OCTOBER 9, 2024.

CONTACTS

Phone: **+998 50 737 87 88**

Website: <https://ist-journal.uz>

Email: innovationist2025@gmail.com

The scientific electronic journal "Innovation Science and Technology" has been included in the list of scientific publications recommended for the publication of main scientific results of dissertations for the award of PhD and DSc degrees in economics and technical sciences, in accordance with the Resolution No. 370 of the Presidium of the Higher Attestation Commission of the Republic of Uzbekistan, dated May 8, 2025.

Editorial board:



Sharipov Kongiratbay Avezimbetovich,
Doctor of Technical Sciences (DSc), Professor



Abdurakhmanova Gulnora Kalandarovna, Doctor of
Economic Sciences (DSc), Professor



Cham Tat Huei,
Doctor of Philosophy (PhD), Professor (Malaysia)



Muhammad Imran Sadiq
Doctor of Philosophy in Economics (PhD), Professor,
Malaysia



Ahmed Aziz Ismail
Doctor of Technical Sciences (DSc),
Professor (Egypt)



Lee Chin
Doctor of Philosophy in Economics (PhD), (Malaysia)



Asongu Simplicé
Doctor of Philosophy in Economics (PhD), Cameroon



Rui Dang
Doctor of Chemistry (DSc), Professor, China



Zahoora Ahmed
Doctor of Philosophy in Economics (PhD), Turkey



Shujaat Abbas
Doctor of Philosophy in Economics (PhD), Russia



Tina A Coffelt
Doctor of Philosophy in Educational Sciences (PhD),
USA



Abdikarimova Dinara Rustamxanovna
Doctor of Economic Sciences (DSc), Professor

Kurbonbekova Mohichehra Turobjonovna
Doctor of Economic Sciences (DSc), Professor

Alimardonov Ilkhom Muzrabshokovich
Doctor of Economic Sciences (DSc), Professor



Razakova Barno Sayfiyevna
Doctor of Philosophy in Economics (PhD)



Khasanov Sarvar Ulugbek ugli
Doctor of Philosophy in Economics (PhD)



Kholikova Rukhsora Sanjarovna
Associate Professor (PhD)



Xoliyorova Shoxista Qahramon qizi
PhD in Economics, Assistant Lecturer at the Department TSUE

CONTENTS

DETERMINING WAYS TO IMPROVE THE DESIGN OF THE NEEDLE THREAD TENSION REGULATOR IN A SEWING MACHINE	8
Zarina Mukhitdinovna Nurlibaeva, Anvar Zhuraevich Djuraev	
STRATEGY FOR DEVELOPING THE TOURISM POTENTIAL OF THE SURKHANDARYA REGION THROUGH 2030.....	13
Muminova Mavjuda Sharifovna	
MATHEMATICAL MODEL, ALGORITHM, AND SOFTWARE SUITE FOR ACOUSTIC LOCALIZATION OF UNDERWATER OBJECTS	20
Islomov Diyorbek Zafar o'g'li	
WAYS TO IMPROVE THE METHODOLOGY OF EXPORT FINANCING IN UZBEKISTAN	25
Qarshiyev Daniyar Eshpulatovich	
EVALUATION OF ADAPTIVE MODELS OF ENSURING THE STABILITY OF THE TRANSPORT AND LOGISTICS SERVICES MARKET IN THE FERGANA REGION	31
Khakimov Dilshodjon Rakhmonalievich, Ruziboyeva Zahro Anvar kizi	
EVENT-DRIVEN VAR ANALYTICS FOR OPEN FOREIGN EXCHANGE POSITION MANAGEMENT: EMPIRICAL EVIDENCE AND A DIGITAL PLATFORM DESIGN FOR UZBEKISTAN'S BANKS.....	35
Doniyor Abdurashidovich Djalilov	

EVENT-DRIVEN VAR ANALYTICS FOR OPEN FOREIGN EXCHANGE POSITION MANAGEMENT: EMPIRICAL EVIDENCE AND A DIGITAL PLATFORM DESIGN FOR UZBEKISTAN'S BANKS

Doniyor Abdurashidovich Djalilov

Director of the Risk Management Department (Chief Risk Officer), JSC Octobank
Independent PhD Researcher (second year), Graduate School of Business and Entrepreneurship under the
Cabinet of Ministers of the Republic of Uzbekistan
Specialty: 08.00.16 — Digital Economy and International Digital Integration

E-mail: 9884581@gmail.com

ORCID: 0009-0003-6363-0309

Science ID: MTV-0426-0059

Abstract. This study evaluates whether regulatory control of open currency positions (OCPs) is sufficient to measure the economic foreign exchange risk of a commercial bank and translates the findings into requirements for a digital risk-management platform. Official monthly exchange rates of the Central Bank of the Republic of Uzbekistan for January 2020 – September 2025 (69 observations) are used to construct four model portfolios with the same aggregate long OCP equal to 10% of banking-system regulatory capital. Parametric, historical-simulation, and Student-t Monte Carlo VaR estimates are compared; Expected Shortfall, Kupiec backtesting, and five stress scenarios are also applied. Although every portfolio has the same regulatory position ratio, monthly 99% parametric VaR ranges from 0.22% to 1.58% of regulatory capital — a 7.24-fold difference. A 10-day square-root-of-time conversion preserves the disparity, producing estimates of approximately 0.15% – 1.09% of capital. The diversified portfolio's VaR is 44.1% below the sum of standalone currency VaRs, demonstrating information about correlations that the additive OCP measure cannot capture. The article's second contribution is an event-driven platform design in which every accepted exchange-rate update or transaction atomically updates the position ledger, revalues exposures, recalculates OCP, VaR, Expected Shortfall, and stress scenarios, tests both regulatory and internal limits, and stores an auditable snapshot. Manual spreadsheet-based analysis cannot provide the same calculation frequency, data consistency, or traceability. VaR should therefore complement — not replace — OCP limits, while a digital platform converts the 10-day, 99% VaR requirement of paragraph 91¹ of Regulation No. 3427 into a continuous management control.

Keywords: foreign exchange risk; Value-at-Risk; open currency position; event-driven architecture; digital risk platform; regulatory capital; backtesting; stress testing.

JEL classification: G21, G28, G32, O33.

Annotatsiya. Ushbu tadqiqot tijorat bankining iqtisodiy valyuta xavfini baholashda ochiq valyuta pozitsiyalarini (OVP) regulativ nazorat qilish yetarli yoki yetarli emasligini tahlil qiladi va olingan natijalarni raqamli xatarlarni boshqarish platformasiga qo'yiladigan talablarga tatbiq etadi. Bank tizimining regulativ kapitalining 10 foiziga teng bo'lgan bir xil umumiy uzun OVPga ega to'rtta model portfelini shakllantirish uchun O'zbekiston Respublikasi Markaziy bankining 2020-yil yanvar – 2025-yil sentabr oylari uchun rasmiy oylik valyuta kurslaridan (69 ta kuzatuv) foydalanildi. Parametrik, tarixiy simulyatsiya va Student-t Montekarlo VaR baholari o'zaro solishtirildi; shuningdek, Expected Shortfall (kutilayotgan yo'qotish), Kupiec bektestingi va beshta stress-senariy qo'llanildi. Har bir portfel bir xil regulativ pozitsiya ko'rsatkichiga ega bo'lishiga qaramay, oylik 99 foizli parametrik VaR regulativ kapitalning 0,22 foizidan 1,58 foizigacha bo'lgan diapazonni tashkil etdi, bu esa 7,24 baravar farqni ko'rsatadi. Vaqtning kvadrat ildizidan foydalanilgan 10 kunlik qayta hisoblash ushbu tafovutni saqlab qolib, kapitalning taxminan 0,15% – 1,09% miqdoridagi ko'rsatkichlarini berdi. Diversifikatsiyalangan portfelning VaR ko'rsatkichi alohida valyutalar bo'yicha VaRlar yig'indisidan 44,1 foizga past bo'lib, additiv OVP ko'rsatkichi qamrab ololmaydigan korrelyatsiyalar haqidagi axborotni namoyon etadi. Maqolaning ikkinchi hissasi hodisaga yo'naltirilgan (event-driven) platforma arxitekturasini loyihasi bo'lib, unda qabul qilingan har bir valyuta kursi yangilanishi yoki tranzaksiya pozitsiya daftarini atomar tarzda yangilaydi, risk pozitsiyalarini qayta baholaydi, OVP, VaR, Expected Shortfall hamda stress-senariylarni qayta hisoblaydi, regulativ va ichki limitlarni tekshiradi hamda audit qilinishi mumkin bo'lgan snapshotlarni saqlaydi. Electron jadvallarga asoslangan qo'lda tahlil qilish bunday hisoblash

chastotasi, ma'lumotlar izchilligi va kuzatuvchanlikni ta'minlay olmaydi. Shu sababli, VaR OVP limitlarini almashtirmasdan, balki ularni to'ldirishi lozim, raqamli platforma esa 3427-sonli Nizomning 91¹-paragrafidagi 10 kunlik, 99 foizli VaR talabini uzluksiz boshqaruv nazoratiga aylantiradi.

Kalit so'zlar: valyuta xavfi; Value-at-Risk; ochiq valyuta pozitsiyasi; hodisaga yo'naltirilgan arxitektura; raqamli risk platformasi; regulyativ kapital; bektesting; stress-testdan o'tkazish.

JEL klassifikatsiyasi: G21, G28, G32, O33.

Аннотация. В данном исследовании оценивается, достаточно ли регуляторного контроля открытых валютных позиций (ОВП) для измерения экономического валютного риска коммерческого банка, а полученные результаты трансформируются в требования к цифровой платформе управления рисками. Официальные ежемесячные обменные курсы Центрального банка Республики Узбекистан за январь 2020 г. – сентябрь 2025 г. (69 наблюдений) используются для построения четырех модельных портфелей с одинаковой совокупной длиной ОВП, равной 10% регуляторного капитала банковской системы. Сравниваются параметрические оценки VaR, моделирование на основе исторических данных и метод Монте-Карло с t-распределением Стьюдента; также применяются Expected Shortfall (ожидаемые убытки), бэкtesting Купика и пять стресс-сценариев. Хотя каждый портфель имеет одинаковый регуляторный коэффициент позиции, месячный 99%-й параметрический VaR варьируется от 0,22% до 1,58% регуляторного капитала, что отражает разницу в 7,24 раза. Пересчет на 10-дневный горизонт с использованием правила квадратного корня из времени сохраняет эту диспропорцию, давая оценки в диапазоне примерно 0,15% – 1,09% капитала. VaR диверсифицированного портфеля на 44,1% ниже суммы индивидуальных валютных VaR, что демонстрирует информацию о корреляциях, которую аддитивный показатель ОВП не способен отразить. Вторым вкладом статьи является проект платформы с событийным управлением (event-driven architecture), в которой каждое принятое обновление обменного курса или транзакция атомарно обновляет реестр позиций, переоценивает риски, пересчитывает ОВП, VaR, Expected Shortfall и стресс-сценарии, проверяет как регуляторные, так и внутренние лимиты и сохраняет снимок данных для аудита. Ручной анализ на основе электронных таблиц не может обеспечить аналогичную частоту расчетов, согласованность данных или прослеживаемость. Таким образом, VaR должен дополнять, а не заменять лимиты ОВП, тогда как цифровая платформа превращает требование о 10-дневном 99%-м VaR из пункта 91¹ Положения № 3427 в инструмент непрерывного управленческого контроля.

Ключевые слова: валютный риск; Value-at-Risk; открытая валютная позиция; событийная архитектура; цифровая платформа рисков; регуляторный капитал; бэкtesting; стресс-тестирование.

Классификация JEL: G21, G28, G32, O33.

INTRODUCTION

Foreign exchange risk arises when a bank's assets, liabilities, and off-balance-sheet claims are not matched by currency, and exchange rates change before positions are closed. In Uzbekistan, the primary regulatory mechanism is the control of open currency positions (OCP). The Rules on Maintaining an Open Currency Position (Registration No. 3301, as amended) restrict positions by individual currencies and precious metals, aggregate open positions, as well as aggregate long and short positions. While these constraints are transparent, enforceable, and essential for prudential discipline, they do not transform the currency composition of the balance sheet into a probability distribution of potential losses.

The risk-management framework introduces a complementary economic layer. Paragraph 91¹ of Regulation No. 3427 requires market-risk appetite to include a maximum Value-at-Risk (VaR) calculated at a confidence level of at least 99% over a 10-day horizon, both in absolute terms and as a percentage of regulatory capital. The coexistence of OCP and VaR represents structural alignment rather than duplication: OCP measures the size and direction of exposure, whereas VaR integrates that exposure with volatility and correlation factors. Consequently, this study examines whether market participants can comply with identical OCP ratios while maintaining substantially different loss potentials. Artificial intelligence tools were also utilized during the editing process of this text.

Operational execution presents an additional dimension. A position fluctuates whenever a deal is booked, amended, settled, or cancelled, and its local-currency value shifts with exchange-rate changes. VaR, stress losses, and internal limits require recalculation from the same state. While periodic calculations can be performed manually, ensuring full data collection, reconciliation, covariance updates, scenario applications, limit comparisons, and audit logging after every market or transaction event necessitates automated digital solutions. The core objective is maintaining the required frequency, dimensionality, and consistency of the calculations.

The purpose of this article is twofold: (1) to quantify the economic-risk dispersion that remains unobserved when aggregate OCP is held constant; and (2) to formulate an event-driven platform design that transforms VaR from a periodic report into a continuous control mechanism. The empirical hypothesis states that portfolios with

identical regulatory OCP can exhibit statistically and economically distinct VaR profiles. The design hypothesis proposes that a single event-time snapshot can align positions, regulatory limits, VaR, and stress scenarios into a consistent state.

This study contributes to the literature by integrating a regulatory evaluation with an empirical experiment and an operational technology implementation model. The innovation lies in uniting regulatory, statistical, and transactional controls within a unified digital decision cycle.

LITERATURE REVIEW

Modern portfolio measurement originates from the principle that overall risk depends on both standalone volatility and the co-movement among instruments (Markowitz, 1952). VaR operationalized that principle as a loss quantile stated for a specified horizon and confidence level. RiskMetrics (J.P. Morgan/Reuters, 1996), Jorion (2007), and Alexander (2008) established the primary parametric, historical, and simulation approaches used across financial institutions. McNeil, Frey, and Embrechts (2015) emphasize that model assumptions and tail behavior are decisive, particularly when return distributions are non-normal.

A VaR estimate is effective when its predictive performance is validated. Kupiec's (1995) proportion-of-failures test evaluates whether observed exceedances align with the model confidence level. Monte Carlo methods extend this analysis to non-linear payoffs and heavy-tailed factor distributions (Glasserman, 2004). Expected Shortfall complements VaR by measuring the average loss beyond the quantile threshold. Consequently, international market-risk standards combine quantitative models, validation, and stress testing rather than relying on a single measure (BCBS, 2019).

Technology and data governance are equally fundamental. The BCBS 239 principles require accurate, complete, timely, and adaptable risk-data aggregation and reporting (BCBS, 2013). Practically, a risk metric must be reproducible from governed inputs and traceable transformations. While a spreadsheet may calculate VaR correctly at a single point in time, it presents limitations in maintaining continuous data lineage when transactions and market rates arrive asynchronously. Event-driven processing addresses this operational requirement by converting each validated event into a versioned state and recalculating dependent indicators automatically. Artificial intelligence tools were also utilized during the editing process of this text.

The regulatory framework of Uzbekistan integrates both perspectives. Regulation No. 3301 establishes mandatory position constraints, whereas paragraph 91¹ of Regulation No. 3427 incorporates a 99%, 10-day VaR limit into market-risk appetite parameters. Existing domestic discussions typically examine these mechanisms independently. The remaining empirical and architectural question centers on measuring the economic risk dispersion under uniform OCP compliance and defining the digital mechanism required to keep both control layers synchronized throughout the operating day.

RESEARCH METHODOLOGY

Data and portfolio experiment

The empirical dataset contains official monthly average exchange rates of the US dollar (USD), euro (EUR) and Russian ruble (RUB) against the Uzbek sum published by the Central Bank of the Republic of Uzbekistan. The sample covers January 2020–September 2025: 69 exchange-rate observations and 68 log-return observations. The banking system's regulatory capital as of 1 October 2025 is taken as UZS 144,012.8 billion. These inputs are used as a transparent system-level scale rather than as the confidential position of any particular bank.

For currency i in month t , the continuously compounded return is $r_{i,t} = \ln(S_{i,t} / S_{i,t-1})$, where S is the number of Uzbek sums per unit of foreign currency. Positive r denotes appreciation of the foreign currency. Four long-only model portfolios are constructed with the same aggregate OCP equal to 10% of regulatory capital (UZS 14,401.3 billion): A—100% USD; B—100% EUR; C—60% USD, 25% EUR and 15% RUB; and D—100% RUB. Holding both aggregate OCP and aggregate long OCP constant isolates the information contributed by volatility, correlation and concentration.

Risk measures

Three VaR methods are applied at the 99% confidence level. Parametric VaR is $\text{VaR}_\alpha = z_\alpha \sqrt{w' \Sigma w}$, where w is the vector of positions in Uzbek sums, Σ is the sample covariance matrix of currency returns, and z_α is the standard-normal quantile. Historical VaR is the negative empirical 1% quantile of portfolio returns. Monte Carlo VaR is estimated from 200,000 draws of a multivariate Student-t distribution with five degrees of freedom, calibrated to the sample standard deviations and correlation matrix. Historical Expected Shortfall (ES) is the mean loss beyond the historical VaR threshold.

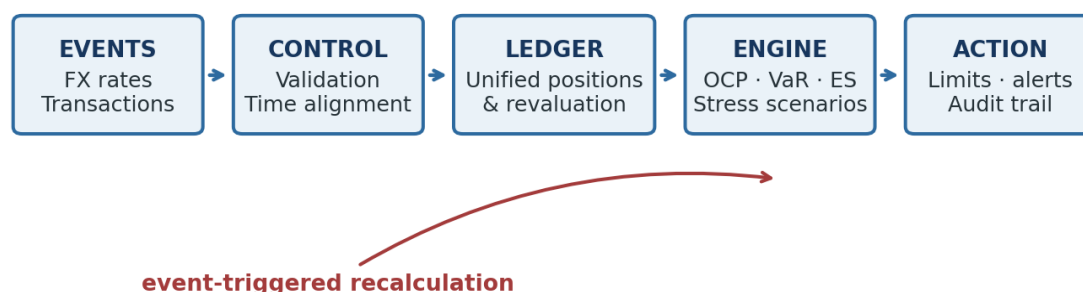
The source frequency is monthly, whereas paragraph 91¹ prescribes a 10-day horizon. To provide a

regulatory-horizon sensitivity, monthly parametric VaR is multiplied by $\sqrt{(10/21)} = 0.690$, assuming 21 trading days per month and independent, identically distributed daily returns. This conversion is reported separately because the assumption does not create the information content of a daily dataset. Production implementation should use governed daily—and where available intraday—risk-factor histories.

Model performance is checked by a rolling 36-month backtest. Each VaR estimate is compared with the next realised monthly return, producing 32 out-of-sample observations. The unconditional-coverage likelihood-ratio test of Kupiec (1995) evaluates the number of VaR exceptions. Stress testing uses five scenarios: a uniform 10% depreciation of all foreign currencies, the observed March 2022 RUB shock, the observed May 2022 EUR shock, and parallel currency-specific shocks of -2σ and -3σ .

Event-driven platform design

The platform component is derived by mapping each analytical dependency to a governed service. Exchange-rate and transaction events enter through controlled interfaces; schema, currency, timestamp, duplication and source checks are applied before acceptance. An accepted event updates a versioned position ledger and creates a single valuation snapshot. OCP, VaR, ES and every stress scenario are then recalculated from the same snapshot and compared with regulatory and internal limits. Results, model versions and input identifiers are persisted together, enabling reproduction and audit (Figure 1).



One event time → one position snapshot → one consistent set of risk metrics

Every accepted transaction or exchange-rate update produces a reproducible calculation and limit decision.

Figure 1. Event-driven digital platform for unified foreign exchange risk calculation¹

The design is event-driven but control-oriented. It does not require a full covariance re-estimation after every transaction; the current approved covariance matrix and model parameters may be cached and versioned, while position-dependent risk is recalculated immediately. Market-data events can trigger both revaluation and, according to governance rules, a parameter refresh. This separation keeps latency manageable without allowing different reports to use different position states.

Limitations

The analysis uses monthly system-level public data and stylised long-only portfolios. The 68-return sample is small for a 1% empirical quantile; historical VaR and ES can therefore depend on one or two extreme observations. The square-root-of-time conversion is a sensitivity estimate, not a substitute for 10-day returns constructed from daily data. The experiment does not model derivatives, optionality, basis risk, liquidity costs or intraday market microstructure. These restrictions limit absolute calibration but do not invalidate the controlled comparison: all portfolios are evaluated with the same data, horizon and OCP ratio.

ANALYSIS AND RESULTS

Return distributions and correlations

The currencies exhibit markedly different risk regimes (Table 1). Monthly RUB volatility is 7.24 times USD volatility; annualised volatility is 23.49% for RUB compared with 3.25% for USD. The Jarque–Bera test strongly rejects normality for USD and RUB, while EUR returns are close to normal in this sample. Heavy tails imply that

¹ Source: developed by the author.

a normal parametric model can understate rare losses, supporting parallel model estimates and stress testing (Table 1).

Table 1

Descriptive statistics of monthly exchange-rate returns, January 2020–September 2025 (%)²

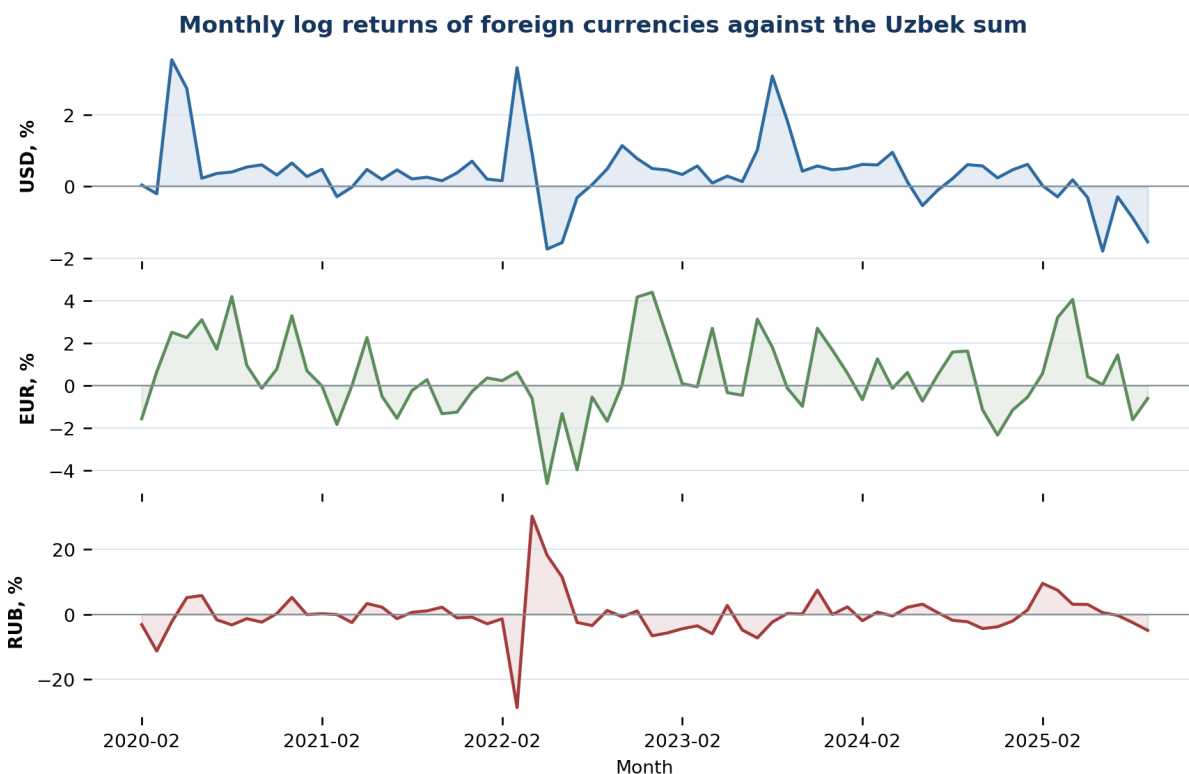
Currency	Mean	Std. dev.	Min.	Max.	Skewness	Kurtosis	JB p-value
USD	0.379	0.937	-1.80	3.53	0.99	6.60	<0.0001
EUR	0.458	1.828	-4.61	4.41	0.08	3.24	0.887
RUB	-0.054	6.780	-28.72	30.25	0.54	12.13	<0.0001

The correlation matrix provides information that an additive OCP measure cannot retain. USD and EUR returns are moderately positively correlated (0.350), whereas RUB returns are negatively correlated with USD (-0.294) and EUR (-0.115). The diversified portfolio can therefore have less risk than the sum of its standalone currency risks (Table 2).

Table 2

Correlation matrix of monthly exchange-rate returns³

Currency	USD	EUR	RUB
USD	1.000	0.350	-0.294
EUR	0.350	1.000	-0.115
RUB	-0.294	-0.115	1.000

Figure 2. Dynamics of monthly exchange-rate returns⁴

VaR under identical regulatory positions

Table 3 presents the central result. Every portfolio has the same aggregate long OCP of 10% of regulatory capital. Nevertheless, monthly 99% parametric VaR ranges from UZS 314 billion (0.22% of capital) for the USD

2 Source: author's calculations based on the Central Bank of the Republic of Uzbekistan Statistical Bulletin, September 2025, Table 3.7. JB = Jarque–Bera test.

3 Source: author's calculations.

4 Source: author's calculations based on official exchange-rate data of the Central Bank of the Republic of Uzbekistan.

portfolio to UZS 2,272 billion (1.58% of capital) for the RUB portfolio. The ratio is 7.24. The regulatory position is identical, but the economic risk is not (Table 3).

Table 3

VaR and Expected Shortfall with aggregate OCP fixed at 10% of regulatory capital⁵

Portfolio	σ , %	Parametric VaR	Historical VaR	Monte Carlo VaR	VaR / capital, %	ES / capital, %
A. USD	0.94	314	253	353	0.22	0.18
B. EUR	1.83	613	601	683	0.43	0.46
C. Diversified	1.14	381	278	427	0.26	0.22
D. RUB	6.78	2,272	2,455	2,535	1.58	2.87

The implied 99% monthly exchange-rate shock, VaR divided by OCP, equals 2.18% for USD, 4.25% for EUR, 2.65% for the diversified portfolio and 15.77% for RUB. Put differently, a RUB OCP equal to 10% of capital has the same parametric VaR as a USD OCP of approximately 72.4% of capital. OCP does not reveal this economic equivalence because it assigns the same weight to each sum-equivalent unit of exposure.

The 10-day sensitivity in Table 4 preserves the ranking and the 7.24-fold spread. The absolute values are lower because the source horizon is shortened under the square-root-of-time assumption. For a production risk-appetite limit, the bank should calculate directly from daily data; the sensitivity is included to connect the public monthly dataset to the horizon specified in paragraph 91¹ of Regulation No. 3427 (Table 4).

Table 4

Parametric VaR converted to a 10-day horizon⁶

Portfolio	Monthly VaR, UZS bn	Monthly VaR / capital, %	10-day VaR, UZS bn	10-day VaR / capital, %
A. USD	314	0.22	217	0.15
B. EUR	613	0.43	423	0.29
C. Diversified	381	0.26	263	0.18
D. RUB	2,272	1.58	1,568	1.09

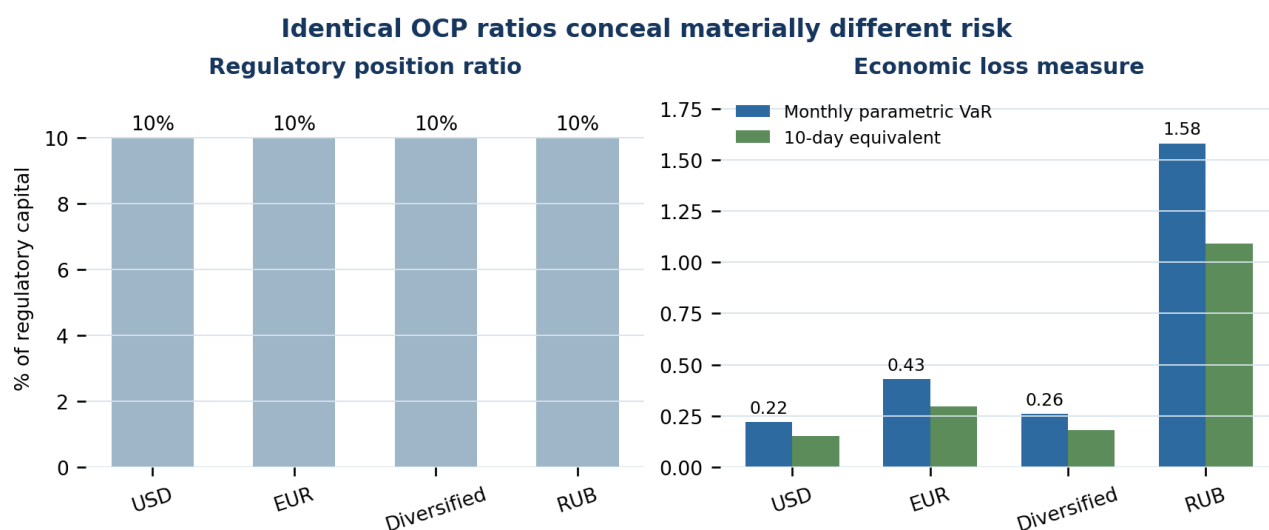


Figure 3. Regulatory position ratio versus VaR-based economic risk⁷

Method choice is also material. Student-t Monte Carlo VaR exceeds parametric VaR by approximately 12.4% for the USD portfolio and 11.6% for the RUB portfolio, reflecting heavy tails. Historical simulation is

5 Source: author's calculations. VaR amounts are UZS billion; capital as of 1 October 2025 = UZS 144,012.8 billion. The reported VaR / capital ratio uses monthly parametric VaR.

6 Source: author's calculations; conversion factor $\sqrt{(10/21)} = 0.690$. Rounded values may not reconcile exactly.

7 Source: author's calculations.

lower for portfolios A and C because the 1% quantile in a 68-observation sample is determined by only the most adverse observations. Thus, the platform should not present VaR as a model-free fact; it should retain the method, parameter set, data window and validation status with every result.

Diversification is measurable. For portfolio C, the sum of standalone currency VaRs is UZS 682 billion, whereas covariance-aware portfolio VaR is UZS 381 billion—a reduction of 44.1%. This does not mean that the OCP limit should be relaxed automatically. It means that internal allocation, pricing and hedging decisions can use information that a gross additive limit deliberately omits.

Backtesting and stress scenarios

At the 99% confidence level, the rolling parametric model passes the Kupiec test for all four portfolios. Historical simulation is rejected at the 5% significance level for portfolios A and C: two exceptions are observed versus 0.32 expected ($p = 0.044$). The limited test length makes acceptance or rejection sensitive to single observations, reinforcing the need for longer daily histories and continuous model monitoring (Table 5).

Table 5

Kupiec backtest of 99% VaR (36-month rolling window; 32 forecasts)⁸

Portfolio	Method	Exceptions	Expected	LR	p-value	Decision at 5%
A. USD	Parametric	1	0.32	0.934	0.334	Not rejected
A. USD	Historical	2	0.32	4.061	0.044	Rejected
B. EUR	Parametric	0	0.32	0.643	0.423	Not rejected
B. EUR	Historical	0	0.32	0.643	0.423	Not rejected
C. Diversified	Parametric	0	0.32	0.643	0.423	Not rejected
C. Diversified	Historical	2	0.32	4.061	0.044	Rejected
D. RUB	Parametric	0	0.32	0.643	0.423	Not rejected
D. RUB	Historical	0	0.32	0.643	0.423	Not rejected

The stress test explains why OCP can be interpreted as a uniform-shock exposure measure. If all long currency positions suffer the same proportional adverse move, portfolio loss equals the common shock multiplied by the sum of long positions. Consequently, every 10%-of-capital portfolio has the same loss under a uniform 10% shock. Once shocks differ across currencies, losses diverge sharply. Under the March 2022 scenario, the RUB portfolio loses 2.87% of capital while the USD portfolio records a gain; under currency-specific -3σ shocks, losses range from 0.28% to 2.03% of capital (Table 6).

Table 6

Stress losses by portfolio (% of regulatory capital)⁹

Scenario	A. USD	B. EUR	C. Diversified	D. RUB
Uniform: all currencies -10%	1.05	1.05	1.05	1.05
Historical: March 2022 RUB shock	-0.33	-0.06	0.22	2.87
Historical: May 2022 EUR shock	0.17	0.46	-0.05	-1.82
Calibrated: -2σ for each currency	0.19	0.37	0.41	1.36
Calibrated: -3σ for each currency	0.28	0.55	0.61	2.03

Why continuous platform calculation is necessary

The empirical results establish that position size alone is insufficient; the operating model determines whether the additional information is available when decisions are made. A transaction can leave aggregate OCP unchanged while shifting exposure from a low-volatility currency to a high-volatility currency, thereby changing VaR substantially. Conversely, a transaction that raises gross exposure can reduce portfolio VaR if it hedges an existing factor. A rate update changes the local-currency equivalent and every capital ratio even when no transaction occurs. These effects must be evaluated together.

In a manual process, position extraction, rate selection, reconciliation, model execution, limit testing and

⁸ Source: author's calculations. LR = likelihood-ratio statistic; $\chi^2(1)$ critical value at 5% = 3.841.

⁹ Source: author's calculations. Positive values denote losses; negative values denote gains.

reporting occur sequentially. During that interval the underlying state may change. The resulting OCP report, VaR calculation and scenario table can refer to different cut-off times. Repeating the cycle after every event is operationally unrealistic and increases key-person, version and formula risk. Automation is therefore a control response to temporal inconsistency, not merely a labour-saving measure.

The proposed platform uses a canonical event identifier and valuation timestamp. After an event passes validation, the system (1) updates currency-level on- and off-balance-sheet positions; (2) revalues them in Uzbek sums; (3) calculates long, short, per-currency and aggregate OCP; (4) applies the approved covariance matrix and VaR model; (5) computes ES and scenario losses; (6) compares results with Regulation No. 3301 limits and internal VaR/stress thresholds; (7) issues alerts according to escalation rules; and (8) stores the input, model version, result and decision. All dashboards and reports read the same completed snapshot (Table 7).

Table 7
Periodic manual analysis versus an event-driven digital platform¹⁰

Control dimension	Periodic manual process	Event-driven digital platform
Trigger	Fixed reporting time or analyst request	Every validated rate or transaction event
Position source	Exports and spreadsheet consolidation	Versioned unified position ledger
Metric consistency	OCP, VaR and scenarios may use different cut-offs	One snapshot for position, limits, VaR, ES and scenarios
Reaction time	Minutes to hours; depends on staff availability	Near-real-time after event processing
Model governance	Files and formulas can diverge	Approved model, parameters and data window are versioned
Limit control	Mostly ex post	Automatic breach and early-warning evaluation
Auditability	Manual evidence collection	Immutable calculation and alert history

Three safeguards are essential. First, event processing must be idempotent so that a duplicate message cannot double a position. Second, calculations must be atomic at snapshot level: users should never see OCP from one state and VaR from another. Third, model and data quality controls must fail visibly. If a rate is stale or a covariance matrix is invalid, the platform should preserve the last valid result, flag its status and escalate the exception rather than silently publish a misleading number.

CONCLUSION AND RECOMMENDATIONS

The empirical hypothesis is supported. With aggregate long OCP fixed at 10% of regulatory capital, monthly 99% parametric VaR differs by a factor of 7.24 across the model portfolios. The disparity remains after conversion to the 10-day horizon. OCP therefore provides a necessary exposure boundary but does not measure volatility, tail thickness, correlation or diversification. It is analytically informative under a uniform shock; actual currency shocks are not uniform.

The technology hypothesis is also supported conceptually. Each transaction or exchange-rate update changes one or more dependent indicators, and manual repetition of the full control chain cannot provide continuous, internally consistent monitoring. An event-driven platform can produce a new unified snapshot of positions, regulatory limits, VaR, ES and scenario losses after every accepted event, while recording the lineage required for validation and audit.

The following recommendations arise from the analysis:

Retain Regulation No. 3301 limits as hard prudential constraints; use VaR and ES as complementary economic-risk limits rather than replacements.

Operationalise paragraph 91¹ of Regulation No. 3427 with direct 10-day VaR based on governed daily data, expressed both in Uzbek sums and as a percentage of regulatory capital.

Implement a unified event-driven position ledger so that transaction events and rate events trigger consistent revaluation, risk measurement, scenario analysis and limit testing.

Run at least parametric and heavy-tail or historical models in parallel, store model versions, and maintain

10 Scalability Workload grows with currencies, events and scenarios Reusable computation scales across portfolios and scenarios Source: developed by the author.

scheduled backtesting and exception escalation.

Display OCP, VaR, ES and stress utilisation side by side by currency, portfolio and legal entity, with early-warning thresholds below formal breaches.

Extend the empirical base to daily observations, additional currencies, precious metals and derivative sensitivities; separately test liquidity and basis-risk add-ons.

The practical implication is clear: compliance answers whether a position is allowed, whereas event-driven VaR analytics answers how much the allowed position can lose under an explicitly defined probability model. Banks need both answers, produced from the same data state and available at the speed at which the risk changes.

REFERENCES

1. Alexander, C. (2008). *Market Risk Analysis, Volume IV: Value-at-Risk Models*. John Wiley & Sons.
2. Basel Committee on Banking Supervision. (2013). *Principles for Effective Risk Data Aggregation and Risk Reporting (BCBS 239)*. Bank for International Settlements. <https://www.bis.org/publ/bcbs239.pdf>
3. Basel Committee on Banking Supervision. (2019). *Minimum Capital Requirements for Market Risk*. Bank for International Settlements. <https://www.bis.org/bcbs/publ/d457.pdf>
4. Central Bank of the Republic of Uzbekistan. (2023, amended 2025). *Regulation on Requirements for Risk Management Systems of Banks and Banking Groups* (registration No. 3427; amendment No. 3427-1). National Database of Legislation. <https://lex.uz/uz/docs/-6436466>
5. Central Bank of the Republic of Uzbekistan. (2021, amended 2025). *Rules on Maintaining an Open Currency Position* (registration No. 3301; amendment No. 3301-1). National Database of Legislation. <https://lex.uz>
6. Central Bank of the Republic of Uzbekistan. (2025). *Statistical Bulletin of the Central Bank, September 2025*. Tashkent. <https://cbu.uz>
7. Glasserman, P. (2004). *Monte Carlo Methods in Financial Engineering*. Springer.
8. J.P. Morgan/Reuters. (1996). *RiskMetrics—Technical Document* (4th ed.). Morgan Guaranty Trust Company.
9. Jorion, P. (2007). *Value at Risk: The New Benchmark for Managing Financial Risk* (3rd ed.). McGraw-Hill.
10. Kupiec, P. H. (1995). Techniques for verifying the accuracy of risk measurement models. *The Journal of Derivatives*, 3(2), 73–84. <https://doi.org/10.3905/jod.1995.407942>
11. Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1), 77–91. <https://doi.org/10.2307/2975974>
12. McNeil, A. J., Frey, R., & Embrechts, P. (2015). *Quantitative Risk Management: Concepts, Techniques and Tools* (Rev. ed.). Princeton University Press.

Proofreader: Zokir ALIBEKOV

Layout and Designer: Oloviddin Sobir ugli

2026. № 9

© When materials are reproduced, the INNOVATION SCIENCE AND TECHNOLOGY journal must be cited as the source. Authors are responsible for the accuracy of the information in materials and advertisements published in the journal. Editorial opinions may not always align with those of the authors. Submitted materials will not be returned to the editorial office.

To publish articles in this journal, you may submit articles, advertisements, stories, and other creative materials through the following links. Materials and advertisements are published on a paid basis.

You may subscribe to the journal at any time using the following details. Once subscribed, please send a screenshot or photo of your payment confirmation to our Telegram page @iqtisodiyot_77. Based on this, we will send the latest issue of the journal to your address each month.

“The journal “INNOVATION SCIENCE AND TECHNOLOGY” has been registered by the Agency for Information and Mass Communications under the Administration of the President of the Republic of Uzbekistan from 09.10.2024 under the registration number №390637. License number: C-5669633. PNFL: 30407832680027

Our address: Tashkent city, Yunusobod district, 19th block,
House 17.



Acceptance of articles

Published every
monthly



Directions

Social, economic, political,
technological, scientific



Scopus || Scientific electronic journal specializing in Scopus

CERTIFICATE NUMBER: №390637

**ORDER NUMBER ACCORDING TO
THE LICENSE REGISTER: C-5669633**

CONTACT:



Contact us
+998 50 737 87 88



Telegram channel
t.me/scopus_IST2100



Journal official website
<https://ist-journal.uz/index.php/IST>