IOCRF
2nd Edition
2026

Conference

The 2nd International Online Conference on Risk and Financial Management

Revisiting AI and Machine Learning Techniques in Finance and Economics

2–4 November 2026, online



Program and Abstract Book

Organizers

MDPI

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The 2nd International Online Conference on Risk and Financial Management

2–4 November 2026 | Online

MDPI

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Prof. Dr. Thanasis Stengos

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Dr. Alessio Faccia
Prof. Dr. Ramona Rupeika-Apoga
Prof. Dr. Sisira Colombage
Prof. Dr. Svetlozar Zari Rachev
Prof. Dr. Thanasis Stengos
Prof. Dr. Xianrong Shawn Zheng

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Welcome from the Chair

Dear Colleagues,

It is my great pleasure to invite you to **The 2nd International Online Conference on Risk and Financial Management: Revisiting AI and Machine Learning Techniques in Finance and Economics (IOCRF2026)**, which will be held **online from 2 to 4 November 2026**.

The conference is organized by MDPI *Journal of Risk and Financial Management*, a peer-reviewed, open access journal that focuses on risk management and all areas of empirical finance, management, and applied financial economics.

Based on the success of the **1st edition**, the primary goal of IOCRF 2026 is to bring together researchers, scholars, and professionals from around the world working in the broad fields of economics and finance and to continue the success of previous editions.

The 2026 edition will feature a series of sessions covering timely and emerging topics, including:

1. Generative AI: paradigm shifts in finance and economics
2. Machine learning for next-generation risk modeling
3. Blockchain and digital assets: frontier analytics
4. Data capitalization: reconstructing economic valuation
5. Ethical AI and financial technology governance
6. Emerging tech convergence: future financial infrastructure

The online format of this conference enables broad, global participation without the constraints of travel or related expenses. This conference format is especially fitting and valuable, as research on AI and big data applications in empirical finance is evolving at a rapid pace. By providing an accessible and timely platform, IOCRF 2026 aims to facilitate the exchange of innovative research, methodologies, and interdisciplinary collaboration.

Participation and attendance are free of charge. All attendees are encouraged to engage actively with the presented research and to take part in meaningful academic discussions throughout the event.

Authors of accepted abstracts may present their work in two ways: through an oral presentation or by submitting a poster for the virtual poster gallery on the conference website. All submissions—whether oral presentations or posters—are eligible for awards. Click **HERE** for instructions on the poster and oral submissions.

We are sincerely grateful for your continued support and interest in IOCRF 2026. We look forward to your participation and to a successful and impactful conference.



Prof. Dr. Thanasis Stengos
Conference Chair
Department of Economics and Finance, University of Guelph, Guelph, Canada



Journal of
Risk and Financial Management

The *Journal of Risk and Financial Management* (ISSN 1911-8074) is an open access journal that publishes the leading research on finance, economics and risk. The journal publishes reviews, regular research papers, and short communications, as well as Special Issues on particular subjects. The aim of the Journal of Risk and Financial Management is to encourage scientists to publish their experimental and theoretical results in as much in detail as possible. Therefore, the journal has no restrictions regarding the maximum length of papers. Full experimental details should be provided so that the results can be reproduced.

Journal Webpage: https://www.mdpi.com/journal/jrfm

Session Chairs



Dr. Alessio Faccia

School of Business, University of Birmingham Dubai, Dubai PO Box 341799, United Arab Emirates



Prof. Dr. Ramona Rupeika-Apoga

Faculty of Economics and Social Sciences, University of Latvia, LV-1586 Riga, Latvia



Prof. Dr. Sisira Colombage

Federation University Australia, Federation Business School, Ballarat, Australia



Prof. Dr. Svetlozar Zari Rachev

Department of Mathematics and Statistics Texas Tech University Lubbock, TX 79409-1042, USA



Prof. Dr. Thanasis Stengos

Department of Economics and Finance, University of Guelph, Guelph, ON N1G2W1, Canada



Prof. Dr. Xianrong Shawn Zheng

Information Technology & Decision Sciences Department, Old Dominion University, Norfolk, USA

Keynote Speakers



Prof. Dr. Julien Chevallier

Laboratoire d'Économie Dionysien (LED), University Paris 8, Saint-Denis, France

DR. JULIEN CHEVALLIER is a Full Professor of Economics at University Paris VIII and a member of the Dionysian Economics Lab (LED). He specializes in empirical finance, applied time-series econometrics, and commodity markets. He holds a Ph.D. in Economics from the University Paris West (2008) and an M.Sc. from the London School of Economics (2005), and has held visiting positions at institutions including Imperial College London, LSE's Centre for Economic Performance, Georgetown University, and the World Bank.

He is the author and co-author of several books on carbon and commodity markets, including Econometric Analysis of Carbon Markets and Pricing and Forecasting Carbon Markets. His research has been widely published in leading journals such as the Journal of Empirical Finance, Quantitative Finance, and European Journal of Operational Research, and he serves on multiple editorial boards.

His work focuses on emissions trading systems, particularly the EU ETS, using financial econometrics to study carbon pricing, market efficiency, risk, and linkages with energy markets. He is a recognized expert in CO_2 trading schemes and has received several awards for his research contributions in energy finance and environmental economics.



Prof. Dr. Svetlozar (Zari) Todorov Rachev

Department of Mathematics and Statistics, Texas Tech University, Lubbock, USA

Prof. Svetlozar (Zari) Todorov Rachev is a professor at Texas Tech University, specializing in mathematical finance, probability theory, and statistics. He is internationally recognized for his work in probability metrics, derivative pricing, and financial risk modeling. Prof. Rachev co-founded FinAnalytica and developed its flagship risk management engine. He has authored over 400 academic publications in mathematics and finance. His Google Scholar h-index is 70, including 33 since 2020. He has held appointments at UCSB, Stony Brook, KIT, and the Steklov Institute.



Prof. and Frey Family Endowed Chair Stan Uryasev

Department of Applied Math. & Statistics, Stony Brook University, Stony Brook, United States

Stan Uryasev is Professor and Frey Family Endowed Chair at the Stony Brook University.

His research is focused on efficient computer modeling and optimization techniques and their applications in finance. He published four books (two monographs and two edited volumes) and more than 130 research papers. He is a co-inventor of the Conditional Value-at-Risk and the Conditional Drawdown-at-Risk optimization methodologies. He developed optimization software in risk management area, including Drawdown and Credit Risk minimization.

His joint paper with Prof. Rockafellar on Optimization of Conditional Value-At-Risk in The Journal of Risk, Vol. 2, No. 3, 2000 is among the 100 most cited papers in Finance. Many risk management/optimization packages implemented the approach suggested in this paper (MATLAB implemented a toolbox).

Stan Uryasev is a frequent speaker at academic and professional conferences. He has delivered seminars on the topics of risk management and stochastic optimization. He is on the editorial board of a number of research journals and is Editor Emeritus and Chairman of the Editorial Board of the Journal of Risk.



Prof. Dr. Xianrong Shawn Zheng

Information Technology & Decision Sciences Department, Old Dominion University, Norfolk, USA

Dr. Xianrong (Shawn) Zheng is an Associate Professor of Information Technology, Old Dominion University, Norfolk, Virginia, United States. He received his Ph.D. degree in Computer Science from Queen's University, Kingston, Ontario, Canada, in 2014. His research interests are AI, Cloud Computing, Data Science, and FinTech. Dr. Zheng is a Member of Association for Computing Machinery (ACM). He is the Editor-in-Chief of International Journal of Web Portals (IJWP), an Editorial Board Member of International Journal of Data Science (IJDS), and a Technical Program Committee Member of IEEE International Conference on Web Services (IEEE ICWS). Also, he is the Guest Editor of Special Issues “Financial Data Science in the Era of Generative AI” for European Financial Management (EFM), “Financial Technologies (FinTech) in Finance and Economics” for Journal of Risk and Financial Management (JRFM), etc.

Invited Speakers



Prof. Dr. Adrian Cantemir Calin

Department of International Business and Economics, Bucharest University of Economic Studies, Bucharest, Romania,; Institute for Economic Forecasting, Romanian Academy, Bucharest, Romania



Prof. Dr. Ahmet Faruk Aysan

College of Islamic Studies, Hamad Bin Khalifa University, Qatar Foundation, Doha, Qatar



Dr. Alexis Montecinos

Clinical Associate Professor of Artificial Intelligence, Questrom School of Business, Boston University, Boston, Massachusetts, United States



Prof. Dr. Clinton Watkins

Director of Global Business Program, Faculty of International Liberal Arts, Akita International University, Akita, Japan



Dr. Pythagoras Petratos

Westminster Business School, University of Westminster, London NW1 5LS, UK



Prof. Dr. Vikas Sharma

Széchenyi István University, Hungary; University School of Business, Chandigarh University, Ajitgarh, India



Assoc. Prof. Xiankui (Bill) Hu

Chair of Department of Finance and International Business, School of Business, Howard University, Washington, USA

Invited Industry Speaker



Mr. Dinesh Velusamy

IT Governance, Risk & Compliance Specialist and Data Protection Officer, Melbourne, Victoria, Australia



Mr. Sarthak Gupta

Data Scientist II, Finance Models, Risk Management, Amazon, Seattle, United States

Program at a Glance

	Day 1	Day 2	Day 3
Morning	**Session 4.** Data Capitalization: Reconstructing Economic Valuation **Session 3.** Blockchain and Digital Assets: Frontier Analytics	**Session 6.** Emerging Tech Convergence: Future Financial Infrastructure	**Session 2.** Machine Learning for Next-Generation Risk Modeling (Part I)
Afternoon	**Session 1.** Generative AI: Paradigm Shifts in Finance and Economics	**Session 5.** Ethical AI and Financial Technology Governance	**Session 2.** Machine Learning for Next-Generation Risk Modeling (Part II)

IOCRF 2026 Program

2 November 2026 (Monday)

Session 4. Data Capitalization: Reconstructing Economic Valuation

Time: 8:30 (CET) | 2:30 (EST, New York) | 15:30 (CST, Asia, Beijing)

Central European Time (CET)	Speaker	Title
08:30 – 08:35	*Welcome from the Session Chair* *Prof. Dr. Sisira Colombage*	
08:35 – 08:55	**Invited Industry Speaker** Mr. Dinesh Velusamy	Data Capital: Discounted by Cyber Risk, Multiplied by AI
08:55 – 09:10	**Oral Speaker** Katerina Fotova Čiković	Analysis of the impact of revenue structure on Amazon platform share prices
09:10 – 09:25	**Oral Speaker** Nizar Baklouti	Capitalizing Data in the Digital Economy: Canada's Experience with Digital Supply-Use Tables
09:25 – 09:40	**Oral Speaker** Khadeeja Farhana C P M	Carbon Exposure, Disclosure, and Investment: A TSVF-Based Asset Pricing Study
09:40 – 09:55	**Oral Speaker** Monodeep Saha	Valuation Governance in Data-Constrained Markets: Integrating Valuation Uncertainty into Credit Risk Analytics via an Institutional Transmission Mechanism

Session 3. Blockchain and Digital Assets: Frontier Analytics

Time: 10:00 (CET) | 4:00 (EST, New York) | 17:00 (CST, Asia, Beijing)

Central European Time (CET)	Speaker	Title
10:00 – 10:05	*Welcome from the Session Chair* *Dr. Alessio Faccia*	
10:05 – 10:25	**Invited Speaker** Prof. Dr. Adrian Cantemir Calin	To be announced
10:25 – 10:45	**Invited Speaker** Dr. Pythagoras Petratos	AI and Machine Learning in Finance and Economics: Technological convergence and Integration
10:45 – 11:00	**Oral Speaker** Federico Cini	Energy Risk and Bitcoin Valuation Across Protocol-Defined Regimes
11:00 – 11:15	**Oral Speaker** Xufeng Zhang	From On-Chain Transparency to Organisational Accountability: A Conceptual Framework for Blockchain-Enabled Reporting
11:15 – 11:30	**Oral Speaker** Karthik Iyer	Financial-crime risk in crypto-asset settlement: a reading of the enforcement record

Session 1. Generative AI: Paradigm Shifts in Finance and Economics

Time: 14:00 (CET) | 8:00 (EST, New York) | 21:00 (CST, Asia, Beijing)

Central European Time (CET)	Speaker	Title
14:00 – 14:05	*Welcome from the Session Chair* *Prof. Dr. Svetlozar (Zari) Todorov Rachev*	
14:05 – 14:35	**Keynote Speaker** Prof. Dr. Svetlozar (Zari) Todorov Rachev	Generative AI and the Transformation of Finance: Concepts, Methods, and Emerging Paradigms
14:35 – 14:55	**Invited Speaker** Prof. Dr. Ahmet Faruk Aysan	AI Governance and Auditing Challenges: A Conscious Economics Perspective
14:55 – 15:10	**Oral Speaker** She Zhang	Auditable RAG Credit Signals from Auto-Retail Filings: A Validation Framework for Dealer Risk Models

15:10 – 15:25	**Oral Speaker** YINGYING YANG	The determinants of AI Washing in Corporate Reporting: Strategic Antecedents and Path Dependence of Symbolic Technological Narratives
15:25 – 15:40	**Oral Speaker** Farzana Afroz	Revisiting Equity–Bond Diversification: Tail Risk, Extreme Events and Option–Implied Evidence from Global ETFs
15:40 – 15:55	**Oral Speaker** Shahd Ahmed Alkhirbawy	AI4Fin: Fine-Tuning AI for Egyptian Financial Sentiment and Slang
15:55 – 16:10	**Oral Speaker** Manuel Salas-Velasco	Financial AI Literacy: Developing and Testing a New Scale for AI-Assisted Financial Decision-Making
16:10 – 16:25	**Oral Speaker** Aida Arbi Nefzi	Reconceptualizing Intellectual Capital through Generative AI: Evidence from Sustainable Banking Performance in Saudi Listed Banks
16:25 – 16:40	**Oral Speaker** Monika Gahlawat	Indian Consumers and AI-Generated Green Finance Messaging: Trust, Skepticism and Purchase Intention
16:40 – 16:55	**Oral Speaker** Harshith Akurati	Racial Encoding in AI-Generated Neighborhood Assessments: Evidence from Vision-Language Models and Google Street View Imagery

3 November 2026 (Tuesday)

Session 6. Emerging Tech Convergence: Future Financial Infrastructure

Time: 9:00 (CET) | 3:00 (EST, New York) | 16:00 (CST, Asia, Beijing)

Central European Time (CET)	Speaker	Title
09:00 – 09:05	*Welcome from the Session Chair* *Prof. Dr. Ramona Rupeika-Apoga*	
09:05 – 09:35	**Keynote Speaker** Prof. Dr. Julien Chevallier	One Problem, Many Solvers: Portfolio Optimization in International Equity Indices
09:35 – 09:55	**Invited Speaker** Prof. Dr. Vikas Sharma	The Future of Financial Infrastructure: Convergence of AI, Blockchain and FinTech for Sustainable Finance
09:55 – 10:15	**Invited Speaker** Prof. Dr. Clinton Watkins	Voluntary Payout Policy Disclosure and Corporate Capital Allocation: Evidence from Japanese Listed Firms
10:15 – 10:30	**Oral Speaker** Saman Ikram Abbasi	Smart and Secure: Leveraging AI-Blockchain Convergence to Transform Banking Infrastructure
10:30 – 10:45	**Oral Speaker** Tamar Gugushvili	TAP-i: A Prototype Platform for AI-Assisted Bank Guarantee Processing in Emerging Markets
10:45 – 11:00	**Oral Speaker** Oumaima Messlohi	Artificial Intelligence in Finance: A Comprehensive Systematic Review of Generative AI, Large Language Models, Applications, Challenges, and Future Research Directions
11:00 – 11:15	**Oral Speaker** Dounia Berrachid	From financial Primitives to regulatory Frameworks: what lessons for Morocco?
11:15 – 11:30	**Oral Speaker** Indra Raj Subedi	Regulating Bancassurance in Nepal: Nepal Rastra Bank's Intervention and Its Implications for Financial Innovation and Financial Market Development

Session 5. Ethical AI and Financial Technology Governance

Time: 14:00 (CET) | 8:00 (EST, New York) | 21:00 (CST, Asia, Beijing)

Central European Time (CET)	Speaker	Title
14:00 – 14:05	*Welcome from the Session Chair* *Prof. Dr. Xianrong Shawn Zheng*	
14:05 – 14:35	**Keynote Speaker** Prof. Dr. Xianrong Shawn Zheng	Investing in AI Infrastructure: A Comparison of LLMs in Capturing Financial News Sentiment

14:35 – 14:50	**Oral Speaker** Salvatore La Barbera	When AI Is the Story: LLM-Based Evidence on AI Narratives, Disclosure Credibility, and IPO Performance
14:50 – 15:05	**Oral Speaker** Leo S.F. Lin	Modeling Agentic Crime: A Proposed ROSI Framework for Deepfake and AI-Enabled Financial Risk
15:05 – 15:20	**Oral Speaker** Stavr Zaugolnikov	Responsible AI Management in Financial Regulation: Organizational Capabilities and Governance in FinTech Adoption
15:20 – 15:35	**Oral Speaker** Li Zeng	From Explainability to Accountability: The FinTRACE-AI Framework for Algorithmic Risk Governance in FinTech
15:35 – 15:50	**Oral Speaker** Koustubh Sharma	Governing Risk at Machine Speed: Operationalizing Model-Risk Management, Fairness Testing, and Explainability for Machine-Learning Credit Models
15:50 – 16:05	**Oral Speaker** Puneet Redu	Governing Agentic Finance: A Framework for EU AI Act Compliance in Autonomous Algorithmic Trading
16:05 – 16:25	**Invited Speaker** Assoc. Prof. Xiankui (Bill) Hu	Groupthink Behavior in AI Models
16:25 – 16:45	**Invited Industry Speaker** Mr. Sarthak Gupta	Designing Oversight In: Governing Agentic AI in Financial Institutions

4 November 2026 (Wednesday)

Session 2. Machine Learning for Next-Generation Risk Modeling (Part I)

Time: 9:00 (CET) | 3:00 (EST, New York) | 16:00 (CST, Asia, Beijing)

Central European Time (CET)	Speaker	Title
09:00 – 09:05	*Welcome from the Session Host* *To be announced Session Host*	
09:05 – 09:20	**Oral Speaker** Idrees Mustafa Aziz	A Gaussian Recency Score for Detecting and Directing Central-Bank Policy-Rate Changes
09:20 – 09:35	**Oral Speaker** Lulian Gabriel IONESCU	Can Old and New Models Work Together? Predicting Volatility across U.S. Sectors with GARCH and Machine Learning
09:35 – 09:50	**Oral Speaker** Piotr Czech	Hidden Coverage Failures in Bitcoin Volatility Prediction Intervals Across Sentiment States
09:50 – 10:05	**Oral Speaker** Pooja Bansal	Dynamic Network Productivity, Club Convergence, and Machine Learning Benchmarking: Evidence from Indian Banks across Ownership Groups
10:05 – 10:20	**Oral Speaker** Michael Masunda	AgentShield-Real: A Unified Multi-Source Neural Framework for Real-Time Financial Fraud Detection Across Heterogeneous Transaction Domains.
10:20 – 10:35	**Oral Speaker** Azz El Arab Gantare	Traditional Determinants of Bank Performance and the Incremental Role of ESG in the MENA Region: Evidence from Fixed-Effects Regression and Elastic Net Machine Learning
10:35 – 10:50	**Oral Speaker** Arjeta Hallunovi	Revisiting AI and Machine Learning Techniques in Finance and Economics: A Regression-Based Perspective
10:50 – 11:05	**Oral Speaker** Bushra Shaikh	Tool-Induced Analytical Variance in Credit Risk Exploration: A Comparative Study Using Python, SQL, and Power BI
11:05 – 11:20	**Oral Speaker** Kamran Razzaq	Predict, Detect, Defend: A Machine Learning Framework for Next-Generation Cyber Risk Modelling
11:20 – 11:35	**Oral Speaker** Ionuț Laurențiu Călin	Mapping Systemic Cross-Curency Risk: Using Graph Neural Networks on Liquidity Flows

Session 2. Machine Learning for Next-Generation Risk Modeling (Part II)

Time: 14:00 (CET) | 8:00 (EST, New York) | 21:00 (CST, Asia, Beijing)

Central European Time (CET)	Speaker	Title
14:00 – 14:05	*Welcome from the Session Chair* *Prof. Dr. Thanasis Stengos*	
14:05 – 14:35	**Keynote Speaker** Prof. and Frey Family Endowed Chair Stan Uryasev	Risk Quadrangle and Applications in Statistics, Data Mining, and Portfolio Optimization

14:35 – 14:55	**Invited Speaker** Dr. Alexis Montecinos	Reinventing Value Creation: The Transformative Impact of Artificial Intelligence on Business Strategy
14:55 – 15:10	**Oral Speaker** Pooja Venugopal Baskaran	ML-Powered Corporate Bond Liquidity Scoring: A Multi-Measure XGBoost Framework on FINRA TRACE Data with SHAP Interpretability
15:10 – 15:25	**Oral Speaker** Ting-Jung Lee	AI-Driven Dynamic Asset Pricing with Regime Switching and Nonlinear Risk Premia
15:25 – 15:40	**Oral Speaker** Zhen Zhang	Machine Learning for Rare-Event Bank Failure Ranking: Rolling Out-of-Sample Evidence from Public FDIC Data
15:40 – 15:55	**Oral Speaker** James W. Kolari	Industry Risk in Asset Pricing: A Machine Learning Approach
15:55 – 16:10	**Oral Speaker** Salma El Faroui	Integrating Artificial Intelligence into Climate Risk Management: An Intellectual Cartography of a Decade of Research on Financial Decision-Making
16:10 – 16:25	**Oral Speaker** HASNA EL MEKKI	Does Machine Learning Outperform Traditional Scorecards? Evidence from a Benchmark Credit Risk Dataset
16:25 – 16:45	Flash Poster Presentation (5 mins per person)	**Amna BOUHOREIRA** Predicting Default Risk in Buy Now, Pay Later Services: A Comparative Study of Random Forest and XGBoost **Babu George** Trading the Story Before the Price: A Reflexivity-Aware Neural Framework for the Narrative Risk Premium **Calo Mesquita** Selective Forecasting of Realized Volatility Using Prediction Confidence **Ali Ait Sidi Lkhir** Aggregation Choice and the Limits of Machine Learning in Financial Stress Measurement: Evidence from Twenty Emerging Markets, 2007–2025
16:45 – 16:50	*Closing Remark* *Prof. Dr. Thanasis Stengos*	

IOCRF 2026 Poster List

Submission ID	Title	Authors Name
S1. Generative AI: Paradigm Shifts in Finance and Economics		
Sciforum-208568	Artificial Intelligence and Audit Quality: A Systematic Review of Human–AI Interaction in Auditing.	Aimad Sassioui *, Issam Benhayoun
Sciforum-196214	Simulating Systemic Market Crashes and Behavioral Cascades Using Generative AI Multi-Agent Systems	Gustav Olaf Yunus Laitinen-Fredriksson Lundstrom-Imanov *, Rana Irem Turhan
Sciforum-203387	Generative Artificial Intelligence in Financial Risk Management: A Structured Review of Applications, Risks, and Governance Challenges	İlknur Arslan Aras *
Sciforum-204294	ARTIFICIAL INTELLIGENCE AT THE HEART OF BEHAVIORAL FINANCE	Omar TAOUAB, Rajae Sabhi *
Sciforum-201385	FINLLAMA: PARAMETER-EFFICIENT FINANCIAL SENTIMENT LEARNING USING LARGE LANGUAGE MODELS	Vibha Mishra *, Ashutosh Mohapatra, Meenakshi Kandpal, Jyotirmayee Rautaray
Sciforum-208277	AI, ESG, and Corporate Carbon Performance: The Moderating Role of Financing Constraints	Ziyang Shi *

S2. Machine Learning for Next-Generation Risk Modeling		
Sciforum-208566	Aggregation Choice and the Limits of Machine Learning in Financial Stress Measurement: Evidence from Twenty Emerging Markets, 2007–2025	Ali Ait Sidi Lkhir *
Sciforum-203737	Predicting Default Risk in Buy Now, Pay Later Services: A Comparative Study of Random Forest and XGBoost	Amna BOUHOREIRA *, Fatima Zohra BEKADDOUR *
Sciforum-208661	Machine Learning in Market Risk and Model Risk Governance: A Framework for Regulatory-Compliant Adoption in Investment Fund Contexts	Andreea Chiruta (Negru) *
Sciforum-208618	GAECO-NET: Graph Aware EigenCleaning Optimizer for Variance Reduction and Low-Friction Portfolio Allocation	Bose Kaikini *, Dao Bui *
Sciforum-203274	Selective Forecasting of Realized Volatility Using Prediction Confidence	Caio Mesquita *
Sciforum-203525	Detection of Market Stress Through Adaptive Liquidity-Scaling Signals	Dragos Bozdog *, Mohammad Shipon, Yash Deelip Karbhari
Sciforum-200617	AI Enabled Cyber Risk Salience Measurement from Global Cybersecurity News Metadata	Fahim Sufi *
Sciforum-203586	Machine Learning-Based Risk Modeling for Operational Performance and Cost Optimization in Fecal Sludge Treatment Plants: A Decision Support Framework for Urban Sanitation	Florette Léocadie Mouakem Ninla *
Sciforum-203911	Forecasting Inflation Using Machine Learning vs. Traditional Time Series Models: Evidence from the Post-Pandemic Period	Florin Laurențiu Nicolae *, Iulian-Gabriel Ionescu
Sciforum-204343	Artificial intelligence for Stock index prediction: A systematic review on Africa	Hajar OUANNOU *, Youness Zerhouni LAQRIB
Sciforum-207159	Does Global News Tone Add Predictive Value for Market Stress? Out-of-Sample Evidence from GDELT and the VIX	Han Li *, Xufeng Zhang
Sciforum-204270	Regime-Conditioned Convolutional Autoencoders with Recurrent Networks for Implied Volatility Surface Forecasting	Harsh Milind Tirhekar *
Sciforum-203932	A Gaussian Recency Score for Detecting and Directing Central-Bank Policy-Rate Changes	Idrees Mustafa Aziz *

Sciforum-201886	EAGLE: Execution-Aware Gated Learning for Cost-Robust Multi-Agent Trading Systems	Keshav Agarwal *
Sciforum-203583	PREDICTIVE ANALYTICS FOR MARKET RISK: AI MODELING FOR STOCK PRICE FORECASTING AND HEDGING STRATEGIES	Meryam Jouihri *, sofia Ayouche, Ahlam Mohammadi
Sciforum-203869	Currency-Specific Exchange Rate Pass-Through under Monetary Policy Thresholds and Structural Breaks: SVECM Evidence from the United States	Mohammad Shahriar Azad Bhuiyan *
Sciforum-202950	Do OPEC Relief/Stabilization Signals Improve Brent Volatility Forecasts? State-Dependent Evidence from Monthly Oil Market Reports	Moxuan Zheng *, Zhen Zhang *, Xiao Han, Luyun Lin, Tongchen Zhang, Liancheng Gong, Lixing Lin, Yao Xiao
Sciforum-207533	Mapping the Evolution of Machine Learning for Mortgage Repayment Prediction: A Bibliometric Analysis and Research Agenda for Automated Decision-Support Systems	Olajumoke Folasade Jejelola *, Amos Olaolu Adewusi, Akuakanwa Eziukwu Nwosu
Sciforum-180439	AI-Informed Cyber Risk Governance: An Expected Loss Optimisation Framework for RMF Adoption in Mid-Sized Enterprises	Prashnatita Pal *, Rituparna Bhattacharya
Sciforum-203915	Cross-Asset Stress Transmission for Insurance ALM: A Public-Data Early-Warning Framework	Rui Zong *, Tianyi Shi *
Sciforum-203927	atch-VTT: A Memory-Efficient Transformer for Volatility-Based Anomaly Detection and Risk-Off Portfolio Management	SARA CHEGDAL *, Mustapha Kabil, Abdeljalil Settar
Sciforum-208641	An Explainable AI–Enabled Risk-Adjusted Financing Framework for Investment Readiness in Fragile Agri-Food Systems	Sarah Njweng Chi *
Sciforum-208681	Friction, Not Magnitude: Illiquidity-Driven Mean Reversion in Crude Oil Futures	Tzuling Hsieh *, Dragos Bozdog
S3. Blockchain and Digital Assets: Frontier Analytics		
Sciforum-207574	Crypto-Asset Trading Risk Governance	Damir Mihanovic, Božidar Tomašković, Lovorka Blažević *
Sciforum-208484	Risk Propagation Mechanisms in Decentralized Finance: A PRISMA-Based Systematic Review	Ehsan Derakhshi Ghazijahani *
S4. Data Capitalization: Reconstructing Economic Valuation		
Sciforum-208394	From Digitalization to Customer-Based Value in Tourism: The Mediating Role of Personalized Experience	Constantina Alina Milos (Ilie) *

Sciforum-193316	Data Capitalization and Valuation Paradigm Shift: A Dynamics Model of Valuation Regime Transition	Danni Cao *
Sciforum-208586	Valuation Governance in Data-Constrained Markets: Integrating Valuation Uncertainty into Credit Risk Analytics via an Institutional Transmission Mechanism	Monodeep Saha *
Sciforum-182576	Advancing Financial Literacy. Enhancing Knowledge, Behavior, and Resilience in a Digital Era	Murat Şengöz *
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Session 1. Generative AI: Paradigm Shifts in Finance and Economics

Sciforum-164559: Generative and Stochastic Modeling for Financial Risk Management: Hybrid Approaches for Forecasting and Fraud Detection

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Recent advances in generative artificial intelligence are reshaping financial risk management by enabling more flexible modeling of uncertainty, complex dynamics, and rare events. This study investigates hybrid modeling frameworks that integrate classical stochastic models with modern machine learning and generative AI techniques for financial forecasting and fraud detection. We focus on financial time series characterized by nonlinearity, volatility clustering, and structural breaks, which challenge traditional econometric approaches. The proposed framework combines stochastic processes (including ARIMA-type and volatility-based models) with machine learning methods such as ensemble learning and neural networks, alongside emerging generative models and explainable AI (XAI) tools. Generative components are leveraged to enhance scenario generation and stress testing, allowing for improved representation of tail risks and extreme market conditions. Machine learning models are optimized through systematic hyperparameter tuning to improve predictive accuracy and robustness across different forecasting horizons. Empirical results on real-world financial datasets demonstrate that hybrid generative–stochastic approaches outperform standalone classical or machine learning models in terms of forecasting accuracy, stability, and adaptability. In the context of fraud detection, the integration of generative models enhances the detection of anomalous and rare patterns, while XAI techniques improve model interpretability and transparency—critical requirements for regulatory compliance and informed decision-making in financial institutions. Overall, this work highlights the transformative role of generative AI as a paradigm shift in finance, offering scalable and interpretable solutions for forecasting, risk assessment, and fraud detection. The findings offer practical insights for financial practitioners and contribute to the growing body of literature at the intersection of generative modeling, machine learning, and financial risk management.



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Sciforum-173658: La Inteligencia Artificial y la Eficiencia Energética Como Motores de la Creación de Valor Sostenible en las PYMES

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Micro, small, and medium-sized enterprises (MSMEs) play a strategic role in economic resilience and in the transition toward sustainable development models, particularly in emerging economies. However, they face significant financial, technical, and organizational constraints that hinder the adoption of advanced technologies for optimizing energy use. In this context, artificial intelligence (AI) has emerged as a key tool to enhance energy efficiency and support sustainable value creation. The objective of this study is to explain how the adoption of AI for energy management drives sustainable value creation in manufacturing and service MSMEs, considering the mediating role of operational energy efficiency.

The research adopts a quantitative approach with a non-experimental, cross-sectional, and explanatory design. The unit of analysis consists of formally established MSMEs located in Northern Peru. Data will be collected from approximately 150 firms through a structured questionnaire administered to owners or senior managers. The analytical model includes three latent constructs: AI adoption for energy management, operational energy efficiency, and sustainable value creation, encompassing economic, environmental, and social dimensions. The proposed relationships will be examined using Partial Least Squares Structural Equation Modeling (PLS-SEM).

The study is expected to validate an explanatory model demonstrating that AI adoption significantly improves energy efficiency and, through this mechanism, strengthens sustainable value creation and organizational resilience in MSMEs. The findings aim to provide empirical evidence to support managerial decision-making and inform public policies focused on promoting sustainable digital transformation and energy-efficient business practices in MSMEs.



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Sciforum-184437: Revisiting Equity–Bond Diversification: Tail Risk, Extreme Events and Option–Implied Evidence from Global ETFs

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Introduction:

The breakdown of traditional equity–bond diversification during recent market regime shifts has renewed attention to tail risk, extreme events, and forward-looking measures of portfolio risk. This study re-examines the performance of global equity–bond exchange-traded fund (ETF) portfolios over the period 2020–2025, characterized by structural changes in correlations, elevated volatility, and non-Gaussian return behavior.

Methods:

We develop a unified empirical framework combining rolling-window portfolio optimization, Conditional Value-at-Risk (CVaR) allocation, extreme-value tail estimation using the Hill estimator, and long-memory volatility modeling via FIGARCH. Portfolio performance is evaluated under mean–variance, CVaR, and equally weighted strategies in both long-only and long–short settings. Forward-looking risk is incorporated through option pricing under the Normal Inverse Gaussian (NIG) Lévy process, with implied volatility surfaces computed using Fourier transform techniques.

Results:

Results show that diversification benefits persist but mean–variance optimization fails to adequately capture downside risk under heavy-tailed and asymmetric return distributions. CVaR-based portfolios provide improved control of moderate tail risk and stronger risk-adjusted performance, particularly in long–short implementations. Extreme-tail analysis indicates that variance minimization reduces exposure to rare catastrophic losses, while CVaR focuses on losses beyond the Value-at-Risk threshold. Volatility estimates further reveal significant long-range dependence across regimes.

Conclusions:

These findings support a multi-dimensional portfolio construction framework integrating variance, tail risk, extreme events, and option-implied information. The proposed approach offers a more robust basis for risk management under structural market change and has important implications for institutional investors.



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Sciforum-196214: Simulating Systemic Market Crashes and Behavioral Cascades Using Generative AI Multi-Agent Systems

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Introduction: Traditional agent-based models (ABMs) in finance rely on rigid, rule-based heuristics that fail to capture the complex, bounded rationality and psychological biases of human traders. This study introduces a novel framework utilizing Generative AI Multi-Agent Systems to simulate systemic market crashes and behavioral cascades in financial networks.

Methods: We construct a simulated financial market environment populated by multiple heterogeneous Large Language Model (LLM)-based agents. Each agent is initialized with unique trading personas (e.g., risk-averse institutional investor, noise trader, aggressive speculator) and programmed with cognitive biases, including herding behavior and loss aversion. The agents interact dynamically, executing trades based on real-time simulated financial news feeds and macroeconomic shocks.

Results: Our simulations demonstrate that LLM-based agents exhibit realistic emergent behaviors under stress. When subjected to negative macroeconomic shocks, generative agents initiate self-reinforcing panic-selling loops, generating endogenous market crashes that closely mimic historical "flash crashes." Unlike traditional ABMs, these generative agents dynamically adapt their strategies based on contextual textual information, leading to complex, non-linear behavioral cascades.

Conclusions: This research highlights the paradigm-shifting potential of generative multi-agent systems in financial risk management. By providing a more realistic simulation of market dynamics, our framework offers regulators and financial institutions a robust, proactive tool for stress-testing and predicting systemic risk propagation.



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Sciforum-201385: Finllama: Parameter-Efficient Financial Sentiment Learning Using Large Language Models

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The vast availability of textual data such as financial news, financial corporate announcements, earnings and macroeconomic news plays an important role in financial markets. The sentiment contained in unstructured textual information plays a critical role in market sentiment, returns and trading. As a result, financial sentiment analysis is an important area of study in the broader areas of Natural Language Processing (NLP) and financial analysis. Early approaches for financial sentiment analysis involved lexicon-based approaches that used lexicons of sentiment words to dictate sentiment. To overcome the shortcomings of the above approaches, machine learning techniques were introduced, which capable of acquiring sentiment from data-driven sources, but require data feature engineering and focus mainly on individual financial documents. The aim of this paper is to build and deploy a large-scale efficient financial sentiment analysis model using large language models based on the usage of the parameter efficient models of fine-tuning. The paper will involve the sentiment analysis of the articles for the financial news and classify them into the pre-defined categories of sentiments which are positive, neutral and negative. The paper involves acquiring and pre-processing the large scope financial news data namely by securing the Financial-News-Multisource data. The main tasks in the project include secure access to data, large-scale text processing, text cleaning, removing duplicates and dividing the data into chunks to be processed. It also includes automated sentiment labeling of data using a pre-trained model specific to the financial domain and low cost finetuning of a large language model using Low-Rank Adaptation (LoRA) approach to make the language model fit for the new domain. The project involves no domain related to forecasting financial market, no trading strategy and no deployment of trading system. They are also not manually labelled with sentiment information; sentiment labels are automatically generated instead to enable scalability.



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Sciforum-201494: AI4Fin: Fine-Tuning AI for Egyptian Financial Sentiment and Slang

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Although the domain of financial sentiment analysis has been dramatically altered by the rise of large language models, existing solutions have yet to be adapted to work on the Egyptian discourse around financial markets. The vast majority of financial language models, like FinBERT, are trained exclusively on English-language datasets, while general-purpose language models for Arabic can work on dialectal texts, they are not tuned for finance-related information and cannot handle the informal, heavily code-switched nature of the language used to discuss finances in Egypt. This paper presents AI4Fin, which trains an open-source large language model for fin-sentiment analysis, fin-summary generation and expression explanation of Egyptian financial discourse with the emphasis on dialectal, code-switched and slang languages. Datasets were prepared with texts scraped from social media posts, articles written in Formal Standard Arabic and artificially constructed datasets of financial slang. These datasets were processed in order to preserve dialectical features, labeled using weak label-ing through CamelBERT (especially for social-media scraped) followed by human post-processing, revision, and balanced without leakage. The LLaMA-3.1-8B model was fine-tuned using QLoRA, an approach for efficient parameter tuning in an eight-billion parameter model on a single consumer graphics card, accomplishing three tasks — classification, summarization and expression explanation — in one model, reaching accuracy 84.79 and macro-F1 of 0.77, and in a head-to-head comparison it outperformed GPT-5.5 by over thirty macro-F1 points. The fine-tuned model was deployed within a hybrid retrieval-augmented chatbot for end-user interaction.



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Sciforum-201838: Indian Consumers and AI-Generated Green Finance Messaging: Trust, Skepticism and Purchase Intention

Monika Gahlawat

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Abstract

Purpose

India's financial sector is undergoing a quiet but consequential transformation. As banks and FinTech platforms deploy generative AI to craft sustainability-focused communication, millions of consumers now encounter green finance messaging authored not by humans but by algorithms. Whether this shift strengthens confidence or deepens skepticism remains empirically unresolved, particularly across emerging markets where digital literacy and institutional trust vary considerably.

Methodology

Grounded in the Stimulus-Organism-Response framework, Signalling Theory, and Attribution Theory, a conceptual model is developed wherein AI source disclosure shapes perceived message authenticity, which drives green skepticism and subsequently influences green trust and purchase intention. Primary data were collected from urban Indian consumers through a structured survey. Partial Least Squares Structural Equation Modelling via SmartPLS 4 is used for hypothesis testing, with digital literacy and prior greenwashing experience as moderating variables.

Findings

AI source disclosure amplifies green skepticism and weakens perceived authenticity, thereby eroding green trust. Revealing AI sources leads to greater green skepticism and reduced perceived authenticity, which in turn harms green trust. Digital literacy moderates this effect, with consumers familiar with AI being comparatively more tempered in their skepticism. Green trust is an important link between skepticism and purchase intention for ESG mutual funds, green bonds and sustainable fixed deposits.

Originality

The study is one of the first empirical studies on consumer responses to AI-generated green finance messaging in an emerging market. It extends the theory of green consumer behaviour to the AI-mediated space and provides practical recommendations for financial marketers managing algorithmic sustainability communication in India.



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Sciforum-203387: Generative Artificial Intelligence in Financial Risk Management: A Structured Review of Applications, Risks, and Governance Challenges

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Ğenerative artificial intelligence and large language models are transforming financial risk management, banking, investment analysis, regulatory compliance, and fintech governance. This study aims to synthesize the emerging literature on the applications, risks, and governance challenges of generative AI in finance. A structured systematic literature review was conducted using the Web of Science Core Collection. The initial search identified 295 records. After filtering for article-type publications, 166 records remained; after restricting the language to English, 165 articles were retained. For conference submission, the 50 most relevant articles were screened through title and abstract review and analyzed thematically.

Preliminary findings indicate that the literature clusters around five themes: AI-enabled financial text analysis, banking and customer-service applications, investment and portfolio decision support, regulatory compliance and fraud detection, and governance-oriented concerns including explainability, privacy, bias, hallucination, accountability, cybersecurity, and model risk. The reviewed studies suggest that generative AI can improve information extraction from financial documents, automate reporting, support scenario generation, enhance fraud monitoring, and assist decision-making under uncertainty. However, its adoption also creates operational, ethical, reputational, and regulatory vulnerabilities, particularly when outputs are inaccurate, opaque, biased, or insufficiently supervised.

The study concludes that generative AI should not be implemented as an autonomous substitute for professional judgment in financial institutions. Instead, its integration requires human oversight, transparent validation processes, data-protection safeguards, explainable model design, institutional accountability mechanisms, and alignment with emerging regulatory expectations. These findings contribute to risk and financial management debates by framing generative AI as both a strategic innovation and a governance challenge.



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Sciforum-203823: The Determinants of AI Washing in Corporate Reporting: Strategic Antecedents and Path Dependence of Symbolic Technological Narratives

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Artificial intelligence has become a prominent element of corporate strategic narratives, yet little is known about what drives firms to overstate their AI orientation and whether such behavior reflects isolated opportunism or persistent organizational routines. We conceptualize AI washing as a symbolic–substantive gap in which firms project an AI-oriented technological identity that is not supported by subsequent verifiable innovation outputs. Building on symbolic management and legitimacy perspectives, we argue that AI washing represents a strategic response to legitimacy pressures and resource incentives under conditions of technological opacity.

Using Chinese A-share listed firms from 2010 to 2024, we develop complementary measures of AI washing that capture the mismatch between AI-related narratives in annual-report MD&A sections and firms' subsequent AI innovation outputs, combining textual disclosure, R&D intensity, and AI patent applications. We find that financial distress significantly increases AI washing, consistent with firms using future-oriented technological narratives to redirect attention from weak fundamentals. Media visibility and investor attention are also positively associated with AI washing, suggesting that external attention may increase the returns to symbolic technological positioning when underlying technological capabilities are difficult to verify. AI-related government subsidies further increase AI washing, revealing a potential unintended consequence of technology-oriented policy support. Finally, AI washing exhibits strong path dependence: firms with prior histories of greenwashing and digital washing are significantly more likely to engage in subsequent AI washing.

Our findings extend symbolic management research from misrepresentation of realized performance to future-oriented symbolic technological narratives, showing how technological opacity enables firms to construct innovation identities before substantive outcomes become observable. The study also introduces a narrative–output decoupling approach to measuring AI washing and demonstrates that symbolic disclosure practices can persist and transfer across substantive domains.



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Sciforum-203951: Auditable RAG Credit Signals from Auto-Retail Filings: A Validation Framework for Dealer Risk Models

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Captive auto-finance companies extend wholesale (floorplan) credit to thousands of franchised dealers whose financial condition is reported largely through unstructured narrative. Traditional dealer credit models rely on structured financial ratios and behavioural data, often discarding the forward-looking "soft" information that management discloses in text. We propose a retrieval-augmented generation (RAG) framework that converts public auto-retail filings into grounded, point-in-time credit features, including covenant-headroom tone, floorplan-risk language, liquidity adequacy, and going-concern flags. Each non-null feature carries a verbatim citation to its source and passes a deterministic quote-verification gate, making the extractor a validation object in its own right rather than a free-form language model. We evaluate the extractor as a feature-generation component for credit risk models: the benchmark is a traditional structured-ratio model, the challengers add RAG features or non-LLM textual baselines from the same retrieved passages, and all comparisons use out-of-time validation, correlated-AUC testing, issuer-block bootstrap inference, split and label-threshold sensitivity, feature attribution, and model-governance diagnostics. On 369 issuer-quarter observations for ten US-listed auto retailers, grounded RAG features add a small amount of discrimination under a fixed gradient-boosted learner: out-of-time AUC rises from 0.852 to 0.857 and remains positive after adding an equity-volatility market control (0.845 to 0.856). Generic non-LLM text baselines do not improve the structured model in this public panel: keyword/tone features reduce AUC to 0.822 and TF-IDF/SVD features to 0.837. The RAG lift is modest, statistically fragile, and not a final dealer-default performance estimate, but the exercise demonstrates an auditable extraction and validation design that can be deployed on a captive's internal dealer financials with realised default flags.



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Sciforum-204174: The Artificial Intelligence Impact on Energy Infrastructure, Economic Activity and Workforce

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The economic landscape is increasingly influenced by Artificial Intelligence (AI) integration as a general-purpose technology (GPT). This classification places it in the same category as the steam engine, electricity and the internet as the potential impact it can have on systems of production and exchange. This tends to become a structural shift in the core functioning of modern economies. Even though the initial shock has been felt in 2023-2024, the current period aims to be one of experimentation and structural integration where the effects on productivity, labor market and macroeconomic stability are starting to manifest at national and company level. AI crossed the isolated use cases era and is going to become a center pillar of enterprise strategy. Many companies report using AI in at least one business function. The depth of the integration differs from sector to sector. Information technology, marketing and finance are the most advanced in implementing these tools, while other sectors follow a more gradual path. The future is unclear regarding the AI impact, but the policy makers will have to find a delicate balance between supporting the capital intensive build out of AI infrastructure and ensure that the benefits are shared through reskilling the workforce and inclusive trade policies. The danger of wealth concentration and speculative instability has increased and must be mitigated for AI to fulfill its potential

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Sciforum-204210: Revisiting AI in Finance and Economics: The Generative Paradigm and Its Implications for Markets and Policy

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The rapid emergence of Generative Artificial Intelligence marks a fundamental shift in how financial systems operate and how economic theories are tested and applied. Traditional AI and machine learning models in finance have largely focused on prediction and classification using historical datasets. Generative AI, powered by Large Language Models, diffusion models, and synthetic data frameworks, moves beyond prediction to creation, simulation, and reasoning. This paper revisits core AI and ML techniques in finance and economics through the lens of this generative paradigm.

The study explores implications across three critical domains. First, in financial markets, generative AI is enabling dynamic scenario generation, synthetic data augmentation for risk models, and natural language-driven trading and advisory systems. These capabilities allow institutions to model tail risks and market shocks that conventional models fail to capture. Second, in economic policy and research, generative AI facilitates agent-based policy simulations, real-time narrative economic forecasting, and automated synthesis of vast economic literature. This supports central banks and policymakers in testing interventions and communicating outcomes with greater clarity. Third, in institutional decision-making, generative tools are democratizing access to complex financial analysis by transforming data into actionable insights for both experts and non-experts.

However, the generative turn also raises pressing questions on model reliability, interpretability, data privacy, and regulatory oversight. The paper proposes a framework for responsible adoption based on explainable AI, human-in-the-loop validation, and domain-specific governance.

Using case studies from global banks, fintech platforms, and policy think tanks, this paper argues that generative AI represents not just a technological upgrade but a structural reorientation of finance and economics. It concludes with recommendations for academia, industry, and regulators to revisit existing AI/ML techniques to build more adaptive, transparent, and inclusive financial systems.



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Sciforum-204263: Artificial Intelligence, Executive Compensation, and Firm Value: Evidence from Saudi Financial Institutions

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Artificial intelligence (AI) has emerged as a strategic resource that enhances organizational innovation and competitive advantage. While prior research has documented the positive relationship between AI adoption and firm performance, limited evidence exists regarding the organizational mechanisms through which AI creates value. This study investigates whether total senior executives' compensation mediates the relationship between AI adoption and firm value among Saudi financial institutions. Using a panel dataset of Saudi-listed financial companies, AI adoption is measured through content analysis of annual reports, while firm value is proxied by Tobin's Q. Mediation analysis is employed using a series of regression models and the product-of-coefficients approach.

The findings reveal that AI adoption has a positive and significant effect on firm value. AI adoption also significantly increases total senior executives' compensation, suggesting that firms reward executives for leading digital transformation initiatives and managing AI-enabled organizational change. Furthermore, executive compensation exhibits a positive and significant association with firm value. The indirect effect of AI on firm value through executive compensation is statistically significant, confirming a partial mediation relationship. Although the direct effect of AI remains significant after controlling for executive compensation, its magnitude decreases, indicating that executive incentives constitute one of the channels through which AI contributes to firm value.

These findings highlight the complementary role of managerial incentive systems in realizing the economic benefits of AI investments. The study contributes to the emerging literature on AI-enabled value creation by demonstrating that executive compensation partially translates technological investments into enhanced market valuation. The results provide practical implications for boards of directors, investors, and policymakers seeking to align executive incentives with digital transformation strategies under Saudi Vision 2030. Future research may explore additional organizational mechanisms, including innovation capability, digital maturity, and corporate governance, that further explain how AI enhances firm value.



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Sciforum-204294: Artificial Intelligence at the Heart of Behavioral Finance

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This paper explores the innovative role of artificial intelligence (AI) in mitigating behavioral biases in financial decision-making. Based on a theoretical framework grounded in behavioral finance, it examines how AI-powered tools can enhance rationality in investment choices. Behavioral biases, such as confirmation bias, hindsight bias, fixation bias, and overconfidence, are widely documented major factors that distort investor judgments and lead to suboptimal financial outcomes (Kahneman & Tversky, 1979; Barberis & Thaler, 2003).

This study employs a conceptual and exploratory approach, developing a theoretical model that demonstrates how AI systems, through machine learning algorithms, predictive analytics, and data-driven decision support, can help identify, mitigate, or even correct cognitive distortions in financial behavior. The paper presents several hypothetical scenarios to illustrate how AI can improve portfolio allocation, risk assessment, and market timing decisions by reducing emotional and cognitive interference.

This study examines in detail the advantages and disadvantages of integrating artificial intelligence (AI) into financial decision-making processes. While AI improves accuracy, efficiency, and objectivity, it also raises concerns regarding the transparency of algorithms, ethical considerations, and the reliability of models. The findings suggest that AI represents a promising, albeit complex, tool for enhancing the quality of decisions in the financial sector, opening new avenues for academic research and practical financial innovation.



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Sciforum-204341: Financial Education and Inclusion Among Middle School Students in Romania

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The purpose of the research presented in this paper is to examine the level of financial education and the degree of financial inclusion for students in Romania. To achieve this goal, a questionnaire was administered in secondary schools in urban and rural areas in 11 counties of the country, to which 323 students responded. The questionnaire was designed to achieve the objective of identifying the behavior of the subjects towards bank card payments, the use of internet banking applications and budget management. The data were analyzed in terms of distribution by gender, by county and by area of origin and were compared with the data available at national level in NBR reports or internationally in OECD reports in order to draw conclusions regarding the attitude towards banking digitalization, towards non-cash payments and towards the financial behavior of students. This study adopts a mixed analytical approach that combines micro-level survey data with macro-level indicators of financial inclusion. The first component of the analysis is based on a questionnaire administered to eighth-grade students in Romania (the period should be mentioned) to examine the relationship between financial literacy and the use of digital banking tools. To analyze broader disparities in financial inclusion across demographic groups, the second component complements the survey evidence with macro-level indicators derived from the Global Findex database. Of course, the analysis took into account the statistical and econometric tools using a series of methods and models, such as the survey method, comparative analysis, descriptive statistics, and principal component analysis. Based on the analyzes made and presented in this scientific report, some proposals and recommendations were formulated.

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Sciforum-204375: Racial Encoding in AI-Generated Neighborhood Assessments: Evidence from Vision-Language Models and Google Street View Imagery

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Large vision-language models (VLMs) can now interpret real-world imagery at scale, creating new pathways for incorporation into financial decisions such as mortgage underwriting, property appraisal, and insurance pricing. This paper examines whether VLM-derived neighborhood disorder scores encode racial demographic information in ways that produce illegal disparate impact under the Fair Housing Act and Equal Credit Opportunity Act when deployed in automated credit allocation systems.

We apply GPT-5.5 to Google Street View imagery across the 100 largest US counties using population-weighted Census block-level sampling, generating structured scores for physical disorder, security, graffiti, litter, vacancy, and boarded windows. Scores are validated against Opportunity Atlas socioeconomic outcomes (n=98 counties), with strong correlations across income, poverty, mobility, and inequality measures. Split-half reliability across 500 counties yields R^2=0.65 for the disorder index and R^2=0.90 for the security index.

Disorder scores correlate significantly with share Black (ρ=+0.301, $p < 0.01$) but not share White (ρ=-0.140, ns). Multivariate OLS controlling for income, poverty, education, employment, and inequality presents share Black statistically insignificant (β=0.029, p=0.396). Formal mediation analysis estimates 82% of the bivariate racial association is explained by poverty and income, replicating independently across 200 counties (β=0.026, p=0.326). Prompt sensitivity testing shows demographic-neutrality instructions reduce the racial correlation from ρ=+0.239 to ρ=+0.097 (ns). Separately, CLIP embeddings derived without any scoring prompt predict mobility at cross-validated R^2=0.54 and correlate with share Black at r=-0.564, confirming the visual signal persists independently of prompt design.

Despite full mediation of the direct racial effect, deploying these scores in lending produces disparate impact through an indirect socioeconomic pathway actionable under existing fair lending regulations. These findings provide empirical grounding for AI risk governance in automated financial systems.



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Sciforum-204591: Reconceptualizing Intellectual Capital through Generative AI: Evidence from Sustainable Banking Performance in Saudi Listed Banks

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This study examines how artificial intelligence–enabled intellectual capital can contribute to sustainable banking performance in Saudi Arabia. Building on the intellectual capital and sustainable performance literature, the paper extends the traditional Value Added Intellectual Coefficient framework by incorporating an AI-enabled digital knowledge dimension. The proposed framework combines human capital efficiency, structural capital efficiency, and capital employed efficiency with an AI-enabled intellectual capital disclosure index constructed from banks' annual reports, sustainability reports, and digital transformation disclosures.

The AI-enabled intellectual capital disclosure index is developed using a structured content-analysis approach, in which AI-related disclosures are coded across several dimensions, including AI adoption, data analytics, automation, machine learning, digital banking, cybersecurity, fintech integration, and employee digital skills. The components are normalized and aggregated using an equal-weighting scheme, while manual verification and alternative weighting checks are used to assess validity and robustness.

Using panel data from Saudi listed banks, the study investigates whether AI-related knowledge capabilities enhance sustainable performance beyond traditional intellectual capital components. Sustainable banking performance is assessed through financial, operational, and sustainability-oriented indicators, while controlling for bank size, capitalization, risk, and macro-financial conditions. Theoretically, the study extends the intellectual capital literature by conceptualizing AI-enabled knowledge capabilities as an emerging intangible resource that complements human, structural, and capital-employed efficiency in explaining sustainable banking performance.

The paper also contributes to the growing literature on artificial intelligence in finance by providing an emerging-market perspective on how banks can transform digital and knowledge-based resources into sustainable value creation. The Saudi banking sector provides a relevant context given its strong digitalization agenda, regulatory modernization, and alignment with Saudi Vision 2030. The expected findings have practical implications for bank managers, regulators, and policymakers seeking to strengthen sustainable performance through AI adoption, knowledge management, and digital capability development.



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Sciforum-208277: AI, ESG, and Corporate Carbon Performance: The Moderating Role of Financing Constraints

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Amid the global pursuit of carbon neutrality, how artificial intelligence (AI) reshapes corporate environmental behavior and low-carbon transformation has attracted growing policy and academic interest. Using panel data of Chinese A-share listed firms covering 2012 to 2024, this paper adopts a moderated mediation model to systematically explore the impact of AI on corporate carbon emission performance (CEP), as well as the mediating role of ESG performance and the moderating effect of financing constraints. The empirical results show that AI significantly improves corporate carbon emission performance. ESG acts as a partial mediator: AI facilitates corporate carbon reduction by promoting firms' comprehensive sustainable development. Financing constraints generate an asymmetric moderating effect along the mediation path. In the first stage, financing constraints weaken AI's positive effect on ESG performance; in the second stage, they strengthen ESG's contribution to lowering carbon emissions, forming a "restrain first, promote later" pattern. Heterogeneity tests demonstrate that this environmental effect of AI is more pronounced for state-owned enterprises, heavy-polluting firms and enterprises located in eastern China. Baseline outcomes remain valid after multiple robustness checks including core variable replacement and instrumental variable estimation. This study confirms that the environmental dividends brought by AI are highly conditional. It provides valuable implications for governments to design targeted green financial systems and support enterprises to formulate effective low-carbon transformation strategies.



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Sciforum-208434: Financial AI Literacy: Developing and Testing a New Scale for AI-Assisted Financial Decision-Making

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The rapid diffusion of generative artificial intelligence (AI) is reshaping how individuals access, interpret, and use information when making complex decisions. In the finance, AI-powered systems such as large language models can provide personalized explanations, compare financial products, and support decisions related to borrowing, saving, investing, and retirement planning. This technological transformation challenges traditional assumptions about financial decision-making, where individual financial knowledge has been considered a fundamental determinant of decision quality. For decades, research on financial literacy has emphasized that individuals with higher levels of financial knowledge are better equipped to evaluate financial products, understand risks, and make informed choices. Financial literacy has therefore become a central policy objective worldwide, based on the ground that improving individuals' knowledge can enhance their financial well-being. However, the increasing availability of AI-generated financial information raises a new question: if individuals can obtain sophisticated financial guidance from AI systems, does financial knowledge remain the primary determinant of sound financial decisions? Although generative AI may reduce information barriers by making financial explanations and recommendations more accessible, its benefits depend critically on users' ability to interact with and evaluate AI-generated outputs. AI systems may produce incomplete, inaccurate, or overly confident recommendations, particularly when relevant personal circumstances, risk preferences, or future uncertainties are not properly considered. Consequently, individuals need more than access to AI tools; they require the ability to understand how to use them effectively, recognize their limitations, and integrate their recommendations appropriately into financial decision-making. This paper introduces the concept of Financial AI Literacy, defined as the ability to effectively evaluate, verify, and integrate AI-generated financial information when making financial decisions. To operationalize this emerging construct, we develop an initial measurement instrument combining self-reported perceptions of Financial AI Literacy with an objective assessment based on individuals' evaluation of AI-generated financial recommendations in realistic decision scenarios.



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Sciforum-208568: Artificial Intelligence and Audit Quality: A Systematic Review of Human–AI Interaction in Auditing.

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Artificial intelligence is increasingly transforming auditing by enhancing data processing, risk assessment, and decision support capabilities. Despite its growing adoption, the implications of AI for audit quality remain fragmented across diverse theoretical and empirical traditions. This study systematically reviews the literature on human–AI interaction in auditing to examine how audit quality is conceptualized, measured, and influenced in AI-enabled audit environments. Following the SPAR-4-SLR protocol, 116 peer-reviewed articles published between 2015 and April 2026 were identified from Scopus and Web of Science and screened through a PRISMA-compliant procedure. A mixed-method review design combining bibliometric analysis and deductive thematic synthesis was employed to address five research sub-questions. The findings reveal a rapidly expanding field but characterized by limited theoretical consolidation. Three distinct conceptions of audit quality emerge from the literature, namely performance-based, relational, and governance-based. However, these perspectives remain largely disconnected and offer no unified explanation of how AI influences audit outcomes. Across studies, reliance calibration emerges as the central mechanism shaping the relationship between auditors and AI systems. The review highlights how algorithm aversion, automation bias, and explainability influence auditors' reliance decisions, while individual, technological, organizational, and institutional factors condition these effects. The analysis further reveals that fewer than half of the reviewed studies employ an explicit theoretical framework, and no single perspective adequately captures cognitive, organizational, and institutional dimensions simultaneously. The emergence of generative and agentic AI introduces additional challenges, including hallucinated outputs, narrative-driven automation bias, and reduced verifiability of audit evidence. This review reframes the debate from whether AI improves audit quality to how auditors establish appropriate reliance on AI systems and proposes directions for future theory development, empirical research, and regulatory consideration.

Author contributions: Conceptualization, Aimad Sassioui and Issam Benhayoun; Methodology, Aimad Sassioui; Software, Aimad Sassioui; Validation, Aimad Sassioui and Issam Benhayoun; Formal analysis, Aimad Sassioui; Investigation, Aimad Sassioui; Data curation, Aimad Sassioui; Writing - original draft, Aimad Sassioui; Writing - review and editing, Issam Benhayoun; Visualization, Aimad Sassioui; Supervision, Issam Benhayoun; Project administration, Issam Benhayoun.



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Session 2. Machine Learning for Next-Generation Risk Modeling

Sciforum-157139: Quantum–AI Statistical Dangerousness: A Next-Generation Framework for Entangled Risk Modeling

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This paper introduces Quantum–AI Statistical Dangerousness (QSD), an advanced probabilistic framework that extends classical Statistical Dangerousness into the domains of quantum information theory and machine learning. The model reconceptualizes systemic risk as a dynamic, non-commutative process, where uncertainties are not only stochastic but also structurally entangled. Within this framework, each system state is represented as a density matrix , enabling the simultaneous treatment of randomness, dependence, and measurement sensitivity. QSD integrates quantum statistical measures —including von Neumann entropy, purity, quantum relative entropy, and a quantum hazard function —to quantify both probabilistic variability and structural instability. By coupling this formalism with artificial intelligence methods, particularly Quantum Generative Adversarial Networks (QGANs) and Transformer-based architectures, the framework learns evolving risk states and forecasts threshold exceedances under complex interdependencies. The learning process aligns classical metrics with quantum representations through tailored loss functions, optimizing prediction of nonlinear and rare-event behavior. The resulting Quantum Dangerousness Index (QDI) unifies exceedance probability, informational entropy, and dynamic hazard into a single, adaptive indicator of systemic dangerousness. Applied across finance and environmental domains, QSD identifies fragile regimes, emergent contagion patterns, and hidden couplings that classical risk models overlook. The framework thus provides a mathematically consistent and computationally intelligent bridge between classical risk analytics and quantum-enhanced forecasting.



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Sciforum-166909: Explainable Machine Learning for Indian Loan Approval Prediction using Data Balancing and Ensemble Models

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Access to credit continues to play a vital role in economic participation, particularly in developing regions where financial inclusion efforts are ongoing. However, loan-approval practices still rely largely on manual assessments or rigid credit scoring rules, which often limit transparency and overlook newer forms of risk information. To address these limitations, this work outlines a machine learning-based framework for loan approval prediction that emphasizes interpretability and regulatory alignment rather than serving as a complete deployed system. The proposed approach integrates data preprocessing, class balancing, and ensemble learning techniques—specifically Random Forest and XGBoost—to identify approval patterns within a merged dataset representing both urban banking and rural lending environments in India. To mitigate the opaque nature typically associated with ensemble models, SHAP-based interpretation is introduced to highlight the influence of individual features on predicted outcomes, enabling clearer communication of decisions to lenders, auditors, and applicants. Although the framework has not yet undergone comprehensive implementation or benchmarking against existing loan-approval platforms, the design contributions are notable. These include the construction of a unified Indian loan dataset, the use of class imbalance handling to address skewed distributions, a structured plan for comparative evaluation of ensemble models, and a transparent explanation component consistent with regulatory expectations. This work is intended as a foundation for future development and testing, with the expectation that full implementation, empirical validation, and comparative studies will form the next phase. If successfully realized, such a platform may support faster, fairer, and more interpretable lending decisions across diverse financial institutions.



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Sciforum-171280: Institutional Sentiment as an Early Warning System for Supply Chain Risk: A Machine Learning Approach

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Supply chain risk has intensified amid growing global uncertainty, creating the need for advanced analytical approaches that provide timely early warning signals for operational decision-making. Traditional risk models largely rely on market indicators and historical performance data, while institutional communications that shape global economic and commodity conditions remain underutilized. This study develops a machine learning–based framework for supply chain risk modeling by extracting sentiment and thematic signals from large-scale institutional textual information. Using freely available secondary datasets, the research applies sentiment analysis, topic modeling, and predictive learning techniques to transform unstructured text into quantitative risk indicators. These indicators are linked to operational risk outcomes such as commodity price volatility, disruption frequency, and lead time variability through time-series forecasting models. The results show that institutional sentiment significantly enhances the prediction accuracy of supply chain risk events beyond conventional economic measures, offering effective early warning capabilities for operations planning and procurement strategies. The study contributes to operations and supply chain management literature by introducing institutional text analytics as a novel and scalable source of risk intelligence. From a managerial perspective, the findings demonstrate how data-driven risk forecasting can support proactive mitigation, improved resilience, and more robust supply chain design in volatile environments.



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Sciforum-179075: ML-Powered Corporate Bond Liquidity Scoring: A Multi-Measure XGBoost Framework on FINRA TRACE Data with SHAP Interpretability

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Introduction: Corporate bond illiquidity remains a persistent challenge in fixed income markets, with significant implications for pricing accuracy, transaction cost analysis, and portfolio risk management. Traditional single-measure proxies — such as the Amihud illiquidity ratio or Roll spread — capture only partial dimensions of bond market liquidity, leaving systematic mispricing risk unaddressed. This paper introduces a machine learning framework that integrates multiple classical and market-microstructure liquidity measures into a unified, interpretable scoring system for US corporate bonds.

Methods: Using FINRA TRACE transaction data, we engineer 40+ features spanning four liquidity dimensions: price impact (Amihud illiquidity ratio, Kyle's lambda), trading costs (Roll spread, effective bid-ask spread), market depth (inter-trade duration, trade size distribution), and flow toxicity (volume-weighted price impact). An XGBoost classifier is trained on investment-grade and high-yield bond universes, with Optuna-driven hyperparameter optimisation and time-series-aware cross-validation to prevent look-ahead bias. Model interpretability is addressed through SHAP (SHapley Additive exPlanations) analysis, identifying the marginal contribution of each feature to individual liquidity scores.

Results: The multi-measure XGBoost model achieves superior classification accuracy compared to single-measure baselines (Amihud, Roll), with SHAP analysis revealing that inter-trade duration and Kyle's lambda are the dominant predictors of bond illiquidity episodes. The model identifies liquidity deterioration signals 1–3 days ahead of spread widening in high-yield segments.

Conclusions: This framework provides a scalable, ML-powered approach to corporate bond liquidity scoring with direct applications in RFQ pricing desks, portfolio construction, and regulatory liquidity stress testing. Code and data pipeline are available on GitHub.



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Sciforum-180439: AI-Informed Cyber Risk Governance: An Expected Loss Optimisation Framework for RMF Adoption in Mid-Sized Enterprises

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Cybersecurity incidents increasingly generate substantial operational and financial losses, which require organisations to adopt governance approaches that support both risk control and economic decision-making. While the Risk Management Framework (RMF) is widely recognised as a structured mechanism for managing cybersecurity risks, limited research has examined its economic value and the organisational determinants of its adoption. This study addresses this gap by investigating RMF adoption in mid-sized software enterprises from an expected-loss optimisation perspective.

The research integrates evidence from four large-scale industry sources—the Stack Overflow Developer Survey, ENISA Threat Landscape Reports, OpenSSF Secure Practices Survey, and Verizon Data Breach Investigations Report (DBIR). Using descriptive analytics, exploratory factor analysis, binary logistic regression, and hypothesis testing, the study evaluates the organisational factors influencing RMF adoption and assesses its impact on mitigating cyber risks.

The findings reveal a significant disconnect between RMF awareness and implementation, indicating that technical knowledge alone is insufficient to achieve effective risk governance. Leadership support emerges as the most influential organisational factor. The absence of leadership commitment represents the strongest barrier to adoption (loading = -0.58), whereas executive endorsement significantly increases the likelihood of RMF implementation ($\beta = 1.1671$, $p < .001$). Organisations adopting RMF demonstrate measurable operational benefits, including a 40% improvement in threat detection capability and a 66% reduction in incident response time.

To extend existing RMF literature, the study develops an expected-loss evaluation model that links cybersecurity governance with risk economics by representing cyber risk as a combination of breach probability and loss severity. The analysis indicates that effective RMF implementation can reduce expected cyber loss by approximately 60–70%, transforming RMF from a compliance-orientated practice into a quantifiable risk-reduction investment. The proposed framework contributes a novel decision-support perspective for evaluating cybersecurity governance and offers practical guidance for enhancing cyber resilience and organisational risk efficiency.



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Sciforum-190502: Revisiting AI and Machine Learning Techniques in Finance and Economics: A Regression-Based Perspective

Arjeta Hallunovi

University Aleksander Moisiu Durres

Artificial Intelligence (AI) and Machine Learning (ML) techniques are transforming modern finance and economics by improving predictive accuracy, decision-making processes, and risk assessment models. This study revisits the role of AI and ML approaches in analyzing financial and macroeconomic dynamics, emphasizing their application in forecasting economic growth, financial stability, and investment performance. The research employs a regression-based framework integrating traditional econometric models with machine learning algorithms to examine the relationship between economic indicators and financial outcomes.The proposed empirical model is specified as:GDP_t = \beta_0 + \beta_1 INF_t + \beta_2 GC_t + \beta_3 CO2_t + \beta_4 AI_t + \varepsilon_t where GDP_t represents economic growth, INF_t inflation, GC_t green credits, CO2_t carbon emissions, and AI_t the artificial intelligence and machine learning index used to capture technological integration in financial systems. The study combines Ordinary Least Squares (OLS), Random Forest Regression, and Neural Network models to compare forecasting efficiency and explanatory power.Using panel data from Western Balkan countries for the period 2010–2025, the findings are expected to demonstrate that AI-enhanced financial systems contribute positively to economic resilience, sustainable investments, and risk mitigation. Furthermore, machine learning techniques outperform traditional regression methods in identifying nonlinear relationships and hidden financial patterns.The study contributes to the growing literature on digital finance and sustainable economic development by providing evidence on how AI-driven analytical models can support policymakers, financial institutions, and investors in improving strategic decision-making under economic uncertainty.



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Sciforum-193679: AgentShield-Real: A Unified Multi-Source Neural Framework for Real-Time Financial Fraud Detection Across Heterogeneous Transaction Domains.

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Financial fraud is no longer a standalone institution problem— it evolves across borders, platforms, and currencies faster than any single fraud detection system can follow, damaging the global economy by $534 billion in 2025 (Nilson Report, Issue 1232, 2025). Existing fraud detection frameworks optimise for a single transaction domain and fail to capture cross-domain laundering patterns — creating a detection blind spot that sophisticated criminal networks deliberately exploit across multiple transaction domains. This paper presents AgentShield-Real, the first unified multi-source neural framework that simultaneously learns from three complementary public benchmark datasets — PaySim (2,770,409 mobile money transactions), IEEE-CIS (590,540 real-world e-commerce transactions with 432 features), and Elliptic++ (46,564 labelled Bitcoin transaction nodes) — within a single cross-domain detection pipeline. AgentShield-Real fuses all three datasets into a single heterogeneous graph pipeline. Entity schemas across three datasets are reconciled through type-specific input projections that map heterogeneous node types to a shared 128-dimensional embedding space. The framework uses focal loss to handle extreme class imbalance, a SHAP-grounded explanation layer aligned to EU AI Act Article 13 and SR 11-7 requirements, and delivers the first simultaneous multi-domain evaluation in the fraud detection literature. Experiments demonstrate that AgentShield-Real achieves F1 = 0.8459 and MCC = 0.8465 on PaySim — surpassing the best baseline by 37.6 F1 points — AUROC = 0.8802 with Recall = 0.7601 on IEEE-CIS, detecting 76% of all fraud events versus Gradient Boosting's 34.8%, and AUROC = 0.7212 on Elliptic++ under rigorous temporal split evaluation. Each dataset evaluated independently within the unified pipeline- the contribution is consistent multi-domain coverage, not end-to-end cross-chain tracking, which remains open research problem. No single baseline achieves operationally viable performance across all three domains simultaneously, establishing AgentShield-Real as the first consistent multi-domain fraud detection framework. All code, trained models, and datasets are publicly available to ensure full reproducibility.



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Sciforum-199518: Comparative Analysis of Ensemble Gradient Boosting Classifiers for Credit Default Prediction using ML Optimization Framework

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The growing use of ML (machine learning) methods in credit risk evaluations has exacerbated the trade-off among accuracy in prediction and model understanding, posing challenges to compliance with regulations under frameworks such as the Europe's General data protection regulation (GDPR) and Basel III/IV guidelines. This study compares five machine learning classifiers—logistic regression, random forest, gradient boosting machine, extreme gradient boosting (XGBoost), and Light gradient boosting machine (LightGBM) by using the statistically calibrated credit risk database designed after benchmarking German Credit dataset.

The study helps in three ways. Firstly SMOTE enhanced training framework used to address the class disparity found in credit portfolios. Secondly, Shapely Additive Explanations (SHAP) used in both local as well as global levels to assess the impact of borrower attributes on estimated default probability. Third, Kolmogorov-Smirnov (KS) separation analysis and cost-sensitive threshold optimization used to match classification judgments to asymmetrical monetary loss functions.

The results showed Logistic Regression model alongside calibrated based regularization methods had the best discriminatory performance of each model tested, with an area under receiver operating characteristics curve, AUC of 0.6516 under cross-validation while retaining full interpretability and auditability. LightGBM provides in-depth insights on feature interactions, mainly combined effect of borrower age and credit exposure on default risk. Under a cost structure in which false-negative errors were penalized fivefold, the best classification threshold stabilized at 0.317, lowering projected misclassification costs by 23% compared to the traditional threshold of 0.5.

The results obtained indicate that interpreted ML techniques can aid in effective credit risk assessment while increasing transparency and enabling regulatory compliance.



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Sciforum-200617: AI Enabled Cyber Risk Salience Measurement from Global Cybersecurity News Metadata

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Introduction: Cyber risk is shaped not only by verified incidents, but also by how threats become publicly visible through cybersecurity reporting. For risk modelling, this visibility matters because it influences organisational attention, policy concern, investment priorities, and perceptions of emerging digital threats. This study develops an AI enabled cyber risk salience framework for converting global cybersecurity news metadata into measurable temporal, thematic, and source aware risk indicators.

Methods: The study analyses 18,307 usable cybersecurity news records collected between 3 October 2023 and 2 June 2026. Complete month analysis uses 18,263 records across 32 months, drawn from 190 source domains, 18,248 unique titles, and 17,922 unique URLs. The framework combines title level multi label thematic coding, monthly aggregation, early to late salience comparison, Jensen Shannon divergence, and source concentration metrics. Eleven cyber risk themes were measured, including vulnerabilities and exploits, malware and botnets, AI security, nation state activity, phishing, data breaches, ransomware, cloud and identity, critical infrastructure, supply chain compromise, and cryptocurrency related risks.

Results: Cybersecurity reporting showed marked temporal volatility, with a 3.4 fold difference between the highest and lowest complete month volumes. The most visible theme was vulnerabilities and exploits, appearing in 2,816 records, or 15.4% of usable records, followed by malware and botnets with 1,509 records and AI security with 1,407 records. Late period cyber risk salience increased most strongly for vulnerabilities and exploits, from 13.5% to 21.3%, and AI security, from 6.0% to 13.6%, while ransomware declined from 5.8% to 1.6%. Source concentration was substantial, with the top five domains contributing 60.9%, the top ten 77.1%, and the top twenty 91.5% of all records.

Conclusions: This study contributes to next generation risk modelling by showing how cybersecurity news metadata can be transformed into structured cyber risk salience intelligence. The framework supports horizon scanning, AI security monitoring, source aware risk interpretation, and public cyber risk analytics without conflating news visibility with verified attack prevalence.



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Sciforum-201886: EAGLE: Execution-Aware Gated Learning for Cost-Robust Multi-Agent Trading Systems

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Multi-agent trading systems optimise signal generation but systematically neglect execution friction, the gap between simulated and live performance that arises from transaction costs rather than signal quality. This paper introduces **EAGLE-Adaptive**, a deterministic pre-trade permission framework that addresses this gap through the **Signal-Execution Compatibility Score (SECS)**, a four-component composite metric evaluating slippage quality, volatility momentum, liquidity depth, and regime stability via a weighted harmonic mean. Unlike prior approaches that rely on hand-tuned parameters, SECS weights are optimised through exhaustive grid search with walk-forward validation, providing a reproducible and data-driven optimisation procedure. A dual-gate architecture independently evaluates execution quality and signal quality before permitting any trade, while an online adaptive threshold responds to non-stationary market conditions without requiring batch retraining of model weights. Empirical evaluation on multi-year cryptocurrency market data demonstrates that EAGLE-Adaptive achieves statistically significant and temporally consistent reductions in execution-induced loss relative to static-cost controls, with improvements confirmed across all out-of-sample validation folds. The framework is fully deterministic, interpretable, and composable with existing signal-generation architectures, demonstrated here using a breakout strategy, thereby enabling integration with broader AI-driven and multi-agent trading pipelines. These results suggest that execution-aware permission mechanisms can substantially reduce the gap between simulated and live trading performance while remaining transparent, reproducible, computationally efficient, and suitable for practical deployment in cost-sensitive algorithmic trading environments.



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Sciforum-201974: Tool-Induced Analytical Variance in Credit Risk Exploration: A Comparative Study Using Python, SQL, and Power BI

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Financial data analysts commonly use Python, SQL, and Power BI to analyse financial datasets, yet little formal examination evaluates whether these tools produce reliably consistent results on the same data. Inconsistencies between tools could affect analytical quality and lead to contradictory business decisions a critical concern in credit risk contexts where decisions directly affect borrowers and creditors. While larger financial institutions rely on standardised data pipelines, smaller lending organisations, fintech startups, and private credit providers frequently analyse data in tool-specific environments, making tool-induced variance a practically significant but underexplored problem. Machine learning models for credit risk prediction have received considerable research attention, yet the upstream analytical pipeline how tool choice affects data handling and insight generation remains understudied.

This study applies exploratory data analysis across Python, SQL, and Power BI on the Give Me Some Credit dataset (150,000 borrowers, Kaggle). A key finding emerged during data preparation: missing values encoded as "NA" were handled inconsistently. Python's pandas correctly identified 29,731 missing income values as NaN. SQLite's CAST function silently converted "NA" to zero an invisible data integrity risk. Power BI imported the same column as Text type, requiring manual intervention before numerical analysis was possible.

Four findings were confirmed across all three tools: a 93%/7% class imbalance between non-defaulters and defaulters; defaults peaking in the 40-60 age group; debt ratio emerging as a surprisingly weak predictor; and late payment history as the strongest predictor, with defaulters averaging 15 times more 90-day late payments. Relying solely on debt ratio would have produced misleading conclusions, demonstrating the risk of single-tool analysis.

These findings support standardised upstream data preparation pipelines particularly for fintech startups and small credit institutions without dedicated data engineering teams, where tool choice can silently affect credit decision quality.



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Sciforum-202161: MACE: A Matched-Cost Falsification Framework for Evaluating AI Governor Placement in Financial Risk Management

Hitesh Sundra

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Financial AI systems increasingly deploy governors— mechanisms that block, abstain from, de-risk, or escalate model-driven decisions to human review. Evaluating these governors is difficult because conventional selected-risk metrics confound genuine intervention skill with intervention budget and clustered market structure. A governor that concentrates interventions on volatile periods or broad market stress may appear effective while contributing little beyond an equal-budget structural policy.We introduce MACE (Matched-Cost Falsification Benchmark), a protocol for testing whether a financial AI governor's intervention placement contains information beyond matched alternatives. MACE compares governors with equal-budget null policies that preserve structures such as time, asset identity, volatility regime, crisis exposure, and score ordering. Rather than asking only whether selected states were risky, MACE asks whether they were selected better than structurally comparable alternatives. The benchmark supports score- and mask-based submissions and evaluates safety gain, intervention efficiency, error rates, and robustness across matched controls. We evaluate MACE using seven controlled synthetic mechanism worlds and a fixed ETF market panel. The synthetic tests isolate structural shortcuts including clustered stress, regime dependence, delayed information, contagion, and misleading confidence signals. In the canonical spurious-regime setting, 7 of 10 governors fail at least one matched null despite appearing competitive under conventional selected-risk evaluation. A ten-seed robustness study shows that the failure mechanism recurs while its severity and exact governor ordering vary across generated markets. MACE provides a reproducible falsification framework for distinguishing genuine asset-level dynamic intervention skill from budget spending on structurally obvious risk. It is not a trading-alpha benchmark or safety certificate; rather, it raises the evidentiary standard for financial AI governance, model-risk validation, and responsible deployment of machine-learning decision systems.



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Sciforum-202802: AI-Driven Behavioral Risk Modeling for Investor Retention in Wealth Management

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Investor retention has become a critical challenge for wealth management firms operating in increasingly volatile financial markets. During periods of market uncertainty, investors are often exhibit behavioral biases such as loss aversion, anchoring, herding, and panic-driven decision-making, which may lead to irrational investment decisions, portfolio withdrawals, and client attrition. Although existing risk management approaches primarily rely on financial and market-based indicators, they often pay limited attention to the behavioral factors that significantly influence investor decision-making. This limitation highlights the need for an integrated risk management approach that combines behavioral finance with emerging artificial intelligence (AI) technologies to strengthen behavioral risk management and improve investor retention.

This study proposes a conceptual AI-driven behavioral risk management framework for investor retention in wealth management. The framework integrates behavioral finance with AI-driven analytical techniques, including machine learning, Natural Language Processing (NLP), predictive analytics, and quantitative risk analysis, within a unified analytical architecture. It integrates diverse behavioral and financial information to support behavioral risk assessment, drawing on client communication, portfolio engagement, transaction patterns, market volatility, and financial activity. Furthermore, the framework proposes the integration of NLP techniques to identify behavioral signals from client interactions and machine learning approaches to support investor risk profiling, behavioral risk assessment, and intelligent decision-making. In addition, it incorporates an intelligent advisor-support component to facilitate proactive risk identification and behaviorally informed communication strategies for personalized investor engagement.

By integrating behavioral finance with AI-driven analytical techniques, this study addresses an important research gap in behavioral risk management for wealth management. It establishes a structured conceptual foundation for future empirical research and promotes the development of AI-enabled behavioral risk management and intelligent decision-support systems capable of supporting proactive investor retention and advancing next-generation financial risk modeling in wealth management.



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Sciforum-202950: Do OPEC Relief/Stabilization Signals Improve Brent Volatility Forecasts? State-Dependent Evidence from Monthly Oil Market Reports

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Introduction: Official institutional communication is an underused source for commodity risk forecasting. This paper examines whether the predictive value of relief/stabilization language in OPEC Monthly Oil Market Reports (MOMR) varies with prior oil-market volatility. **Methods:** The study links 291 unique MOMR publications from January 2001 through April 2026 to daily Brent spot prices from the U.S. Energy Information Administration. Each report is aligned to the first Brent trading day after its verified publication date. A deterministic dictionary measures language about market balance, spare capacity, inventory builds, and supply recovery. An expanding-window ridge model adds the change from the previous available report's dictionary share to a market-history baseline containing lagged volatility and recent absolute returns. Forecasts are assessed using RMSE and variance-form QLIKE, with the state-dependent analysis treated as exploratory. **Results:** The predictive value of the OPEC text signal is state-dependent. Across 170 full out-of-sample forecasts, the signal produces a modest QLIKE reduction. Among 46 forecasts for which prior 30-trading-day volatility exceeds its expanding 75th percentile, adding the signal reduces QLIKE by 2.7%, a statistically significant improvement under the unadjusted paired HAC-normal test ($p = 0.0159$). In this high-volatility state, the targeted signal also achieves lower QLIKE than generic risk-dictionary and TF-IDF ridge alternatives. **Conclusions:** Changes in OPEC relief/stabilization language provide incremental forecasting information when oil markets are already volatile. Future evaluation on new releases can determine whether this state-dependent predictive value persists.



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Sciforum-203274: Selective Forecasting of Realized Volatility Using Prediction Confidence

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Forecasting realized volatility is a central problem in financial econometrics, where most approaches focus on predicting volatility levels rather than directional movements. This paper proposes a selective forecasting framework that uses class probability estimates to identify high-confidence predictions of realized volatility direction, addressing the limitation of evaluating all forecasts equally.

The empirical analysis covers 11 stocks listed on B3—ABEV3, BBAS3, BBDC4, BRKM5, CSNA3, ELET3, EMBR3, GGBR4, ITUB4, PETR4, and VALE3—providing a diversified cross-section of major Brazilian companies across different sectors. Using a split sample of 3,000 trading days, the first 1,500 observations are used for estimation and the remaining 1,500 for fixed out-of-sample evaluation. This static design isolates the contribution of confidence-based forecast selection from the effects of repeated parameter re-estimation. A Heterogeneous Autoregressive (HAR) model estimated by OLS serves as the benchmark directional classifier, while Support Vector Machine (SVM) and Random Forest models are trained using the same explanatory variables and provide class probability estimates.

The results indicate that overall classification performance is broadly comparable across models. However, predicted probabilities contain relevant information about forecast reliability. In the highest-confidence decile, precision reaches 90.9% for BBAS3 and EMBR3 and exceeds 80% for BBDC4 and GGBR4. Across the 11 stocks, average precision in the highest-confidence decile is approximately 78.5%, while low-confidence predictions exhibit substantially weaker performance.

These findings suggest that probability estimates provide information beyond directional forecasts and can support selective forecasting strategies. By focusing on predictions with sufficiently high confidence, the framework offers practical applications in volatility trading, options pricing, and dynamic risk management.



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Sciforum-203335: Margin Compression Without Fee Substitution: Evidence from Euro Area Negative Rate Policy

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The prolonged period of negative interest rates in the Euro Area raises a fundamental question about whether unconventional monetary policy reshapes bank business models beyond traditional lending channels. Using a difference-in-differences design comparing Euro Area banks with non-Euro Area European banks over 2010–2023, this paper examines whether ECB negative rate policy (NIRP) induced a structural shift in bank revenue composition. The central finding is that NIRP significantly compressed net interest margins among Euro Area banks relative to the control group (β = -0.22 pp, p = 0.018), consistent with the deposit franchise mechanism. By contrast, there is no significant aggregate shift toward fee-based income, and balance-sheet retraction, rather than income substitution, appears to be the dominant adjustment channel. A supplementary causal-forest analysis shows that baseline operational efficiency and liquidity positioning, rather than bank charter type, best predict which banks adjusted most under NIRP, complicating prior heterogeneity findings based on institutional categories. This result survives covariate-overlap trimming, though propensity diagnostics indicate the exercise is constrained by near-deterministic treatment assignment given institutional covariates, a limitation we argue is itself informative for applying causal machine learning to macro-institutional treatments in banking. The findings suggest NIRP reshaped banking primarily through margin compression and efficiency-conditioned adjustment rather than uniform fee substitution, with implications for how unconventional monetary policy is evaluated and how bank heterogeneity is measured.



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Sciforum-203525: Detection of Market Stress Through Adaptive Liquidity-Scaling Signals

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Conventional risk models often treat liquidity events and return-scaling behaviors as separate phenomena, which limits early detection of regime shifts. This study introduces a unified risk-modeling framework that links an entropy-weighted Composite Liquidity Index (CLI) with a distribution-based measure of time-varying self-similarity to produce an adaptive, regime-sensitive risk signal.

The CLI aggregates three liquidity proxies, Amihud illiquidity, the Pastor–Stambaugh liquidity factor, and rolling log-volatility, with weights that adjust daily based on each measure's cross-sectional discriminatory power rather than fixed weighting. In parallel, a matrix of Hurst exponents is estimated by minimizing Kolmogorov–Smirnov distances between rescaled return distributions across pairs of investment horizons, yielding a non-parametric indicator of scaling stability. The framework is applied to daily data for 50 large-cap S&P 500 constituents from 2000 to 2025.

The composite liquidity signal and the median Hurst exponent decline jointly during major stress episodes, including the Dot-Com Crash, the Global Financial Crisis, the COVID-19 shock, and the recent monetary tightening cycle. Dispersion in the Hurst-exponent matrix widens during these periods, indicating that scaling behavior becomes increasingly fragmented across horizons as liquidity conditions deteriorate.

Entropy-adaptive liquidity weighting combined with fractal scaling diagnostics provides an extensible, model-agnostic building block for next-generation risk models. The framework enables detection of liquidity-driven instability and non-stationary return dynamics, with potential extensions to sector-level analysis, higher-frequency data, and alternative asset classes.



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Sciforum-203542: AI-Driven Dynamic Asset Pricing with Regime Switching and Nonlinear Risk Premia

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Traditional asset pricing models typically assume that systematic risk exposures and risk premia remain constant over time. This paper extends the traditional framework by developing a machine learning approach to regime-dependent dynamic asset pricing that integrates Gaussian Hidden Markov Models (HMMs) with conditional asset pricing theory to identify latent economic states and estimate state-dependent risk compensation, thereby providing a foundation for nonlinear AI-based asset pricing models.

Using monthly macro-financial variables—including equity market returns, realized volatility, credit spreads, yield-curve measures, and short-term interest rates—we identify latent market regimes over the period 1991–2025. The estimated HMM classifies market conditions into three economically interpretable states: Expansion, Normal, and Stress. These regime labels are then merged with monthly returns of broad-market, style, and sector exchange-traded funds (ETFs) to examine whether investment performance and systematic risk vary across latent economic conditions.

Within each regime, we estimate annualized returns, Sharpe ratios, maximum drawdowns, conditional CAPM betas, and the cross-sectional market price of risk. The empirical results reveal substantial regime dependence across all performance measures. Growth-oriented and technology-focused ETFs exhibit stronger risk-adjusted performance during Expansion and Normal regimes, whereas defensive sectors experience smaller drawdowns during Stress periods. Conditional CAPM betas differ across regimes, suggesting that systematic market risk exposures are state dependent rather than constant through time. Furthermore, the estimated market price of risk is positive and statistically significant during Expansion and Normal regimes, while the corresponding estimate is negative during Stress periods, providing evidence that investors price systematic risk differently across economic environments.

These findings indicate that latent market regimes contain economically meaningful information beyond that captured by traditional linear asset pricing models and support the development of regime-conditioned multifactor models and AI-driven nonlinear stochastic discount factor frameworks for dynamic asset pricing.



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Sciforum-203583: Predictive Analytics for Market Risk: AI Modeling For Stock Price Forecasting and Hedging Strategies

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Introduction: Financial markets are increasingly exposed to nonlinear dynamics, volatility clustering, and extreme-risk events that challenge traditional econometric forecasting and risk management models. This study investigates whether artificial intelligence and deep learning architectures can improve stock price forecasting, market risk measurement, and dynamic hedging performance compared with conventional benchmarks.

Methods: Daily market data from January 2015 to March 2026 were collected for AAPL, MSFT, TSLA, AMZN, and SPY, together with macroeconomic and volatility indicators. A strict chronological data split was applied, with training, validation, and out-of-sample testing periods to avoid look-ahead bias. Seven predictive models were evaluated: Random Walk, ARIMA, Random Forest, XGBoost, LSTM, GRU, and a multi-head attention Transformer. Model performance was assessed using RMSE, MAE, MAPE, and R^2. The best-performing model was then integrated into a market risk framework using VaR, CVaR, Kupiec backtesting, and dynamic hedging strategies.

Results: The Transformer model achieved the strongest out-of-sample forecasting performance, with RMSE = 0.72, MAE = 0.51, MAPE = 0.85%, and R^2 = 0.982, outperforming statistical, machine learning, and recurrent deep learning benchmarks. In market risk estimation, the AI-driven framework improved VaR and CVaR calibration and reduced exception rates compared with the traditional GARCH benchmark. The dynamic AI-based hedging strategy reduced maximum drawdown and improved the Sharpe ratio relative to the unhedged portfolio.

Conclusions: The findings suggest that attention-based AI architectures can enhance financial forecasting, tail-risk measurement, and portfolio protection. This research highlights the potential of integrating predictive analytics, risk modeling, and adaptive hedging to support more robust financial risk management decisions.



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Sciforum-203586: Machine Learning-Based Risk Modeling for Operational Performance and Cost Optimization in Fecal Sludge Treatment Plants: A Decision Support Framework for Urban Sanitation

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Urban sanitation services in many low- and middle-income countries face growing operational and financial risks due to rapid urbanization, inadequate monitoring systems, and inefficient resource allocation. Fecal sludge treatment plants (FSTPs) are particularly vulnerable to fluctuating sludge inflows, equipment failures, rising operational costs, and limited data-driven decision-making. These challenges reduce treatment efficiency and threaten the sustainability of sanitation services.

This study proposes a machine learning-based framework to model operational and economic risks in FSTPs and support evidence-based decision-making, using **SECA Cameroon** as a case study. The framework integrates operational, financial, and environmental data to identify key factors affecting plant performance and operating costs. Machine learning algorithms are applied to predict risk scenarios, estimate cost variations, and detect patterns associated with reduced treatment efficiency.

The proposed framework enhances infrastructure management through predictive maintenance, optimized resource allocation, and strategic planning. It also supports the digital transformation of sanitation services by providing an intelligent decision-support system capable of generating timely recommendations for plant managers and policymakers.

This research addresses the urgent need for data-driven risk management in rapidly urbanizing African cities, where financial constraints and operational uncertainties often compromise service delivery. By combining machine learning with data analytics, the framework demonstrates how artificial intelligence can strengthen operational resilience, improve cost efficiency, and support sustainable urban sanitation management.

The study contributes a scalable and adaptable decision-support model that can be implemented in different sanitation contexts. Its findings provide practical insights for utility operators, policymakers, and researchers seeking to improve infrastructure performance through next-generation risk modeling and data-driven decision-making.



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Sciforum-203721: Machine Learning for Rare-Event Bank Failure Ranking: Rolling Out-of-Sample Evidence from Public FDIC Data

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Introduction: Bank failure prediction is an extreme rare-event risk-modeling problem in which overall accuracy can conceal weak identification of vulnerable institutions. While most prior early-warning research relies on linear statistical methods, these approaches may fail to capture complex, interacting risk thresholds. This study tests whether nonlinear machine learning improves prospective U.S. bank-failure ranking relative to transparent statistical benchmarks, explicitly accounting for the exceptionally low natural base rate of failure. **Methods:** This research utilizes public FDIC regulatory financial and failure records to construct a quarterly panel covering 11,235 institutions from 2001Q1 through 2025Q4. An L2-regularized logistic regression, a one-quarter hazard logit compounded to four- and eight-quarter horizons, and a fixed-parameter XGBoost model are evaluated in expanding-window annual tests with fold-specific preprocessing. Primary outcomes are annual-block precision-recall area under the curve (PR-AUC) and recall within the highest-risk 1% of bank-quarter observations. Test-size-weighted means are reported across 13 event-containing blocks alongside 1,000 paired annual-block bootstrap replications. Four targeted XGBoost sensitivity variants alter class weighting or tree depth. **Results:** XGBoost achieved mean PR-AUCs of 0.438 at both horizons, versus 0.352 and 0.335 for regularized logistic regression. At the top-1% cutoff, XGBoost recalled 75.9% and 66.8% of positive bank-quarter observations. Mean PR-AUC differences versus logistic regression were 0.086 (95% CI, 0.049-0.120) and 0.103 (0.053-0.146). All five XGBoost specifications retained positive PR-AUC differences with 95% intervals excluding zero. The class-weighted baseline had worse Brier scores than both logit benchmarks, and its raw scores are not population failure probabilities. **Conclusions:** XGBoost adds robust rank-ordering value for bank-risk triage under temporal out-of-sample evaluation. It is best interpreted as a prioritization tool; absolute probability use requires separate calibration and validation.



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Sciforum-203737: Predicting Default Risk in Buy Now, Pay Later Services: A Comparative Study of Random Forest and XGBoost

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Buy Now, Pay Later (BNPL) has emerged as one of the fastest-growing segments of the global financial technology (FinTech) industry, offering consumers flexible payment options while creating new challenges in credit risk management. The rapid expansion of BNPL services has increased the likelihood of borrower defaults, making accurate and timely default prediction essential for maintaining portfolio quality and supporting sustainable lending practices. This study investigates the application of supervised machine learning techniques for binary classification to predict whether BNPL users are likely to default or successfully repay their obligations. Two widely used ensemble learning algorithms, Random Forest and XGBoost, were developed and compared using a dataset comprising 10,345 BNPL transactions.

Model performance was evaluated using four key metrics: Accuracy, Area Under the Receiver Operating Characteristic Curve (AUC-ROC), Recall, and the F1-score. Experimental results indicate that the Random Forest model consistently outperformed the XGBoost model, achieving an overall accuracy of 97% while demonstrating superior discriminative capability in distinguishing between defaulting and non-defaulting customers. The findings highlight the potential of machine learning methods to strengthen credit risk assessment by providing more accurate and reliable default predictions. Consequently, these predictive models can support financial technology institutions in enhancing lending decisions, minimizing credit losses, optimizing risk management strategies, and promoting responsible growth within the rapidly expanding BNPL ecosystem.



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Sciforum-203869: Currency-Specific Exchange Rate Pass-Through under Monetary Policy Thresholds and Structural Breaks: SVECM Evidence from the United States

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Introduction: Empirical research on exchange rate pass-through typically treats currencies as uniformly influential and overlooks regime shifts induced by systemic crises, potentially biasing estimates of currency risk and monetary policy effectiveness. This paper addresses three gaps — currency homogenization, neglect of structural breaks, and uniform treatment of monetary policy transmission— in what is, to the author's knowledge, one of the first unified frameworks evaluating currency-specific pass-through, monetary thresholds, and crisis-related structural breaks for the United States.

Methods: A Structural Vector Error Correction Model (SVECM) is estimated using quarterly U.S. data for GDP, the Federal Funds Rate, GBP/USD, JPY/USD, and oil prices from 1985Q1–2024Q2, and for EUR/USD from 1999Q1–2024Q2, reflecting the euro's introduction. The model jointly evaluates these series alongside Bai–Perron multiple breakpoint tests identifying structural regime shifts. Robustness is assessed using Bayesian VAR and threshold VECM specifications, Hansen threshold tests, and bootstrap impulse response analysis.

Results: The euro dominates U.S. growth transmission: a 1% euro depreciation increases next-quarter GDP by 0.36% ($p < 0.05$), while the British pound and Japanese yen have negligible effects. Bai–Perron tests identify structural breaks at 2008Q3 and 2020Q1, with euro pass-through strengthening after the Global Financial Crisis (0.41 vs. 0.36). Monetary transmission is nonlinear: Federal Funds Rate shocks significantly affect output only above a 2.5% threshold, confirming weak policy traction near the zero lower bound. Oil price shocks form a secondary transmission channel, with a 20% increase reducing GDP by 0.4% within two quarters.

Conclusions: Exchange rate pass-through is a currency-specific, regime-dependent mechanism rather than a uniform process. To the extent that firm- and portfolio-level currency exposure tracks the aggregate transmission channel identified here, these results suggest euro exposure may warrant closer risk-management attention than GBP or JPY exposure; macroeconomic stabilization, meanwhile, requires alternative policy instruments when interest rates fall below identified thresholds. The results establish an econometric benchmark for next-generation risk modeling, providing a reference against which machine learning approaches to macro-financial forecasting can be evaluated.



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Sciforum-203871: Predict, Detect, Defend: A Machine Learning Framework for Next-Generation Cyber Risk Modelling

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Introduction: This study examines how machine learning can advance next-generation cyber risk modelling, focusing on phishing detection and prevention. Phishing remains one of the most common and evolving cyber threats, exploiting both technical weaknesses and human psychology to obtain confidential information. Blacklists and static rule-based filters often fail to catch advanced techniques such as spear-phishing, homograph attacks, and dynamically generated malicious URLs. This study draws on email content, URL structure, website metadata, and user interactions to enhance the real-world applicability of ML in detecting and preventing phishing attacks.

Methodology: Phishing and legitimate emails, URLs, and website content were collected and pre-processed. Feature engineering extracted suspicious URL patterns, domain age, sender reputation, and textual features as phishing indicators. Transformer-based models analysed email text for phishing-related keywords and phrases, while supervised classifiers, random forest, support vector machines, and gradient boosting identified phishing URLs using features such as link count, domain names, and special characters. Convolutional neural networks assessed visual similarity between phishing and legitimate brand pages to detect spoofed interfaces, and ensemble models combined multiple outputs to strengthen detection robustness. Performance was evaluated using precision, recall, F1-score, and false-positive rate, with emphasis on minimising detection time for real-time filtering.

Findings: ML models substantially outperformed traditional blacklist- and rule-based filters in detecting known and novel phishing attempts. Transformer-based NLP models effectively identified deceptive language and social engineering cues, while CNNs classified brand-mimicking websites. Multimodal ensemble approaches combining URL-based, content-based, and visual features achieved the highest detection accuracy, capturing the diverse tactics phishing attacks employ.

Conclusion: Aligning ML techniques, NLP, visual similarity detection, and ensemble learning with phishing's distinct characteristics enables more accurate, adaptive anti-phishing defences. This multimodal approach improves real-time detection and reduces false alarms, better protecting users and organisations while informing future research into adaptive filtering, user-awareness-integrated security, and brand protection.



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Sciforum-203911: Forecasting Inflation Using Machine Learning vs. Traditional Time Series Models: Evidence from the Post-Pandemic Period

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The post-2021 inflationary episode renewed a long-standing question in applied macroeconomic forecasting: whether flexible machine-learning estimators predict inflation more accurately than classical time-series models, and whether any such advantage is concentrated in periods of structural instability rather than being general. This paper compares classical econometric benchmarks with machine-learning estimators over several forecast horizons, using a recursive pseudo-out-of-sample design in which every model setting is determined exclusively from information available before each forecast origin, so that no specification is chosen with knowledge of the period being predicted. Simple naive benchmarks are included alongside the econometric ones, so that any reported gain is measured against a realistic lower bound rather than against a weak comparator. To distinguish the contribution of the model class from that of the volume of information supplied to it, the machine-learning estimators are evaluated twice: once under the same restricted information set available to the classical multivariate benchmark, and once under a substantially broader set of macroeconomic predictors. Forecast accuracy is assessed by standard loss measures and by tests of equal predictive accuracy appropriate to overlapping multi-step forecast errors, and is compared across a period of low and stable inflation and the post-pandemic cycle, the latter extending through the subsequent disinflation. The objective is to establish the conditions under which the additional flexibility of machine-learning methods, and the additional information they can accommodate, translate into practical forecasting gains.



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Sciforum-203915: Cross-Asset Stress Transmission for Insurance ALM: A Public-Data Early-Warning Framework

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Insurance balance sheets are exposed to stress through multiple market channels, including equity drawdowns, volatility spikes, real-rate shocks, inflation expectations, and credit-spread widening. These channels are often studied separately, yet they interact during crisis periods and can jointly affect asset-liability management, hedging pressure, and strategic allocation decisions. This study proposes a public-data machine-learning framework for measuring and forecasting cross-asset stress transmission from an insurance ALM perspective.

The framework constructs market-pressure indicators from readily available data, including equity returns, VIX-family volatility measures, Treasury yields, TIPS real yields, breakeven inflation, and investment-grade and high-yield credit spreads. These indicators are grouped into equity-volatility pressure, rate and real-yield pressure, and credit-spread pressure. Logistic regression and gradient-boosted decision trees are used to estimate the probability of subsequent market-stress events, allowing both interpretable linear relationships and nonlinear cross-asset interactions to be evaluated. Lead-lag relationships are additionally examined to characterize how stress propagates across equity, volatility, rates, and credit markets.

Model performance is evaluated using an expanding-window out-of-sample design that preserves the temporal ordering of the data and limits look-ahead bias. Predictive performance is assessed using ROC-AUC, precision-recall AUC, Brier score, and recall among the highest predicted-risk observations. Performance is also examined separately during major historical stress regimes, including the 2020 COVID crash, the 2022 inflation and real-rate shock, and the 2023 banking stress episode.

The framework maps observable market conditions to economically interpretable proxies for insurance ALM pressure rather than attempting to replicate proprietary liability valuations. Equity and volatility conditions proxy pressure on equity-linked guarantees and option budgets; Treasury and real-yield movements proxy duration-mismatch pressure; and credit-spread deterioration proxies credit-migration and liquidity pressure in general-account portfolios. The resulting framework is intended as a transparent early-warning layer for risk managers rather than a black-box trading signal. Its contribution is to connect cross-asset market signals and machine-learning forecasts to insurance ALM governance, supporting stress dashboards, regime-aware strategic allocation, and model-risk discussions for insurers managing option-embedded liabilities and long-duration general-account portfolios.



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Sciforum-203927: atch-VTT: A Memory-Efficient Transformer for Volatility-Based Anomaly Detection and Risk-Off Portfolio Management

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Detecting market stress at daily resolution is central to modern risk modeling, yet the deep architectures capable of it are often too heavy to be practical. The Variable-Temporal Transformer (VTT) captures inter-variable structure effectively [1], but its attention scales with the raw sequence length, inflating model size and destabilizing threshold calibration on the small samples typical of financial data. We introduce Patch-VTT, which tokenizes each input window into patches [2] so that attention operates over compact regime-level tokens rather than individual days. Using S&P 500 daily data from 1980 to 2026, we build five volatility features from a GARCH(1,1) model [3] and reconstruct 100-day windows through a patched variable-temporal backbone, combined with a cross-attention head that restores per-day resolution and a rank-based fusion of the patch and point reconstruction errors. Days whose fused error exceeds the 95th percentile of the validation distribution are flagged. The patched design cuts the backbone parameter count by roughly thirtyfold and its dominant attention dimension by close to sevenfold, while yielding detections stable across random initializations. The model recovers the principal stress episodes of 2018 to 2025, and most flagged days correspond to innovational volatility-regime shifts rather than isolated shocks [4]. A risk-off overlay that reduces equity exposure following each flag raises the Sharpe ratio from 0.62 to 0.89±0.22 and lowers the maximum drawdown from 34% to 19% relative to buy-and-hold; the improvement persists once the 2020 crisis is excluded (Sharpe ratio 0.91±0.26). Patch tokenization thus makes transformer-based volatility detection lighter and steadier, with period-robust economic value.

References:

Kang, H., & Kang, P. (2024). Transformer-based multivariate time series anomaly detection using inter-variable attention mechanism. Knowledge-Based Systems, 290, 111507.Nie, Y., Nguyen, N. H., Sinha, P., & Kalagnanam, J. (2023). A time series is worth 64 words: Long-term forecasting with transformers. ICLR.Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. Journal of Econometrics, 31(3), 307–327.Chen, C., & Liu, L. M. (1993). Joint estimation of model parameters and outlier effects in time series. JASA, 88(421), 284–297.



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Sciforum-203932: A Gaussian Recency Score for Detecting and Directing Central-Bank Policy-Rate Changes

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Central bank policy rates change rarely and in discrete steps, which makes both the timing and the direction of the next move difficult to forecast, particularly for models conditioned only on macroeconomic variables. This paper asks how far a bank's own rate history alone can go. We propose a Gaussian-kernel recency score (GPI), which weights recent rate changes by a smooth kernel in the lag, and a hybrid extension (GPIH) that blends this score with an empirical streak hazard, both estimated per country using only in-sample data to avoid leakage. On monthly BIS policy rates spanning 48 economies (3,658 stay-state test months, 768 breaks), GPIH achieves the best F1 score (0.430) and Cohen's kappa (0.204) among all models evaluated, verified using a 10,000-draw country-cluster bootstrap. Under the resulting class imbalance, an always-stay rule is the most accurate single model yet detects no breaks at all; standard machine learning classifiers, including logistic regression, random forest, and XGBoost, given the identical information set, also underperform GPIH by wide and statistically significant margins. We extend the framework to a three-state direction problem (cut, stay, or hike) using separate cut- and hike-specific recency intensities, achieving a macro-F1 of 0.531 while again outperforming the same machine learning benchmarks. Notably, adding cross-excitation terms between cut and hike intensities, or features capturing the length of same-direction cycles, does not improve and can worsen out-of-sample performance. Taken together, the results suggest that recency of recent policy activity, rather than the duration of the current stance or additional model complexity, is the dominant signal available in history-only central-bank policy-rate forecasting.



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Sciforum-203964: Trading the Story Before the Price: A Reflexivity-Aware Neural Framework for the Narrative Risk Premium

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Traditional portfolio allocation often treats market sentiment as noise. That misses how stories now move through markets before they appear in prices. This paper treats social sentiment as a mispriced risk factor, which we call narrative beta, and argues that investors can earn a premium by identifying a story before prices adjust. The central claim isthat financial narratives tend to move through emergence, amplification, and decay, with social sentiment often peaking about 24 to 48 hours before related asset prices respond. That delay may come from how people process market information, including hierarchical spread, confirmation-seeking behavior, weekend discussion cycles, and the gap between emotional reaction and rational adjustment. To estimate this Narrative Risk Premium, we propose a multi-head attention transformer that combines social media, news, geopolitical signals, and market data. The model links three tasks: embedding the narrative, measuring sentiment intensity, and translating that signal into risk-weighted portfolio adjustments. We test the approach in stages, starting with historical backtests on 2018 to 2024 sentiment data, then paper trading on live feeds, then limited live deployment with strict risk controls. The strategy also has to account for reflexivity. If too much capital follows the same signal, the signal weakens. A credible system must estimate its own market impact, not just predict other traders' reactions. It also has to detect coordinated narrative manipulation, especially AI-generated campaigns built with large language models. The broader goal is a market system that can price narrative risk while identifying stories designed to distort prices.



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Sciforum-203977: Dynamic Network Productivity, Club Convergence, and Machine Learning Benchmarking: Evidence from Indian Banks across Ownership Groups

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This paper examines the convergence patterns of risk-adjusted bank productivity across distinct ownership groups in the Indian banking industry by employing the state-of-the-art club convergence clustering procedure. To construct a comprehensive measure of bank productivity and its constituent components, we propose a three-stage dynamic network structure operationalised through the Dynamic Sequential Malmquist–Luenberger Productivity Index (DSMLPI), which adopts a holistic view of the bank production process by explicitly capturing the internal linkages among multiple divisions via intermediate processes and incorporating carryover flows across time periods to embed a meaningful temporal dimension in the analysis. Drawing on a balanced panel dataset spanning 2010–2017, our empirical results reveal that, in the absence of any discernible catching-up effect, the observed surge in bank productivity within the Indian banking industry is attributable entirely to technological progress rather than to improvements in productive efficiency. We identify distinct convergence clubs for overall bank productivity and its technical change component at both the aggregate industry level and the disaggregated ownership-group level; however, a single convergence club is detected for the efficiency change component across the industry as a whole. To rigorously validate these club convergence findings, we benchmark these results against unsupervised machine learning clustering algorithms, wherein tests of silhouette stability, seed sensitivity, and economic coherence collectively demonstrate that k-means clustering yields groupings that are ambiguous, unstable, and economically incoherent on our small banking panel, whereas the earlier procedure consistently produces stable, theoretically grounded clubs; thereby firmly establishing the methodological superiority of econometric convergence analysis over unsupervised machine learning for datasets of this scale and structure.



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Sciforum-204058: Rényi Projections Onto Transportation Polytopes: Tail-Sensitive Couplings and a Generalised Sinkhorn Algorithm for Robust Risk Modelling

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We study projections of a strictly positive reference matrix A onto the transportation polytope $\Pi(a,b)$ by minimising $D_\alpha(P\|A)$, $\alpha>1$. The limit $\alpha\downarrow 1$ recovers the Kullback–Leibler/Schrödinger–Sinkhorn projection, whereas $\alpha>1$ penalises large likelihood ratios P_{ij}/A_{ij} more strongly. We prove existence and uniqueness, dual attainment, and the KKT representation $P_{\alpha,ij}=A_{ij}(u_i+v_j)_+^{1/(\alpha-1)}$, yielding a threshold support with a connected active graph. After gauge fixing, a generalised Sinkhorn-type alternating scheme converges globally and, under strict complementarity, locally linearly. On intervals where strict complementarity persists, the value and optimiser are C^1 in α; an explicit hypergradient enables calibration of α against a differentiable validation loss.

In risk modelling, a,b may represent separately calibrated loss marginals and A a historical or expert dependence prior. In a joint equity–credit or multi-asset loss grid, simultaneous threshold exceedances describe systemic-stress scenarios. If a KL-based fit underrepresents observed co-exceedances, α can be selected out of sample using a joint-exceedance score or a smooth expected-shortfall surrogate. Thus α is a likelihood-ratio sensitivity parameter, while the resulting change in tail risk remains data- and constraint-dependent rather than universally monotone.

The numerical study is a finite-dimensional proof of concept, including a resolved 2×3 transportation problem; no large-scale benchmark is claimed. For dense n×m inputs, a sweep requires O(Knm) arithmetic and O(nm) storage if each scalar row or column root is solved in at most K iterations. The contribution beyond entropic transport is the integration of structural theory, convergent computation, and differentiable calibration of α, linking constrained coupling to distributionally robust risk modelling.



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Sciforum-204086: Critical Thresholds in a Limit Order Book with Mutually Exciting Order Flow

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In the Kelly–Yudovina limit order book, independent Poisson bid and ask arrivals generate critical prices $\kappa_b < \kappa_a$: bids below κ_b and asks above κ_a accumulate, while orders in the active interval are eventually matched. We replace the arrival streams by a stationary bivariate linear Hawkes process. Writing $\Phi=(\varphi_{ij})$ for the integrable kernel matrix and $K=\int_0^\infty \Phi(s)ds$, we assume $\rho(K)<1$; price marks remain independent conditional on order side. The stationary arrival-rate vector is $\Lambda=(I-K)^{-1}\mu$.

Our design separates mean activity from temporal clustering. We compare the Hawkes book with an auxiliary Poisson book having the same rates Λ, derive a fluid-limit characterisation of $K \mapsto (\kappa_b(K),\kappa_a(K))$, obtain its first-order expansion at $K=0$, and simulate symmetric and asymmetric excitation against the matched-rate benchmark. This contrast isolates changes attributable to dependence rather than average order flow. The novelty is therefore not Hawkes-driven order flow itself, but an excitation-to-threshold map for the Kelly–Yudovina matching mechanism and a decomposition of mean-rate and clustering effects.

The thresholds have a direct liquidity-risk interpretation: they delimit price regions in which passive orders face persistent non-execution and order accumulation. An upward shift of κ_b or a downward shift of κ_a enlarges the corresponding non-execution region. Simulations with symmetric and asymmetric subcritical kernels quantify one-sided threshold displacement and transient spread excursions under clustered flow. Large movements of these diagnostics identify high-frequency regimes with severe non-execution exposure and potential liquidity dry-ups. The framework converts Hawkes kernels estimated from event data, or specified for stress testing, into interpretable execution- and liquidity-risk indicators.



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Sciforum-204143: How Normalization Shapes Fairness–Performance Trade-offs in Threshold-Based Credit Decision Systems

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Machine Learning (ML) models are increasingly used in credit risk assessment, creating a growing need for decision mechanisms that balance predictive performance and fairness. Fairness-aware threshold optimization has emerged as an attractive post-processing approach because it enables explicit control of fairness—performance trade-offs without modifying the underlying predictive model. These approaches typically aggregate heterogeneous performance and fairness metrics through scalarized objective functions, implicitly relying on normalization to ensure comparability across metrics. Despite its widespread use, normalization is generally treated as a neutral preprocessing step whose influence on optimization outcomes is assumed negligible. This paper investigates the impact of normalization on fairness-aware threshold optimization in credit risk modeling. Using a common optimization framework, three representative normalization strategies, including empirical min-max, theoretical-bound, and distance-to-ideal normalization, are evaluated across Logistic Regression, Random Forest, and XGBoost classifiers on both synthetic and real-world credit datasets. The analysis reveals that normalization substantially influences optimization outcomes. Different normalization schemes reshape the geometry of the objective landscape, alter optimal decision thresholds, and modify fairness—performance trade-offs. As a consequence, identical policy preferences may lead to materially different operational decisions depending solely on the normalization strategy employed. The observed effects are consistent across models and datasets, indicating that normalization acts as a structural component of the optimization process rather than a purely technical scaling operation. These findings highlight the importance of explicitly assessing normalization choices in machine learning-based risk modeling. More broadly, they demonstrate that normalization should be regarded as a modeling decision that directly affects fairness-aware credit decision systems and their governance.



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Sciforum-204180: Mapping Systemic Cross-Curency Risk: Using Graph Neural Networks on Liquidity Flows

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Traditional macroeconomic risk assessment tools and econometric methods struggle to model the highly interconnected and multi-dimensional nature of over-the-counter (OTC) foreign exchange and derivatives markets. While classic statistical and linear algebraic models excel at evaluating market indicators in isolation, they usually assume independence of separate currency pairs. As such, they fail to capture the complex structural dependencies and vulnerabilities that manifest in cross-currency derivatives. To bridge this gap, this paper proposes an unsupervised, topology-aware computational framework that maps global liquidity as a directed currency exchange multi-graph. In this setup, individual currencies serve as topological nodes, while the directed edges represent specific transaction properties which encompass, but are not limited to, instrument type, counterparty sectors or reporting origins. An unsupervised Graph Autoencoder is implemented over this model to map the global foreign exchange market into a low-dimensional latent embedding space. The proposed pipeline is empirically evaluated using the Bank for International Settlements (BIS) Triennial Central Bank Survey of foreign exchange and OTC derivatives markets. By isolating edges with a high reconstruction error, the model manages to flag systemic anomalies and hidden asset-concentration risks before they propagate into the market. Ultimately, this approach provides central banks and regulators with a novel, but proactive computational oversight tool.



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Sciforum-204270: Regime-Conditioned Convolutional Autoencoders with Recurrent Networks for Implied Volatility Surface Forecasting

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Accurate forecasting of the Implied Volatility Surface (IVS) is a fundamental challenge in financial engineering, derivatives pricing, hedging, and risk management due to the high-dimensionality of option grids and non-linear market dynamics. Traditional models struggle with complex patterns, while standard deep learning architectures suffer from noise. This paper presents a novel two-stage deep learning framework for IVS forecasting that combines (1) a regime-conditioned convolutional autoencoder that learns latent representations of daily 11x34 IVS grids conditioned on the VIX regime, and (2) temporal sequence models (LSTM, GRU, Transformer) that forecast future latent vectors. Using 1,423 daily S&P 500 IVS grids from OptionMetrics (2020–2025) via WRDS, we conduct a comprehensive 226-configuration hyperparameter sweep. Our best model, a GRU with a 60-day lookback window, achieves out-of-sample RMSE of 0.066 for 1-day, 0.083 for 5-day, and 0.100 for 20-day horizons. This represents a 5.7% RMSE improvement over the persistence baseline at the 20-day horizon. Although the Diebold-Mariano test indicates that this difference is not statistically significant at the 5% level (p=0.646) due to limited test set size, the model demonstrates consistent directional outperformance. The findings show that a 60-day context window is optimal, GRUs outperform Transformers at this data scale, and the autoencoder's reconstruction floor sets a bound on forecasting accuracy. The framework provides interpretable representations that correlate cleanly with market indicators, offering a robust tool for risk management.



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Sciforum-204315: Traditional Determinants of Bank Performance and the Incremental Role of ESG in the MENA Region: Evidence from Fixed-Effects Regression and Elastic Net Machine Learning

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The growing integration of Environmental, Social, and Governance (ESG) considerations into financial decision-making has intensified interest in whether sustainability-related factors provide information beyond traditional determinants of bank performance. Despite this growing attention, evidence from the Middle East and North Africa (MENA) remains limited, even though the region offers a distinctive institutional setting characterized by the coexistence of Islamic and conventional banking systems, relatively low ESG disclosure and heterogeneous macroeconomic conditions. Addressing this gap, this study investigates two interconnected questions across the largest listed commercial banks in ten MENA economies: (i) identifying and ranking key drivers of bank profitability using both econometric inference and machine learning, and (ii) assessing whether the inclusion of ESG information improves the explanatory power of the fixed-effects regression model and the predictive performance of Elastic Net models. Using a panel of 51 banks, regression results indicate that funding liquidity and deposit ratio are the most economically and statistically important determinants of bank performance, while GDP growth also exerts a robust positive effect. In contrast, the effects of bank size, capital adequacy, credit risk, and inflation vary between models. Furthermore, results show that neither the aggregated ESG measure nor its individual dimensions is associated with bank profitability after controlling for bank-specific and macroeconomic factors. The Elastic Net analysis yields consistent evidence, identifying traditional financial variables as the dominant predictors of bank profitability, whereas the inclusion of ESG variables does not improve predictive accuracy. By integrating econometric inference with machine learning within a single analytical framework, this study provides one of the first comprehensive assessments of both the explanatory and predictive relevance of ESG for bank performance in the MENA region. The findings suggest that traditional financial fundamentals continue to dominate ESG metrics in explaining and predicting bank profitability, offering important implications for investors, bank managers, regulators, and policymakers.



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Sciforum-204343: Artificial Intelligence for Stock Index Prediction: A Systematic Review on Africa

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Artificial intelligence (AI) and machine learning (ML) are increasingly utilised in financial market forecasting, offering advanced capabilities to capture the complexity of stock market fluctuations. However, targeted, comprehensive syntheses focusing on emerging African markets remain scarce despite a growing body of broader global reviews. The existing literature is often fragmented across individual countries, making it challenging to understand the African context. Following PRISMA 2020 guidelines, this systematic review analyses English-language studies published between 2020 and 2025 from the Scopus database. The present study evaluates the application of machine learning (ML), deep learning (DL), and hybrid models in predicting African stock indices. The findings reveal that index prediction using artificial intelligence techniques remains unevenly distributed across the continent. Current literature is heavily concentrated on four primary markets that are viewed as the most established and which are characterised by greater financial development and data availability: Nigeria (NGX All Share), South Africa (JSE ALSI), Morocco (MASI), and Egypt (EGX30). Across standard performance metrics, deep learning architectures consistently emerge as the most prominent and effective predictive approaches. By synthesising the current state of research, this study uncovers regional visibility gaps, identifies critical data quality limitations, and provides actionable recommendations to advance cross-market comparative analysis and expand coverage across underexplored African exchanges.



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Sciforum-204357: Machine-Learned Scarcity Numeraires for Water–Energy Risk and Sustainable Asset Valuation

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Introduction: Financial valuation still relies largely on monetary numeraires that may not internalize bio-physical scarcity. This study aims to develop an original resource-based valuation framework in which water, energy, and related sustainability pressures enter the unit of account used to compare asset prices and risk exposures. The focus is not on replacing currencies, but on testing whether a scarcity-sensitive numeraire can provide more stable and informative representations of financial value under environmental constraints. **Methods:** We seek to construct a panel of resource-scarcity indicators, including water stress, renewable and fossil energy dependence, climate anomalies, commodity prices, sector-level ESG disclosures, and institutional sustainability reports. Dimensionality reduction and clustering can be used to identify latent scarcity regimes. Supervised machine learning and regularized optimization can then estimate time-varying resource weights that minimize asset-price instability, inflation co-movement, and downside-risk measures. A complementary compact NLP/LLM module can extract water–energy risk signals from policy and corporate texts and tests whether these textual variables improve out-of-sample risk explanation. **Results:** The expected output is a dynamic scarcity-adjusted numeraire and a set of empirical diagnostics linking resource pressures to sectoral valuation, commodity sensitivity, and market volatility. We expect water–energy interactions to be especially informative for utilities, agriculture, energy-intensive industries, and critical-mineral supply chains. **Conclusions:** The study aims to contribute to AI-based risk modeling and the reconstruction of economic valuation by translating environmental scarcity into a testable financial metric. The framework is meant to offer a bridge between sustainable finance, resource economics, and machine learning, while preserving a cautious interpretation: the proposed numeraire is an empirical risk and valuation tool, not a deterministic pricing rule.



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Sciforum-205175: Industry Risk in Asset Pricing: A Machine Learning Approach

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We apply machine learning to the problem of building an industry risk factor for asset pricing models.

Extending work by Fama and French (2020), we propose a novel approach for extracting valuable information from the cross section of industry portfolio returns. Using individual industries, we estimate a multifactor model and associated alpha parameters. Upon incorporating scaled alphas into a cross sectional regression of industry portfolio excess returns, we estimate a cross section industry factor as the market price of industry alpha risk.

In our empirical tests, we employ 30 industries in the sample period July 1963 to June 2024 from Kenneth French's online data library. Standard Fama and MacBeth (1973) out-of-sample cross-sectional regressions are estimated to test the hypothesis that industry risk is a salient factor in pricing industry stock portfolios.

Upon augmenting the CAPM as well as different multifactor models with a cross section industry factor, we find that their associated loadings are statistically significant and materially boost explanatory power in terms of explaining industry portfolio excess returns. As robustness checks, we repeat the analyses using 47 industry portfolios as well as subperiods with similar results.

Our findings contribute to the large literature on multifactor models spanning traditional approaches based on observable firm and stock characteristics and machine learning approaches based on (for example) principal component analysis (PCA).3 However, our factors are not as opaque as those identified by PCA; instead, they are derived from samples of portfolios sorted on observable industry classifications and, therefore, are closely related to industry risk. Thus, our cross section factor construction methods take advantage of both traditional and machine learning approaches. Importantly, unlike PCA factors, the economic interpretation of our cross section factor is readily identifiable to be attributable to industry risk contained in industry-sorted test asset portfolios.



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Sciforum-205370: Hybrid Recommendation And Deep Learning Architectures For Investment Portfolio Optimization

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The transition to artificial intelligence (AI) tools in the financial sector has transformed asset allocation methods, shifting from classical linear econometric models to complex architectures based on deep learning. In an era characterized by massive volumes of heterogeneous market data, traditional models often fail to capture hidden correlations and sudden market shifts. This theoretical paper proposes an innovative model for optimizing investment portfolios by integrating hybrid recommendation systems with deep neural networks. The hybrid methodology addresses the limitations of traditional robo-advisors by combining collaborative filtering for behavioral profiling of investor risk aversion with the automatic extraction of nonlinear features from financial time series. To achieve this, the architecture utilizes advanced neural layers to process sequential asset data alongside dense networks that map user-specific financial constraints. The research analyzes the calibration of composite cost functions and the application of regularization techniques to prevent overfitting historical capital market data. This statistical is imperative to minimize the probability of generating false trading signals, directly addressing the warnings issued by the European Securities and Markets Authority (ESMA) regarding the risks of unsupervised AI. Furthermore, the paper introduces elements of Explainable AI (XAI) to ensure that the deep learning output remains interpretable for financial auditors and regulatory bodies. The research findings demonstrate that hybrid architecture based on deep learning offers superior capabilities for modeling risk probabilities and market volatility. By optimizing risk-adjusted performance metrics, the system facilitates the construction of personalized and resilient investment portfolios. In conclusion, this paper establishes a transparent algorithmic framework that is essential for governance and the future decision-making infrastructure within the financial ecosystem.

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Sciforum-206297: LSTM-Based Financial Forecasting with Interpretability: Evidence from US Equity Markets

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This paper examines the predictive performance of Long Short-Term Memory (LSTM) neural networks in forecasting daily equity prices, using Apple Inc. (AAPL, 2010–2025) as the primary case study and Microsoft Corporation (MSFT) as a cross-asset generalization test through transfer learning. The proposed architecture consists of a three-layer stacked LSTM model optimized for financial time-series prediction. Empirical results demonstrate strong out-of-sample forecasting accuracy, with RMSE = \$7.03, MAE = \$5.50, R^2 = 0.9537, and MAPE = 3.03%, outperforming traditional ARIMA and Support Vector Regression (SVR) benchmarks across both statistical and financial performance measures. Additional evaluation through investment-oriented indicators yields a Sharpe ratio of 1.23 and a directional hit ratio of 0.68, confirming the economic relevance of the generated forecasts for trading and portfolio management applications.

Model interpretability is enhanced through SHAP (SHapley Additive exPlanations) analysis, which identifies the 10–15 most recent price lags as the dominant contributors to predictions, providing evidence consistent with short-term momentum dynamics in equity markets. To assess robustness under extreme market conditions, the model is stress-tested during the COVID-19 crisis period (March 2020), where forecasting accuracy deteriorates significantly, with MAPE increasing from 2.9% to 4.8% ($p < 0.05$), revealing sensitivity to structural breaks and heightened volatility regimes. A fully documented UML-based workflow and publicly available implementation code ensure transparency and reproducibility. The study contributes to the literature on deep learning-based financial forecasting by combining predictive performance, transfer learning validation, explainability analysis, and robustness testing, and offers practical guidance for integrating interpretable artificial intelligence techniques into quantitative investment decision-making.



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Sciforum-207159: Does Global News Tone Add Predictive Value for Market Stress? Out-of-Sample Evidence from GDELT and the VIX

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Introduction: This study examines whether globally aggregated news tone adds stable out-of-sample information for forecasting U.S. market stress beyond observable financial-market conditions.

Methods: Daily GDELT 2.0 Global Knowledge Graph indicators were aligned with the spot Cboe VIX, S&P 500 returns, and the 10-year U.S. Treasury yield from July 2016 to July 2026. Two leakage-safe outcomes were modeled: (1) a next-trading-day VIX jump exceeding the lagged 90th percentile of daily VIX changes over the preceding 252 trading days, and (2) entry within five trading days into a high-VIX state defined by the lagged 75th percentile of the VIX level. Logistic regression and XGBoost were compared using chronological holdout testing, expanding-window validation, probability recalibration, and 2,000-replication moving-block bootstrap inference.

Results: For next-day stress, adding news reduced logistic ROC-AUC from 0.634 to 0.595, but increased XGBoost ROC-AUC from 0.528 to 0.571 (Δ = +0.043, 95% CI: -0.000 to +0.089; p = 0.051). This gain was marginal and did not persist across historical validation windows. For five-day state entry, news reduced logistic ROC-AUC from 0.655 to 0.562 (Δ = -0.093, 95% CI: -0.190 to -0.008; p = 0.029) and reduced XGBoost ROC-AUC from 0.647 to 0.617 (Δ = -0.030; p = 0.375). Direct tone effects and tone-by-regime interactions were not robust.

Conclusions: Broad global news tone does not provide a stable stand-alone early-warning signal. Its only suggestive incremental value appears in nonlinear next-day VIX-jump prediction, while five-day regime-transition forecasts are better explained by prevailing volatility and recent market dynamics. Risk managers should therefore use global news tone only as a supplementary, dynamically validated input.



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Sciforum-207533: Mapping the Evolution of Machine Learning for Mortgage Repayment Prediction: A Bibliometric Analysis and Research Agenda for Automated Decision-Support Systems

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Machine learning (ML) has emerged as a transformative technology for mortgage repayment prediction, offering significant improvements in credit risk assessment, underwriting, and lending decision-making. Despite the rapid growth of research in this field, the intellectual structure, collaboration patterns, thematic evolution, and emerging research directions remain fragmented. This study presents a comprehensive bibliometric analysis of machine learning research on mortgage repayment prediction using 34 journal articles retrieved from the Scopus database covering the period 2000–2025. Following the PRISMA 2020 guidelines, bibliographic records were analyzed using VOSviewer to examine annual scientific production, country contributions, citation patterns, source impact, author collaboration, and keyword co-occurrence.

The findings reveal a substantial increase in research output from 2018 onwards, reflecting growing scholarly interest in applying artificial intelligence to mortgage lending. The United States emerged as the leading contributor in terms of publications and citation impact, while Expert Systems with Applications and Computational Economics were identified as the most influential publication sources. Keyword network analysis revealed four dominant research themes: credit risk assessment and default prediction, machine learning classification algorithms, predictive analytics and forecasting, and deep learning-based credit scoring. Temporal and density visualization indicate that the field has evolved from conventional statistical modelling towards advanced ensemble learning and explainable artificial intelligence, although limited attention has been devoted to automated decision-support systems and practical model deployment.

The study concludes that future research should move beyond algorithm comparison towards the development of explainable, automated, and context-specific decision-support systems capable of supporting transparent and intelligent mortgage lending. The findings provide valuable insights for researchers, financial institutions, policymakers, and developers seeking to advance artificial intelligence applications in mortgage finance.

Author contributions: Conceptualization, Amos Olaolu Adewusi and Akuakanwa Eziukwu Nwosu; Methodology, Olajumoke Folasade Jejelola and Amos Olaolu Adewusi; Validation, Amos Olaolu Adewusi and Akuakanwa Eziukwu Nwosu; Formal analysis, Olajumoke Folasade Jejelola; Resources, Olajumoke Folasade Jejelola and Akuakanwa Eziukwu Nwosu; Writing - original draft, Olajumoke Folasade Jejelola; Writing - review and editing, Olajumoke Folasade Jejelola, Amos Olaolu Adewusi and Akuakanwa Eziukwu Nwosu; Supervision, Amos Olaolu Adewusi and Akuakanwa Eziukwu Nwosu.



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Sciforum-208040: Does Machine Learning Outperform Traditional Scorecards? Evidence from a Benchmark Credit Risk Dataset

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Machine learning (ML) methods are increasingly promoted as the basis for "next-generation" risk models, yet their added value over traditional, interpretable techniques on standard-scale credit portfolios remains debated, with direct implications for model validation and audit practice. This study benchmarks a nonlinear ensemble method against a classical logistic regression scorecard on a well-established public credit dataset.

We used the Statlog German Credit Data (UCI Machine Learning Repository), comprising 1,000 loan applicants (700 good, 300 bad) described by 20 financial and socio-demographic attributes. A Gradient Boosting Classifier (300 trees, depth 3) was compared against a logistic regression baseline within an identical preprocessing pipeline (one-hot encoding, feature scaling). Performance was assessed via a 70/30 stratified holdout and 5-fold cross-validation, using AUC-ROC, accuracy, and Brier score; feature importance was extracted from the ensemble model.

Both models achieved comparable discriminative power (5-fold cross-validated AUC: 0.780 ± 0.023 for logistic regression versus 0.780 ± 0.026 for gradient boosting; holdout AUC 0.794 versus 0.766). The logistic regression baseline showed a marginally better Brier score (0.162 versus 0.177). Checking-account status, credit amount, loan duration, and applicant age were the dominant risk drivers in both models.

On this benchmark, a nonlinear ML model provided no measurable accuracy gain over a transparent scorecard, suggesting that, at limited sample sizes typical of many institutional credit books, model complexity should not be assumed superior. We argue that internal audit and risk governance frameworks should require systematic benchmarking of ML risk models against simple, explainable baselines before deployment, reserving ML's added value for settings with larger or alternative data sources.



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Sciforum-208171: Integrating Artificial Intelligence into Climate Risk Management: An Intellectual Cartography of a Decade of Research on Financial Decision-Making

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With climate change issues becoming more complex, companies, financial institutions, investors, and regulators are facing greater risks, while the growing volume of climate, financial, and sustainability data is creating new opportunities for Artificial Intelligence (AI). Tools such as machine learning, natural language processing, and predictive analytics are now being used in AI-based applications to identify, measure, disclose, and manage climate-related financial risks. Despite this, academic research at the intersection of AI, climate risk management, sustainable finance, and financial decision-making remains scattered across several disciplinary and methodological streams.

This research aims to build an intellectual map of academic research on the subject from 2015 to 2026. Using a systematic literature review approach, it maps the main themes, methodological choices, AI techniques, financial applications, and climate-risk dimensions addressed in the literature. Each selected study is analyzed based on its aim, data sources, analytical approach, use of AI, climate-risk classification, financial context, and key contributions.

Special attention is given to the application of AI to measure climate risks, analyze sustainability and ESG disclosures, identify greenwashing, assess credit risk, manage financial portfolios, supervise banks, and support financial decisions. The study brings together these scattered contributions to create a coherent research landscape, thereby revealing dominant areas of research, emerging links, and gaps. It helps deepen the understanding of the potential of AI to convert complex climate data into financially meaningful knowledge and to foster more transparent, credible, and forward-looking climate-risk management in sustainable finance.



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Sciforum-208225: Artificial Intelligence and Machine Learning in Banking: Risk, Regulation, and Governance

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Objectives. This paper revisits the role of artificial intelligence (AI) and machine learning (ML) in finance and economics, with emphasis on banking applications and the regulatory challenges they create. It aims to assess how these technologies improve prediction, automation, and decision-making, while also examining the risks they introduce in terms of transparency, bias, accountability, and compliance.

Methods. The study uses a conceptual and literature-based approach, synthesizing recent academic and policy sources on AI and ML in financial services. It reviews key applications such as credit scoring, fraud detection, risk modeling, and customer analytics, and it examines regulatory themes including model risk management, explainability, data governance, and supervisory oversight.

Results. The analysis shows that AI and ML can improve forecasting accuracy, operational efficiency, and the speed of financial decision-making. At the same time, their use in banking raises serious concerns about algorithmic opacity, discriminatory outcomes, weak auditability, and cybersecurity exposure. These risks become more significant when models are deployed in high-stakes areas such as lending, compliance, and portfolio allocation.

Conclusions. The paper concludes that the benefits of AI and ML in finance and economics can be fully realized only if they are supported by strong governance, human oversight, and clear regulatory frameworks. In banking, responsible adoption requires explainable models, internal controls, and continuous monitoring to ensure that innovation does not compromise fairness, stability, or regulatory compliance.



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Sciforum-208555: Can Old and New Models Work Together? Predicting Volatility across U.S. Sectors with GARCH and Machine Learning

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This study investigates the relative predictive importance of global risk factors for the conditional volatility of the eleven S&P 500 GICS sectors. We ask whether global risk signals contain common predictive information across sectors or whether their relevance is sector-specific and changes across market conditions. Using daily total-return sector indices, we first estimate sector-specific EGARCH models to recover conditional volatility. We then forecast next-day volatility with XGBoost using six cross-market indicators that capture equity-market uncertainty, Treasury-market volatility, global dollar conditions, energy-price shocks, safe-haven dynamics, and corporate credit stress. Forecast performance is evaluated out of sample against conventional econometric and persistence benchmarks. The empirical design treats each sector as a distinct forecasting problem rather than imposing predefined sector classifications. TreeSHAP is used to decompose model forecasts into factor-specific contributions, construct comparable sectoral risk profiles, and identify nonlinearities, threshold effects, and interactions among global risk signals. We further examine whether these profiles remain stable across market regimes and rolling estimation windows. The analysis is designed to reveal which global risks dominate the volatility forecasts of individual sectors, whether the same predictors matter uniformly across the market, and when sectoral exposures diverge from aggregate risk conditions. This sector-level perspective can uncover predictive heterogeneity that is obscured by market-wide models and clarify the extent to which broad indicators such as VIX provide an incomplete representation of sectoral risk. By combining asymmetric conditional volatility modelling, nonlinear forecasting, and time-varying explainability, the study provides a unified framework for mapping cross-market risk signals into sector-specific volatility predictions, with implications for forecasting, portfolio allocation, stress testing, and risk management.



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Sciforum-208556: Hidden Coverage Failures in Bitcoin Volatility Prediction Intervals Across Sentiment States

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Prediction intervals are commonly evaluated using aggregate coverage and average width, but these summaries can conceal failures concentrated in specific market conditions. This study examines whether seven-day-ahead Bitcoin volatility intervals with apparently adequate global calibration remain reliable across Fear, Neutral, and Greed sentiment states.

Intervals are evaluated at a nominal 95% coverage level across 24 chronological walk-forward test windows and three volatility measures: realized, Garman-Klass, and Rogers-Satchell volatility. Raw quantile, symmetric conformal, and conformalized quantile regression (CQR) intervals are compared across econometric, tree-based, LSTM, and GRU forecasters. Sentiment states are defined at the forecast origin using the Alternative.me Crypto Fear & Greed Index (Fear ≤ 33, Neutral 34–66, and Greed ≥ 67). Robustness is assessed using non-overlapping forecast origins, block-bootstrap confidence intervals, and multiple neural-network seeds.

For Garman-Klass volatility, a HAR-OLS raw-quantile interval using only price and volume information achieves 94.58% pooled coverage but only 89.36% during Fear, 5.64 percentage points below the nominal level; overcoverage in Neutral and Greed partly offsets this shortfall. The Fear-state undercoverage remains visible under non-overlapping-origin and block-bootstrap diagnostics. Among intervals with pooled coverage within 0.5 percentage points of the nominal 95% level, the smallest maximum absolute state-specific coverage errors are obtained by an LSTM with regime-specific CQR for realized volatility, a GRU with standard CQR for Garman-Klass volatility, and a GRU with regime-specific CQR for Rogers-Satchell volatility. Regime-specific calibration improves selected cases but not consistently, with gains sometimes smaller than random-seed variation.

Market-state conditioning is therefore most useful as a diagnostic stress test rather than as a universal calibration rule. Evaluating coverage across sentiment states can expose failures hidden by pooled validation and distinguish more balanced interval specifications, while lower- and upper-tail miss rates, temporal dependence, and seed stability provide additional evidence on forecast reliability.

Author contributions: Conceptualization, Piotr Czech; Methodology, Piotr Czech; Software, Piotr Czech; Validation, Piotr Czech; Formal analysis, Piotr Czech; Investigation, Piotr Czech; Resources, Piotr Czech; Data curation, Piotr Czech; Writing - original draft, Piotr Czech; Writing - review and editing, Piotr Czech; Visualization, Piotr Czech; Project administration, Piotr Czech.



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Sciforum-208566: Aggregation Choice and the Limits of Machine Learning in Financial Stress Measurement: Evidence from Twenty Emerging Markets, 2007–2025

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Introduction. Composite stress indices inform macroprudential surveillance, yet two questions remain under-examined: how sensitive their extreme readings are to the aggregation scheme, and whether machine learning improves stress forecasting against a well-specified autoregressive benchmark. Both are addressed for emerging markets using open data only.

Methods. A monthly market stress index is built for twenty emerging economies from daily Yahoo Finance series, 2004–2025. Four components enter: equity volatility, equity drawdown from the twelve-month peak, exchange-rate volatility, and three-month cumulative depreciation. Components are standardised with expanding-window moments to eliminate look-ahead bias; only months with all four components are retained. The usable index spans May 2007 to December 2025: 3,935 country-month observations, unbalanced panel. Three aggregation schemes are compared: equal weighting, first principal component, and a correlation-weighted portfolio scheme (Holló, Kremer and Lo Duca, 2012). Forecasts at one, three and six months compare a ridge autoregression on index lags alone with a full-set ridge, a random forest and a gradient-boosting model. The full feature set comprises own-index lags and rolling moments, lagged cross-country average stress, and global controls (VIX, dollar). Evaluation uses expanding-window forward chaining with paired bootstrap inference on roughly 2,600 out-of-sample observations per horizon.

Results. Peak stress months are October 2008 and March 2020, identified without crisis-date input. Rank correlation across schemes averages 0.908–0.940, yet agreement on top-decile episodes, measured by Jaccard similarity between peak sets, falls to 0.755–0.837 and to 0.143 for individual countries, with divergence concentrated in pegged-currency economies. No specification beats the autoregressive benchmark at any horizon: root mean squared error deteriorates by 4.6–24.7 per cent, all bootstrap intervals excluding zero.

Conclusions. Aggregation choice is immaterial for describing stress trends and decisive for identifying alert-triggering episodes. For continuous-target forecasting, machine learning delivers no gain; whether non-linear models help on discrete classification tasks such as crisis-onset prediction remains open.

Author contributions: Conceptualization, Ali Ait Sidi Lkhir; Methodology, Ali Ait Sidi Lkhir; Formal analysis, Ali Ait Sidi Lkhir; Writing - original draft, Ali Ait Sidi Lkhir.



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Sciforum-208581: A Regime-Gated Hybrid Forecasting Framework: Coupling Autoregressive Distributed Lags, Smooth-Transition Dynamics, and Kolmogorov–Arnold Residual Learning

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We propose and evaluate ARDL–STR–KAN, a three-stage hybrid forecasting framework that decomposes a financial time series into a linear conditional-mean component, a regime-dependent transition mechanism, and a nonlinear residual correction learned by a Kolmogorov–Arnold Network (KAN). The linear backbone is an Autoregressive Distributed Lag (ARDL) model estimated by conditional maximum likelihood; a logistic smooth-transition (STR) gate, with its transition variable selected by an exact Teräsvirta-type F-test, modulates the contribution of the nonlinear stage; and a KAN with learnable B-spline activations approximates the structured nonlinearity remaining in the ARDL residuals. The framework is demonstrated on 25 years of daily NASDAQ Composite data (N = 6,243, 2000–2024) with the 10-year Treasury yield (DGS10) and the volatility index (VIX) as exogenous drivers. On a chronological 80/20 holdout the hybrid attains an out-of-sample RMSE of 0.01063 against 0.01138 for the linear ARDL baseline, a 6.59% reduction with R^2 = 0.9973, and a Harvey–Leybourne–Newbold-corrected Diebold–Mariano statistic of 2.798 (p = 0.0052) confirms that the gain is statistically significant rather than an artefact of in-sample overfitting. Beyond equities, we outline the framework's extension to energy and currency markets, indicating its applicability across diverse macro-financial series. We give the full mathematical derivation, the estimation procedure, the statistical-consistency rationale for the additive decomposition, and a computational discussion of the lag order, the transition mechanism, and the KAN architecture.

Author contributions: Conceptualization, MAZIN MOHAMMED and Dibu AS; Methodology, MAZIN MOHAMMED; Software, MAZIN MOHAMMED; Validation, MAZIN MOHAMMED; Formal analysis, MAZIN MOHAMMED; Resources, MAZIN MOHAMMED; Writing - original draft, MAZIN MOHAMMED; Writing - review and editing, Dibu AS; Supervision, Dibu AS and Sathya P.



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Sciforum-208618: GAECO-NET: Graph Aware EigenCleaning Optimizer for Variance Reduction and Low-Friction Portfolio Allocation

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Mean-variance portfolio optimization is fundamentally limited by estimation error in the sample covariance matrix, an effect that intensifies as the number of assets approaches the length of the estimation window. Methods like linear shrinkage and Marchenko-Pastur eigenvalue filtering apply a single, static correction uniformly across the universe. We introduce GAECO-Net (Graph-Aware EigenCleaning Optimizer), an architecture that instead learns a continuous, asset-specific shrinkage intensity: a spatial graph-convolutional branch and a spectral eigenvalue branch are fused through an additive attention gate that determines, per asset and per rebalancedate, how strongly each eigenvalue is pulled toward the cross-sectional noise-band mean. The cleaned covariance estimate and a jointly-learned expected-return vector feed a closed-form mean-variance decoder, trained end-to-end with a turnover-penalized Sortino objective and a two-phase, five-agent ensemble procedure combining synthetic-regime pre-training with real-data fine-tuning. We evaluate the architecture out-of-sample universe from 2020 through 2024 under realistic execution frictions, benchmarked against Ledoit-Wolf shrinkage, Marchenko-Pastur denoising, and sample-covariance baselines. We evaluate on a suite of statistical tests including a Memmel-corrected Jobson-Korkie Sharpe test, a paired mean-lift test and a Levene variance test. GAECO-Net achieves a structurally and statistically significant reduction in realized return variance relative to every baseline while achieving similar Sharpe and returns – a gap traceable to a multi-year sub-period where the strategy trails benchmarks before decisively overtaking them from 2023 onward. A post-hoc explainability layer produces auditable, per-decision subgraph attributions whose own variance-reduction profile is statistically indistinguishable from, and in several comparisons stronger than, the full model's – indicating that interpretability can be layered onto this architecture at negligible additional statistical cost.



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Sciforum-208629: Mitigating Portfolio Risk via Machine Learning Across Market Regimes: Hierarchical Clustering vs. PCA Matrix Denoising.

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Portfolio optimization relies on the covariance matrix of asset returns that is difficult to estimate reliably in high-dimensional settings where estimation noise destabilizes the optimized weights. We contrast two families of covariance denoising methods: (a) Principal component analysis (PCA) based on Random Matrix Theory (RMT) and the Marchenko-Pastur law, and (b) a machine-learning approach based on hierarchical clustering, with the raw sample covariance and Ledoit--Wolf linear shrinkage. The four estimators are combined with four portfolio strategies, including a Minimum Conditional Value at Risk strategy where tail scenarios are generated from the denoised dependence structure via a Student-t copula and evaluated on a strictly out-of-sample, cost-aware rolling-window backtest over four market regimes: mature (sector ETFs), volatile (cryptocurrencies), global (country ETFs) and individual equities. A controlled sub-sampling experiment isolates the effect of dimension. We find that denoising is more valuable in the risk-oriented stage of portfolio construction rather than return forecasting, and that the efficient method is dependent on the market structure: PCA denoising is best when one factor dominates, while clustering-based shrinkage is best in high-dimensional, group-structured universes. The best denoiser improves risk-adjusted performance relative to the raw covariance in nearly all settings, but these gains are modest and not robust to multiple-comparison correction. Ultimately, the relative performance of an optimized portfolio versus equal weighting depends on the fundamental fit of strategy to universe, not covariance denoising.

Author contributions: Conceptualization, Soukaina AIT OUNOUGMAR; Methodology, Soukaina AIT OUNOUGMAR; Software, Soukaina AIT OUNOUGMAR; Validation, Lhoucine BEN HSSAIN, Jamal AGOURAM and Ghizlane LAKHNATI; Formal analysis, Soukaina AIT OUNOUGMAR; Investigation, Soukaina AIT OUNOUGMAR, Lhoucine BEN HSSAIN and Jamal AGOURAM; Resources, Soukaina AIT OUNOUGMAR; Data curation, Soukaina AIT OUNOUGMAR; Writing - original draft, Soukaina AIT OUNOUGMAR; Writing - review and editing, Lhoucine BEN HSSAIN, Jamal AGOURAM and Ghizlane LAKHNATI; Visualization, Soukaina AIT OUNOUGMAR; Supervision, Lhoucine BEN HSSAIN, Jamal AGOURAM and Ghizlane LAKHNATI; Project administration, Soukaina AIT OUNOUGMAR.



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Sciforum-208641: An Explainable AI–Enabled Risk-Adjusted Financing Framework for Investment Readiness in Fragile Agri-Food Systems

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Agri-food enterprises operating in fragile settings—characterised by climate exposure, conflict, weak institutions, or acute market volatility— face interconnected financial, operational, and governance risks that constrain investment readiness and discourage capital providers. Conventional financing assessments often rely on static financial indicators, limited historical data, and standardised risk thresholds that may overestimate risk, overlook resilience, and inadequately reflect these enterprises' operating realities. This protocol paper outlines a proposed explainable artificial intelligence (XAI)-enabled risk-adjusted financing framework for assessing investment readiness and supporting transparent financing decisions in such contexts.The framework will integrate enterprise-level financial and non-financial data—drawn from smallholder and SME agri-food enterprises in climate-vulnerable and institutionally weak regions—with contextual risk indicators to generate multidimensional risk profiles, investment-readiness scores, and differentiated financing recommendations. Supervised machine-learning models will estimate financing viability and risk, while SHapley Additive exPlanations (SHAP) will demonstrate how specific variables shape each assessment, addressing the tension between predictive performance and interpretability where opaque models risk reinforcing information asymmetries or excluding enterprises with incomplete records (Bussmann et al., 2020; Černevičienė and Kabašinskas, 2022).A mixed-methods design combining enterprise and investment data, stakeholder interviews, and expert validation is proposed. Model performance will be assessed against predictive accuracy, calibration, robustness, and interpretability, alongside fairness criteria examining whether outputs disadvantage enterprises with sparse credit histories, such as women-led or smallholder ventures. Human oversight remains embedded throughout to contextualise outputs and prevent fully automated determinations.This study contributes an integrated approach linking risk assessment, investment readiness, financing design, and explainable machine learning, intended to help investors distinguish perceived from empirically supported risk, and to improve capital allocation toward resilient ventures in fragile settings.

Author contributions: Conceptualization, Sarah Njweng Chi; Methodology, Sarah Njweng Chi; Investigation, Sarah Njweng Chi; Writing - original draft, Sarah Njweng Chi; Writing - review and editing, Sarah Njweng Chi; Visualization, Sarah Njweng Chi.



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Sciforum-208661: Machine Learning in Market Risk and Model Risk Governance: A Framework for Regulatory-Compliant Adoption in Investment Fund Contexts

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The progressive displacement of classical parametric models by machine learning architectures in financial risk management presents a structural tension that remains undertheorized in the literature: as predictive accuracy improves, model interpretability and regulatory defensibility frequently deteriorate. This paper examines that tension across two interconnected domains, market risk quantification and model risk governance, with particular attention to investment fund environments operating under AIFMD and equivalent frameworks.

On the market risk side, the paper evaluates the performance of ML-native approaches, including long short-term memory networks, gradient boosting ensembles, and hidden Markov regime-switching models, against traditional Value-at-Risk and Expected Shortfall methodologies under Basel III/IV constraints. It argues that ML models offer material advantages in tail risk estimation and volatility regime detection, but introduce non-trivial validation challenges that incumbent frameworks were not designed to address.

On the governance side, the paper develops a model risk management framework adapted from SR 11-7 and EBA Guidelines on Internal Models, calibrated to the operational realities of alternative investment managers. The framework addresses model inventory, independent validation, concept drift monitoring, and explainability requirements as constituent pillars of a second-line-of-defense posture.

The contribution is twofold: a structured methodology for risk-adjusted ML model adoption in market risk, and a governance architecture that renders that adoption auditable and supervisory-ready. The paper concludes that competitive advantage in next-generation risk management lies not in model sophistication per se, but in the institutional capacity to govern sophisticated models rigorously.



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Sciforum-208681: Friction, Not Magnitude: Illiquidity-Driven Mean Reversion in Crude Oil Futures

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Abstract: This study examines how market microstructure dynamics and liquidity constraints drive price anomalies across the crude oil futures term structure, specifically analyzing contracts from the near month (CL1) to the far month (CL5). By utilizing the Amihud illiquidity measure, the research systematically contrasts anomalous price behavior under extreme illiquidity regimes against periods of high market liquidity. The analysis employs daily data spanning from January 2001 to June 2006 to ensure a comprehensive evaluation across different market conditions.

The empirical findings demonstrate that extreme illiquidity shocks trigger a pronounced and statistically significant mean-reversion effect. Specifically, applying a contrarian long-only entry upon daily price declines on far-month contracts (CL5) following illiquidity-driven drops yields a 70.0% win rate and an average maximum favorable excursion (MFE) of 11.48% over a 20-day holding period. Conversely, when equivalent price declines occur within high-liquidity environments, they generate persistent downward momentum rather than a corrective reversion. Under these high-liquidity conditions, the Maximum Adverse Excursion (MAE) significantly exceeds the Maximum Favorable Excursion (MFE), resulting in a negative expected return for contrarian strategies.

Furthermore, the study identifies a distinct term structure effect regarding market efficiency: illiquid far-month contracts (CL5) retain pricing inefficiencies for substantially longer durations compared to the highly liquid and heavily traded near-month contracts (CL1). Overall, these results demonstrate that term-structure mean reversion depends conditionally on the prevailing liquidity regime rather than the absolute magnitude of the price shock alone. By isolating the impact of liquidity friction, this research establishes a rigorous quantitative foundation for developing structural arbitrage strategies in commodity futures markets.

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Sciforum-208700: Regime Effects Are Turnover Effects: Matched Controls for Conditional Portfolio Optimization

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A substantial literature reports that conditioning portfolio allocation on aninferred market regime improves risk-adjusted performance, particularly net oftransaction costs. We show that in a realistic cardinality-constrained setting themeasured effect, at all three points where such a signal can enter, is attributableto a variable the mechanism was never designed to control: how much the resultingportfolio trades.

We evaluate 32 arms on CRSP daily data from 2011 to 2024, with 30 matched seeds andfour cost levels, injecting a three-state hidden Markov signal at each point whereit can act on a mean-variance decision: the optimizer's preferences, its covarianceestimate, and its expected returns. Measured conventionally all three work, gaining+0.113, +0.388 and +0.294 Sharpe at 150 bps. Across 27 comparable arms, net-of-costperformance is ordered almost perfectly by realized turnover alone (Spearmanrho = -0.95, p = 2.1e-14), while the same correlation gross of costs isinsignificant.

We introduce a control that resolves the confound: an unconditional strategy,identical in optimizer, constraints and seeds, whose turnover penalty is solved bybisection to match the treatment's trading. Against it the regime effect is -0.069,-0.034 and -0.047 Sharpe, negative at every injection point and cost level, thesign holding in 20-27 of 30 seeds. Reseeding one arm moves Sharpe by 0.233,exceeding four of five effects measured. The finding survives solving the weightingsub-problem exactly. We do not establish that regime conditioning cannot work, butthat a turnover-matched control was necessary to find out.

Author contributions: Conceptualization, Bose Kaikini; Methodology, Dao Bui and Bose Kaikini; Software, Dao Bui and Bose Kaikini; Validation, Bose Kaikini; Formal analysis, Bose Kaikini; Investigation, Bose Kaikini; Resources, Bose Kaikini; Data curation, Bose Kaikini; Writing - original draft, Bose Kaikini; Writing - review and editing, Dao Bui and Bose Kaikini; Visualization, Dao Bui; Supervision, Bose Kaikini; Project administration, Bose Kaikini; Funding acquisition, Dao Bui and Bose Kaikini.



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Sciforum-208880: Explainable Machine Learning for Corporate Financial Distress Classification: Evidence from Albanian Enterprises Receiving the Largest State Treasury Payments

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Introduction: This study examines whether leakage-controlled and explainable machine-learning models can classify an Altman Z″-based financial-distress benchmark among Albanian enterprises receiving the largest aggregate State Treasury payments in 2024. The target is treated as an accounting-risk screen rather than an observed bankruptcy outcome.

Methods: The fixed database contains 100 enterprises, with a computable binary target for 96 firms, including 18 classified as distressed. Direct Altman components are excluded from the predictors. Penalized Logistic Regression, Random Forest, Gradient Boosting, and Support Vector Machine are evaluated through repeated stratified five-fold cross-validation with three repeats. Imputation, missing-value indicators, and scaling are fitted exclusively within the training folds, and PR-AUC is the primary evaluation metric.

Results: Random Forest and Gradient Boosting form the leading group. Gradient Boosting achieves a PR-AUC of 0.943 and balanced accuracy of 0.918, while Random Forest records a PR-AUC of 0.943, ROC-AUC of 0.986, and precision of 0.880. Support Vector Machine attains the highest recall but generates substantially more false positives. Held-out permutation importance identifies the Current Ratio as the dominant predictor, whereas Treasury-payment variables provide little stable incremental information after the accounting indicators are included.

Conclusions: Constrained tree ensembles reproduce the accounting benchmark with strong internal held-out discrimination. However, the small number of distress cases, the contemporaneous cross-sectional design, the retained-earnings proxy, and the conceptual proximity of liquidity ratios to the Altman target limit the scope of inference. The models may support preliminary professional screening, but they do not establish future bankruptcy prediction, causality, or external validity. Temporal validation against observed outcomes is required before operational use.

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Sciforum-208954: Do Macroeconomic Conditions and GDELT Financial News Sentiment Improve NIFTY 50 Forecasts? A Point-in-Time Out-of-Sample Evaluation

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Accurate forecasting of stock market indices remains highly challenging due to the non linear, noisy nature of financial time series. While recent studies demonstrate the efficacy of Long Short-Term Memory (LSTM) networks, many suffer from data leakage and fail to compare against robust baselines. This study rigorously tests whether integrating macroeconomic variables (India VIX, MIBOR, USD/INR, Consumer Confidence Current Index, Consumer Confidence Future Index, and Unemployment) and unstructured Global Database of Events, Language, and Tone (GDELT) financial sentiment can improve Nifty 50 Index predictions. Using a strictly chronological, point-in-time dataset from November 2018 to June 2026 devoid of look ahead bias, this study evaluates single-layer versus multi-layer LSTMs in predicting daily log returns. An ablation study reveals that while a single-layer LSTM (150 neurons) optimized with dropout regularisation achieves a competitive Symmetric Mean Absolute Percentage Error (SMAPE), Diebold-Mariano testing indicates the forecasts are not statistically significantly superior to a naive random walk ($p = 0.8194$). Furthermore, an out of sample trading simulation demonstrates that the model fails to overcome a 0.1% transaction cost drag, underperforming a Buy and Hold baseline. These findings underscore the semi-strong efficiency of the Indian equity market and highlight the necessity of rigorous statistical and economic validation in applied deep learning research.

Author contributions: Conceptualization, Abhishek Pandey; Methodology, Abhishek Pandey; Software, Abhishek Pandey; Validation, Abhishek Pandey; Formal analysis, Abhishek Pandey; Investigation, Abhishek Pandey; Resources, Abhishek Pandey; Data curation, Abhishek Pandey; Writing - original draft, Abhishek Pandey; Writing - review and editing, Abhishek Pandey; Visualization, Abhishek Pandey; Supervision, Abhishek Pandey; Project administration, Abhishek Pandey.



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Session 3. Blockchain and Digital Assets: Frontier Analytics

Sciforum-196062: Financial-Crime Risk in Crypto-asset Settlement: A Reading of the Enforcement Record

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Introduction: International standards for crypto-assets have treated illicit finance as a central regulatory concern since the Financial Action Task Force (FATF) extended its standards to virtual assets in 2018-19. Yet the location of residual financial-crime exposure within crypto-asset settlement remains under-specified. This paper examines whether exposure is better explained by settlement architecture and the practical reach of enforcement than by an arrangement's legal classification.

Methods: A structured documentary analysis examines 31 significant enforcement actions from January 2019 to 12 June 2026, together with FATF targeted updates, mutual-evaluation follow-ups and supervisory notices. Arrangements are coded by custody and control, contact with a regulated intermediary, anonymity-enhancing functionality, cross-border positioning, and the presence of an identifiable entity against which legal obligations can be enforced.

Results: Enforcement is concentrated on custodial intermediaries, whereas non-custodial transfer remains less amenable to instruments designed for identifiable obligors. Travel Rule legislation also exceeds operational supervision: in 2026, 91 of 109 surveyed jurisdictions had legislated, but 55 of those 91 had neither issued findings nor taken supervisory or enforcement action. The remaining enforcement-visible exposure identified in the record clusters at cross-border and offshore perimeter gaps, including transfers that do not encounter a regulated intermediary. Taken together, the findings indicate that legal classification alone does not account for the observed distribution of enforcement-visible exposure.

Conclusions: Enforcement-visible financial-crime exposure can therefore be mapped more tractably through settlement architecture and practical enforcement reach than through legal classification alone. This approach provides virtual-asset service providers with a basis for architecture-sensitive counterparty assessment and supports risk-based allocation of supervisory resources towards non-custodial, cross-border and operationally unsupervised settlement points.



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Sciforum-196897: Consumer Attention, Sentiment Asymmetry, and Cryptocurrency Payment Adoption

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Introduction: Cryptocurrency is heavily traded, but its use as a routine payment instrument is still uneven and difficult to observe with public data. This study examines whether search attention and social-media sentiment can provide early signals of cryptocurrency payment-adoption momentum. Methods: A reproducible monthly proxy panel for January 2019-June 2025 is built from payment-specific search attention, lexicon-based social-media sentiment, a normalised on-chain activity proxy, and a broad crypto-market sentiment control. The analysis uses first differences, one- to four-month Granger-predictability tests, a reduced-form VAR model, and sentiment-regime comparisons. Results: Search attention contains stable predictive information for later payment activity. In the pilot panel, the null that search attention does not Granger-predict transaction activity is rejected at all four lags, including lag 1 ($F = 9.08$, $p = 0.004$). Sentiment is less convincing as a standalone linear predictor, but it is informative as a downside-risk regime. Mean payment activity is much lower during negative sentiment months than during positive months (95.85 versus 103.39), while positive and neutral months are relatively close. Conclusions: The results suggest that search attention helps identify adoption windows, whereas negative sentiment works mainly as a trust brake. The contribution is a transparent, public-data-compatible workflow for monitoring digital-asset payment adoption. Because the panel is a proxy rather than merchant-level payment evidence, the findings should be read as diagnostic and predictive rather than causal.



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Sciforum-202154: Energy Risk and Bitcoin Valuation Across Protocol-Defined Regimes

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This study examines Bitcoin valuation within a regime-dependent framework that combines macro-financial conditions, investor attention, and energy-related drivers. We develop a semi-structural representation in which Bitcoin market capitalization is linked to an equilibrium-consistent set of fundamentals. The analysis is conducted separately across four halving regimes, allowing the valuation mapping to evolve with Bitcoin's protocol and market maturation. Long-run relations are estimated using Dynamic Ordinary Least Squares (DOLS) as a linear benchmark and complemented by XGBoost as a flexible nonlinear in-sample approximator. In the short run, residual-based valuation gaps are incorporated into an error-correction framework to assess whether deviations from the estimated benchmark help explain subsequent adjustments in Bitcoin market capitalization. The results show that Bitcoin valuation is regime-dependent. Equity-market conditions provide the most stable valuation anchor across specifications, pointing to a growing integration of Bitcoin into the broader financial system. Investor attention is more relevant in the early regimes, while energy-related variables become more informative when they are linked to production-side incentives. In particular, mining profitability emerges as the strongest empirical energy-related signal. In the short run, valuation gaps display mean-reverting dynamics, and nonlinear gaps yield stronger and faster adjustment signals than the linear benchmark. Bitcoin valuation is best understood through a regime-specific framework combining macro-financial integration, protocol-driven scarcity, and miner-related incentives.



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Sciforum-206742: From On-Chain Transparency to Organisational Accountability: A Conceptual Framework for Blockchain-Enabled Reporting

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Introduction: Blockchain-enabled reporting is often assumed to strengthen organisational accountability because distributed ledgers make transactions visible, traceable, and resistant to retrospective alteration. This assumption overlooks a central distinction: a technically transparent record does not necessarily identify responsible actors, establish economic substance, explain organisational decisions, or support enforceable consequences. This study examines how blockchain evidence is converted into organisational accountability.

Methods: The study adopts a qualitative theory-building design based on integrative conceptual analysis. It synthesises research on organisational transparency, accountability, information asymmetry, institutional theory, auditability, and blockchain-enabled reporting. Through iterative comparison and conceptual coding, the analysis distinguishes the evidential properties of distributed ledgers from the institutional conditions required for answerability, contestation, and sanction.

Results: The study develops a four-stage accountability conversion framework comprising data visibility, data verifiability, interpretability, and accountability. It introduces the ledger accountability gap, defined as the distance between cryptographically supported evidence and institutionally enforceable responsibility, and accountability conversion capacity, defined as the organisational and field-level ability to connect ledger records with identities, accounting meanings, governance processes, legal obligations, and credible assurance. Six theoretical propositions specify how disclosure relevance, data origination controls, semantic interpretation, role attribution, contestation rights, and assurance scope shape accountability outcomes.

Conclusions: Blockchain transparency should be treated as an evidential input rather than as accountability itself. Organisational accountability emerges only when visible and verifiable records become interpretable, attributable, challengeable, and consequential. The framework extends transparency and accountability theory, clarifies the changing role of assurance, and provides a foundation for qualitative studies of blockchain reporting, tokenised assets, and distributed governance.



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Sciforum-207574: Crypto-Asset Trading Risk Governance

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This paper examines crypto-asset trading risk as a multidimensional governance problem within digital financial platforms. It combines a governance-oriented risk framework with empirical evidence derived from daility market data for Bitcoin, Ethereum, Binance Coin and the S&P 500 over the 2020-2025 period. The empirical design integrates descriptive risk indicators, maximum drawdown measures, correlation analysis, event-window analysis surrounding the Terra-Luna collapse, the FTX failure and major MiCA regulatory milestones, and GARCH (1,1) volatility modelling. The findings demonstrate that crypto-assets exhibit substantially higher volatility and deeper drawdowns than the equity-market benchmark, alongside pronounced volatility clustering, persistent conditional variance and event-sensitive downside reactions. Correlations among crypto-assets are generally stronger than their correlations with the S&P 500, indicating limited diversification benefits during period od market stress. The paper contributes to management and platform-governance research by translating market technological, operational, regulatory and behavioral risks into concrete implications for exchanges, custodians, investors and regulators. The results support transparent custody and segregation rules, standardized risk disclosure, continuous volatility and liquidity monitoring, stronger cybersecurity and compliance systems, effective incident-response mechanisms, and targeted investor education. These measures are particularly important as regulatory frameworks such as MiCA seek to improve market integrity, accountability and investor protection without constraining financial innovation.



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Sciforum-208484: Risk Propagation Mechanisms in Decentralized Finance: A PRISMA-Based Systematic Review

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Introduction: Decentralized finance (DeFi) has developed into an interconnected financial ecosystem built on smart contracts, decentralized exchanges, lending protocols, stablecoins, governance mechanisms, price oracles, and cross-chain bridges. Although prior studies identify individual DeFi risks, less attention has been paid to how local failures propagate across protocols and become systemic.

Methods: This study conducts a PRISMA-based systematic literature review of DeFi risk-propagation mechanisms. A total of 76 candidate records were identified, of which 50 studies were retained for qualitative synthesis. The studies were coded according to risk source, transmission channel, amplification mechanism, systemic outcome, and mitigation response.

Results: Seven major risk domains were identified: smart contract risk, oracle risk, liquidity and lending risk, governance and DAO risk, cross-chain bridge risk, stablecoin and depeg risk, and composability-based systemic risk. The findings show that DeFi risks rarely remain isolated. Smart contract exploits, oracle manipulation, liquidation cascades, governance capture, bridge failures, and stablecoin depegging can spread through shared infrastructure, collateral dependencies, automated execution rules, liquidity pools, wrapped assets, and composable protocol interactions. Automation, leverage, common collateral, and infrastructure concentration can amplify these shocks and transform protocol-level failures into ecosystem-wide stress.

Conclusions: The review develops a mechanism-based taxonomy of DeFi risk propagation and shifts analysis from static risk classification toward a dynamic explanation of contagion. It also identifies priorities for future research, including real-time on-chain systemic-risk monitoring, oracle-liquidation feedback loops, DAO governance capture, bridge contagion, and stablecoin depeg transmission.



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Sciforum-208686: Blockchain Technology for Transparency and Fraud Prevention in Supply Chain Management among Food, Beverages and Tobacco manufacturing companies in Nigeria

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Supply-chain fraud and inadequate transparency remain significant governance challenges for manufacturing firms operating through complex inter-organisational networks. This study examines the relationships among technological, organisational and environmental conditions, blockchain adoption, supply-chain transparency and fraud-prevention capability among food, beverage and tobacco manufacturing firms registered with the Manufacturers Association of Nigeria (MAN) in Lagos, Nigeria. The study adopted a cross-sectional quantitative survey design, anchored on the Technology–Organisation–Environment (TOE) framework. Twelve firms were purposively selected from the MAN directory, with eligible managers in supply-chain, procurement, logistics/warehouse, inventory, ICT/compliance and operations functions participating. Using Cochran's (1977) formula for an infinite population, 389 questionnaires were administered, of which 384 were validly retrieved, representing a 98.7% valid response rate. Multiple regression analysis was conducted using SPSS Statistics Version 29. Technology (β = 0.631, $p < 0.001$) and Environment (β = 0.128, p = 0.006) were positively associated with blockchain adoption, whereas Organisation was statistically insignificant (β = 0.073, p = 0.127). The TOE model explained 55.0% of observed variance in blockchain adoption. Blockchain adoption was positively associated with transparency (β = 0.558, R^2 = 0.311, $p < 0.001$), while blockchain adoption (β = 0.305) and transparency (β = 0.419) jointly explained 41.1% of observed variance in fraud-prevention capability ($p < 0.001$). The study concludes that technological and environmental conditions are significant predictors of blockchain adoption, while blockchain adoption and transparency are positively associated with fraud-prevention capability. Manufacturing firms should adopt blockchain, strengthen supply-chain transparency and improve fraud-control systems with appropriate regulatory support.



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Session 4. Data Capitalization: Reconstructing Economic Valuation

Sciforum-172848: Digital Financial Inclusion and Working Capital Efficiency in Indian MSMEs: Evidence from a Survey Based Empirical Study

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The digital financial inclusion has also changed the way micro, small and medium enterprises (MSMEs) access financial services, but there is little empirical evidence that defines how financial inclusion translates into performance gains at the firm level. This paper will look at whether digital financial inclusion positively impacts the financial performance of firms by improving their working capital efficiency of Indian MSMEs. Based on the financial intermediation theory, transaction cost economics, and liquidity management theory, the paper offers a mediation model according to which digital financial inclusion enhances liquidity efficiency, which in turn leads to performance outcomes. The primary survey data was obtained from 300 MSMEs in the manufacturing, retail, and service industries in India. Exploratory factor analysis, correlation analysis, multiple regression, and bootstrapped mediation testing were used to analyse the data. The findings reveal that working capital efficiency (β = 0.54, $p < 0.001$) is considerably improved by digital financial inclusion, and working capital efficiency (0.62, $p < 0.001$) is also a strong predictor of the financial performance of a firm. Mediation analysis proves that liquidity optimisation takes place as the key transmission mechanism between digital financial inclusion and financial performance, and a partial mediation takes place. The entire model has a performance variance of 44 percent, which means that its explanatory power is large. The results add to the digital economy literature because they determine that the operational liquidity efficiency is the main conduit through which digital finance boosts MSME performance. At the management level, the research highlights the need to ensure that digital financial adoption is matched with organised working capital policies that would achieve quantifiable financial benefits.



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Sciforum-175851: Carbon Exposure, Disclosure, and Investment: A TSVF-Based Asset Pricing Study

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Introduction: Traditional asset pricing methods do not properly account for the forward-looking risks associated with a transition to a low-carbon economy. While size, value, profitability, and investment characteristics are used by multifactor frameworks to explain expected returns, they ignore systematic valuation effects carried due to carbon exposure, green capital allocation, and climate disclosure transparency.

Methods: This study uses an asset pricing framework for Indian stocks to capture firm-level climate transition sensitiveness using a new composite risk factor named the Transition-Sensitive Valuation Factor (TSVF). We formulate an enhanced asset pricing model that incorporates TSVF parameters— Carbon Intensity (CI), Climate Disclosure Score (CDS), and Green Capital expenditure (GCapex) —alongside conventional risk factors. We analyze whether TSVF have an impact on firm valuation (Tobin's Q and M/B ratio) and whether transition preparedness is systematically priced using Fama–MacBeth cross-sectional estimations within CAPM, Fama–French three-factor (FF3), and five-factor models (FF5), as well as portfolio-level time-series regression. 450 firm-year observations from 75 BSE 100 ESG non-financial companies during 2014-2024 is considered.

Results: Through panel regression, CI was inversely related with Tobin's Q and M/B ratio and CDS and GCapex positively connect with firm value and Tobin's Q. Moreover, incorporating TSVF enhances model fit and lowers abnormal returns. Portfolios sorted by transition sensitiveness reveal a consistent pattern in climate betas with a significant positive risk premium. Factor spanning tests indicate TSVF contains unique pricing information beyond traditional factors. High-Minus-Low TSVF portfolio spread yields an annualized premium comparable to established size and value effects. Finally, the GRS test implies that augment TSVF five factor model have greater explanatory power than traditional models.

Conclusion: These results suggest that climate transition sensitiveness is a significant systematic risk factor in the Indian equity market, linking sustainability reporting and multifactor asset pricing theory.



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Sciforum-182576: Advancing Financial Literacy. Enhancing Knowledge, Behavior, and Resilience in a Digital Era

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This study examines the role of financial literacy in shaping financial behavior and enhancing individual financial well-being in an increasingly complex and digital financial environment. Financial literacy goes beyond understanding basic concepts; it encompasses the ability to apply knowledge effectively in decision-making related to budgeting, saving, investing, and debt management. Using a qualitative and conceptual research methodology, this study synthesizes existing academic literature, theoretical frameworks, and empirical findings to explore how financial knowledge translates into responsible financial behavior.

The analysis is grounded in key theoretical perspectives, including the Financial Capability Model, Behavioral Finance Theory, the Theory of Planned Behavior, and the Life-Cycle Hypothesis. These frameworks collectively explain the interactions among financial knowledge, psychological biases, and socio-economic factors in influencing financial decisions. The findings indicate that individuals with higher levels of financial literacy are more likely to engage in systematic saving, prudent borrowing, informed investment, and overall effective financial management. However, financial knowledge alone is insufficient, as behavioral biases such as overconfidence, loss aversion, mental accounting, and present bias can hinder optimal decision-making.

The study further highlights the critical role of digital financial tools and emerging technologies in expanding access to financial education and promoting financial inclusion. It identifies significant disparities in financial literacy across demographic groups, emphasizing the need for targeted, culturally sensitive, and inclusive educational strategies. Policy implications include integrating financial education into formal school curricula, expanding community-based programs, and leveraging digital platforms to enhance financial capability at all life stages.

By synthesizing multiple theoretical perspectives and empirical evidence, this study contributes to understanding the dynamic interplay between financial knowledge, behavioral factors, and digital tools in shaping financial behavior. Overall, enhancing financial literacy is essential for fostering individual financial resilience, reducing socio-economic inequality, and supporting long-term economic stability at both personal and societal levels.



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Sciforum-193316: Data Capitalization and Valuation Paradigm Shift: A Dynamics Model of Valuation Regime Transition

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Independent Researcher

Data capitalization redefines industrial asset boundaries and triggers cross-market valuation regime shift, as non-rival, scalable data assets create unique data control premium (DCP) unrecognized by traditional DCF valuation. Existing literature overlooks systemic market-wide valuation restructuring, ignores omitted variable bias from industrial competition and macro interest cycles, and lacks standardized cross-industry valuation shift indicators. This paper constructs a Valuation Paradigm Transition Dynamics (VPD) model to unpack the formation of DCP and dynamic valuation transition, integrating core economic theories including RBV, surveillance capitalism and Schumpeterian industrial organization theory. We employ a 2018–2025 global panel dataset covering 34,296 firm-year observations across 4,287 firms from 36 countries. Industrial fundamental value is measured via purified DCF with explicit data-driven cash flow exclusion rules; Regime Change Index (RCI) is z-score standardized after industry-specific PCA for cross-sector comparison. We adopt 2SLS to fix endogeneity, add HHI (industry concentration) and real interest rate as omitted controls, insert quadratic DAI to test inverted-U DCP relation, and run mediation analysis for data governance investment (DGI).Regression confirms DCP explains 37.8% of valuation divergence , while privacy risk negatively moderates DCP effects . Significant positive DAI and negative DAI^2 verify an inverted-U curve, extending Farboodi's static diminishing data return theory. Higher industry HHI lifts DCP whereas rising interest rates suppress valuation deviation; standardized RCI consistently pinpoints mid-2022 as the cross-industry transition inflection point, with DGI serving as a valid mediating transmission channel. Data capitalization fundamentally restructures global valuation benchmarks via DCP formation. The validated VPD framework resolves prior empirical defects and clarifies the dual efficiency and anti-competitive influences of data monopoly, delivering targeted references for investors, accounting standard-setters and cross-border data regulators.



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Sciforum-194577: Capitalizing Data in the Digital Economy: Canada's Experience with Digital Supply-Use Tables

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The digital economy challenges traditional national accounts because free digital services and data assets are not fully captured in GDP. The OECD's Digital Supply-Use Tables (SUTs) offer a framework to measure digital industries, products, and transactions. Canada is one of the pioneers in implementing Digital SUTs. This paper examines how Canadian experimental estimates contribute to data capitalization, i.e., the valuation of data as a productive asset.

We analyze Statistics Canada's Digital SUTs for 2017-2019, which follow OECD guidelines. The methodology distinguishes digitally enabling industries, fee-based intermediary platforms, data-driven platforms (e.g., social media), e-tailers, and firms dependent on intermediaries. Products include ICT goods, cloud computing, digital intermediary services, and free digital services. Data assets are valued using a cost-based approach (labour, intermediate consumption, capital services) for in-house production.

Canada's digital industries accounted for about 5.5% of GDP in 2019. Experimental estimates of data investment range from 0.4% to 0.6% of GDP (2018), with an average annual growth of 3-4%. The net stock of data assets reached CAD 105-151 billion in 2018. However, free digital services (social media, search engines) remain outside the SNA production boundary, implying that consumer welfare benefits are still missing from official aggregates.

Canada's Digital SUTs provide a replicable template for data capitalization. Cost-based valuation is feasible, but cross-country harmonization and better treatment of free services are needed. Future research should integrate machine-learning-based imputation for missing prices and extend satellite accounts for household-produced digital leisure services. These findings support the reconstruction of economic valuation in the digital age.



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Sciforum-203422: Modelling the European Carbon Market. Calculating the Value-at-Risk of a Portfolio of Energy Indices

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As the global energy sector undergoes a structural transition, the integration of renewable assets with traditional fossil fuel commodities has introduced complex risk dynamics into investment portfolios. This study examines the market risk characteristics of a diversified energy portfolio comprising traditional oil and gas (XLE), natural gas (FCG), and clean energy (ICLN) indices over the volatile period from January 2021 to January 2024. While prior studies typically assess energy risk using a single volatility model in isolation, this paper contributes to the literature by directly comparing two dynamic Value at Risk (VaR) methodologies within a unified multi-asset framework: a parametric Multivariate GARCH(1,1) model with Student-t innovations, and a semi-parametric Historical Simulation ARMA-Forecasting (HSAF) approach. This design isolates the conditions under which theoretical distributional assumptions diverge from empirical return behavior, an aspect largely unaddressed in existing literature.

Preliminary diagnostics reject the hypothesis of normality, revealing significant negative skewness and excess kurtosis across all three indices. The estimated GARCH parameters indicate a high degree of volatility persistence, suggesting a prolonged half-life for market shocks, while diversification is shown to reduce extreme tail risk without eliminating the non-normal character of the portfolio's return distribution.

The results reveal a meaningful divergence between the two risk measures: the parametric Student-t model produces a notably more conservative VaR estimate than the semi-parametric HSAF method, which relies on the empirical distribution of filtered residuals rather than a symmetric theoretical structure. Backtesting via the Kupiec Proportion of Failures test validates the robustness of the semi-parametric approach in capturing idiosyncratic market jumps without overestimating losses. Practically, these findings give portfolio managers and risk officers an evidence-based basis for choosing between competing VaR frameworks when setting capital reserves, showing that hybrid methodologies combining volatility filtering with historical simulation deliver more efficient, defensible tail-risk estimates than standard parametric approaches alone.



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Sciforum-204354: Digital Education, Labour Force Transformation, and Sustainable Financial Development

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The accelerating pace of digital transformation is reshaping education systems, labour markets, and financial sectors, creating new opportunities and challenges for sustainable economic development. As economies transition toward knowledge- and technology-driven models, digital education has emerged as a critical instrument for developing the competencies required to meet evolving labour market demands and support resilient financial systems. However, the mechanisms through which digital education contributes to sustainable financial development remain insufficiently explored, particularly the mediating role of labour force transformation.

This study proposes a conceptual framework that examines the relationships among digital education, labour force transformation, and sustainable financial development. Drawing on Human Capital Theory, Endogenous Growth Theory, and Digital Transformation Theory, the research argues that investments in digital education enhance workforce digital competencies, foster labour market adaptability, and promote innovation, thereby strengthening financial inclusion, financial efficiency, and sustainable financial market development. Labour force transformation is conceptualized as the primary transmission mechanism linking educational investments to financial outcomes.

The expected findings indicate that digital education positively influences labour force transformation by improving digital skills, human capital, and workforce productivity. In turn, labour force transformation is anticipated to enhance sustainable financial development through increased financial inclusion, technological innovation, digital financial services, and more efficient capital allocation.



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Sciforum-205495: Revisiting Financial Development: From Financial Depth to Financial Efficiency

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Introduction: Financial development has traditionally been assessed through financial depth, commonly measured by indicators such as private credit, bank assets, and market capitalisation. However, a larger financial system does not necessarily imply greater efficiency. While previous studies have focused primarily on financial depth, limited attention has been given to financial efficiency as a distinct dimension of financial development. This study addresses this gap by examining whether greater financial depth translates into higher financial efficiency across selected European economies, thereby providing new evidence on the relationship between the size and effectiveness of financial systems.

Methods: The study employs a balanced panel dataset covering selected European economies from 2004 to 2025, using data obtained from internationally recognised databases. Financial efficiency is measured using the Financial Development Efficiency Index from the IMF Financial Development Database. The empirical analysis applies Ordinary Least Squares (OLS), Fixed Effects (FE), and Random Effects (RE) estimators, supported by standard panel-data diagnostic tests to identify the most appropriate model specification.

Results: The empirical findings reveal a positive and statistically significant relationship between financial depth and financial efficiency across the estimated models, indicating that deeper financial systems tend to allocate financial resources more efficiently. In addition, macroeconomic conditions explain an important share of cross-country variation in financial efficiency, highlighting the role of broader economic fundamentals.

Conclusions: This study contributes to the financial development literature by shifting attention from financial depth to financial efficiency and by distinguishing between the size and effectiveness of financial systems. The findings suggest that financial development should be evaluated not only by the expansion of financial resources but also by the efficiency with which they are allocated and utilised. These results provide useful implications for policymakers seeking to strengthen financial system performance and resilience in an increasingly digital economy.



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Sciforum-207592: Analysis of the Impact of Revenue Structure on Amazon Platform Share Prices

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Amazon originated as a digital platform in the online retail industry but rapidly expanded into multiple sectors, creating a complex platform ecosystem. While previous studies have extensively examined Amazon's business model and financial performance, limited attention has been paid to how changes in its revenue structure relate to the long-term dynamics of its share price. This paper addresses this gap by investigating the relationship between Amazon's evolving revenue composition, key financial performance indicators, and stock price trends. The study employs a longitudinal financial analysis covering fourteen years. It examines changes in the corporation's revenue structure, with particular emphasis on Gross Profit and Net Service Sales, and compares these indicators with the long-term movement of Amazon's share price. The analysis focuses on the characteristics of the platform economy, especially the role of zero marginal cost effects in supporting sustainable growth. The findings demonstrate the exceptional stability of Amazon's operations, reflected in the continuous growth of total revenues, Net Service Sales, and Gross Profit. The results further indicate that the company's share price closely follows these positive revenue trends, suggesting that the evolution of its revenue structure is associated with long-term market valuation. The study contributes to the literature on platform economics by providing empirical evidence on the relationship between revenue structure and stock performance in a leading digital platform ecosystem.

Author contributions: Conceptualization, Joško Lozić; Methodology, Joško Lozić; Formal analysis, Katerina Fotova Čiković; Data curation, Katerina Fotova Čiković; Writing - original draft, Antonija Mandić; Supervision, Antonija Mandić.



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Sciforum-208394: From Digitalization to Customer-Based Value in Tourism: The Mediating Role of Personalized Experience

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Introduction: Digital investments in tourism create economic value only when they translate into customer-relevant outcomes. This study examines whether personalized tourism experience statistically mediates the association between perceived digitalization and behavioral loyalty intentions, conceptualized as retention-related indicators rather than direct measures of financial performance.

Methods: A cross-sectional survey was conducted with 419 Romanian adults who had recent post-pandemic travel experience. Participants were recruited through convenience and snowball sampling. Perceived digitalization, personalized tourism experience, and revisit intention and recommendation behavior were modeled as reflective latent constructs. Confirmatory factor analysis, structural equation modeling, and bias-corrected bootstrapping with 5,000 resamples were performed in AMOS.

Results: Perceived digitalization was positively associated with personalized tourism experience ($\beta = 0.630$, $p < 0.001$), which was positively associated with behavioral loyalty intentions ($\beta = 0.485$, $p < 0.001$). The conditional direct association between perceived digitalization and loyalty intentions remained significant ($\beta = 0.228$, $p < 0.001$). The standardized indirect effect was $\beta = 0.305$, 95% BC CI [0.221, 0.414], supporting partial mediation. The model explained 39.7% of the variance in personalization and 42.6% of the variance in loyalty intentions.

Conclusions: The findings indicate that digitalization is more strongly connected with customer-based value when tourists experience digital service processes as adaptive, relevant, and low effort. From a data-capitalization perspective, digital infrastructure alone appears insufficient; its retention-related value emerges through customer-perceived personalization across service touchpoints. The study does not estimate financial returns, actual repeat behavior, or causal effects.

Author contributions: Conceptualization, Constantina Alina Milos (Ilie); Methodology, Constantina Alina Milos (Ilie); Software, Constantina Alina Milos (Ilie); Validation, Constantina Alina Milos (Ilie); Formal analysis, Constantina Alina Milos (Ilie); Investigation, Constantina Alina Milos (Ilie); Resources, Constantina Alina Milos (Ilie); Data curation, Constantina Alina Milos (Ilie); Writing - original draft, Constantina Alina Milos (Ilie); Writing - review and editing, Constantina Alina Milos (Ilie); Visualization, Constantina Alina Milos (Ilie).



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Sciforum-208586: Valuation Governance in Data-Constrained Markets: Integrating Valuation Uncertainty into Credit Risk Analytics via an Institutional Transmission Mechanism

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Automated valuation models (AVMs) are widely used in property-backed lending to support collateral valuation and credit risk assessment (Crosby, 2000; International Valuation Standards Council (IVSC), 2020). While prior research has examined AVM accuracy, bias and predictive performance, less attention has been paid to how valuation uncertainty generated by AVMs is incorporated into institutional credit risk decisions (French and Gabrielli, 2018).

I am proposing via this paper a conceptual framework positioning valuation governance as the institutional transmission mechanism linking AVM outputs to downstream credit risk analytics, including loan-to-value (LTV) calibration, loss given default (LGD) assumptions and expected credit loss (ECL) estimation (Basel Committee on Banking Supervision, 2017; European Banking Authority (EBA), 2017).

This framework is explicitly situated at the domain level of governance within credit processes. It therefore does not attempt to diagnose macroeconomic regime shifts or enterprise-level capital strategy decisions. Domain-level governance may, however, generate signals or escalation findings that inform enterprise-level deliberations where appropriate and, it explains how valuation governance disciplines the application of collateral values in lending decisions and defines escalation pathways where valuation uncertainty exceeds defined tolerance thresholds.

The framework further suggests that the intensity of valuation governance increases in conditions characterised by market illiquidity, asset heterogeneity, or elevated valuation frequency relative to observable transaction evidence, where the signal-to-noise ratio in automated estimates is likely to deteriorate (French and Gabrielli, 2018; International Valuation Standards Council (IVSC), 2020; Basel Committee on Banking Supervision, 2017).

Keywords

Automated Valuation Models (AVMs), Valuation Governance, Credit Risk Analytics, Loan-to-Value (LTV), Property-Backed Lending, Data-Constrained Markets

Author contributions: Conceptualization, Monodeep Saha; Methodology, Monodeep Saha; Software, Monodeep Saha; Formal analysis, Monodeep Saha; Data curation, Monodeep Saha; Writing - original draft, Monodeep Saha; Writing - review and editing, Monodeep Saha.



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Session 5. Ethical AI and Financial Technology Governance

Sciforum-193418: From Explainability to Accountability: The FinTRACE-AI Framework for Algorithmic Risk Governance in FinTech

Li Zeng

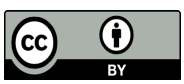
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Artificial intelligence is increasingly embedded in financial technology, particularly in credit scoring, fraud detection, anti-money laundering monitoring, robo-advisory services, and digital risk pricing. While these applications improve efficiency and expand access to financial services, they also create algorithmic risks that cannot be managed through technical explainability alone. Model opacity, biased data, discriminatory outcomes, privacy leakage, weak audit trails, third-party model dependence, and unclear responsibility for automated decisions may lead to consumer harm, credit risk distortion, reputational damage, and regulatory failure. This raises a central research question: how can FinTech governance move from explaining algorithmic decisions to assigning responsibility, enabling audit, ensuring compliance, and correcting harmful outcomes?

To answer this question, this paper develops the **FinTRACE-AI Framework**, a responsible AI governance framework for algorithmic risk in FinTech. The framework is grounded in responsible AI theory, model risk management, financial consumer protection, and accountability-based governance. Methodologically, the paper adopts a conceptual synthesis and comparative regulatory analysis, drawing on AI governance principles, banking model risk management practices, and emerging risk-based regulatory approaches to high-impact AI systems. Unlike existing explainability-centred AI governance models, FinTRACE-AI treats algorithmic risk as a full lifecycle governance problem. It links five dimensions: **Transparency, Responsibility, Auditability, Compliance, and Enforcement**. These dimensions are organised into three operational layers. The technical layer focuses on data provenance, model documentation, fairness testing, explainable outputs, robustness checks, and post-deployment monitoring. The institutional layer assigns internal responsibility through model ownership, independent validation, audit functions, human oversight, consumer protection, and redress mechanisms. The regulatory layer connects financial institutions and technology providers with algorithmic impact assessment, supervisory reporting, regulatory sandbox testing, third-party oversight, and corrective enforcement.

The framework is applied analytically to AI-based credit scoring. The paper shows how biased training data can generate financial exclusion, how opaque feature selection can weaken consumer challenge rights, how model drift can distort credit risk assessment, and how outsourced or vendor-based models can create accountability gaps. FinTRACE-AI translates these risks into concrete governance requirements, including pre-deployment bias testing, adverse impact assessment, model cards, audit trails, responsibility matrices, human review procedures, consumer explanation channels, and regulatory escalation mechanisms.

This study contributes to the literature in three ways. First, it shifts the focus of FinTech AI governance from explainability as a technical property to accountability as an institutional and regulatory process. Second, it integrates responsible AI, model risk management, and financial regulation into a single governance framework tailored to algorithmic financial decision-making. Third, it provides a practical pathway for financial institutions, regulators, and technology providers to identify, trace, audit, and correct algorithmic risks before they become systemic or consumer-protection failures. The paper therefore positions ethical AI governance as a core component of financial risk management and financial stability in the digital finance ecosystem.



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Sciforum-194495: When the Algorithm Accuses: Ethical Dimensions of AI-Driven Forensic Audit Evidence in Financial Crime Proceedings

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Introduction: Artificial intelligence and machine learning are rapidly becoming a cornerstone of forensic auditing, and their use raises a host of ethical problems that are only partially explored in the current literature. Beyond technical issues, important questions of accountability, transparency, fairness, and legal acceptability arise when algorithms identify a business or provide evidence in financial crime cases. There is no formal governance body specifically addressing these ethical issues in forensic auditing. This is an urgent need, highlighted by the EU AI Act 2024, which categorises AI systems for financial crime detection as high-risk and requires adherence from August 2026.

Methodology: The study uses a conceptual framework development methodology comprising a structured literature review of AI governance, AI explainability, AI evidence, and AI ethics from 2018 to 2026, drawing on peer-reviewed journals, regulatory publications, and legal scholarship. The study also reviews documented instances in which AI-generated forensic evidence faced objections or exclusion in financial crime cases, applying four key AI principles (EU AI Act, OECD AI Principles, IEEE Ethically Aligned Design).

Results: Five ethical fault lines were identified: the "black-box admissibility gap" (when a model's output is not sufficiently transparent); algorithmic bias (when AI has different impacts on forensic practices); the "diffusion of accountability" (when responsibility for AI systems is shared); conflicts between forensic AI data needs and GDPR privacy obligations; and "regulatory fragmentation" across jurisdictions, which can lead to "governance arbitrage". An original Ethical AI Forensic Audit Governance Framework (EAFAGF) was developed with 4 pillars: Forensic Explainability Standards, Algorithmic Fairness Auditing, Assigning Accountability, and Jurisdictional Compliance Matrix.

Conclusions: The EAFAGF provides a framework and an evidence-based toolkit for the application of ethical AI, designed for forensic accountants, financial institutions and regulators. The impact is immediate on the governance of fintech policies and the need to overhaul professional auditing standards.



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Sciforum-202538: Impact of Governance on Digital Gold Platforms in South Asia

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Rapidly growing digital platforms for gold have had an enormous effect on gold investment in South Asia, as they provide consumers with more convenient ways to invest in gold compared to traditional gold methods. Many digital platforms are highlighting how they contribute to financial inclusion, while at the same time, there are still issues with regulatory relationships, the issue of transparency, and consumer protection, and operator accountability. This study aims to look at how good governance impacts performance, credibility, and sustainability on digital gold platforms across India, Sri Lanka, and Indonesia. Secondary data sources government publications, regulatory agencies' communications, industry publications/reports, and platform disclosure. Using mixed analysis, descriptive statistics, comparative analysis to compare the relationship between governance practices and market performance, policy analysis, and content analysis of regulatory framework will be used to analyze the data. The data analysis will take place on Microsoft Excel and EViews statistical software. The study results show that better governance regulatory guidelines that are clearly defined, with effective supervisory/oversight and concise reporting, improve investors' confidence and help develop stable markets. On the other hand, if there is poor enforcement of laws, laws not being applied equally, and very little consumer education, there is a risk for operations; thus, a decline in market confidence. This study supports the need to develop coordinated regional common governance standards, develop investor education initiatives, and strengthen regulatory ability. Finally, it is concluded that good governance will help ensure transparency, consumer protection, and promote the sustainable growth of digital gold platforms within South Asia.



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Sciforum-203741: The Ethical Considerations of AI

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Artificial intelligence (AI) is applied across a wide spectrum of the economy, from financial markets to the manufacturing sector, from public administration to the labor market. While its decision-making speed, accuracy, and resource optimization capabilities create significant advantages, ethical issues and social risks also arise. For this reason, the application of AI in the economic sphere should be regulated not only within a technological, but also within an ethical and legal framework. In modern times, artificial intelligence (AI) technologies have begun to be widely applied in various sectors of the economy - financial markets, production processes, public administration and the labor market. The article argues that this process, while increasing economic efficiency, also raises serious ethical and social problems.

The use of AI in economics can sometimes lead to biased results. For example, algorithms used in credit risk assessment may be based on biased data, which can lead to discrimination in terms of gender, age and social background. This article analyses the ethical approach, according to which all economic actors should have equal opportunities and algorithmic biases should be minimized.

The article argues also the “black box” problem – the lack of understanding of the decision-making mechanisms of AI systems can reduce the trust of economic actors. The “black box” phenomenon – that is, the acceptance of the decision-making mechanisms of AI systems without explanation – is a serious risk for economic actors. Algorithms used in financial markets, government fiscal policy, or insurance systems should be explainable, and companies should be held accountable for the consequences of their decisions. Accountability mechanisms – companies and government agencies should be held accountable for the economic consequences of AI-based decisions.



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Sciforum-203774: When AI Is the Story: LLM-Based Evidence on AI Narratives, Disclosure Credibility, and IPO Performance

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Artificial intelligence (AI) has become an increasingly important aspect of the U.S. IPO market. However, it is noteworthy that investors may encounter difficulties in distinguishing issuers with concrete AI capabilities from those who primarily utilize AI as a strategic narrative. The present study investigates the impact of AI-related disclosures, both in terms of content and credibility, on IPO pricing and subsequent performance. The sample comprises U.S. IPOs completed between 2020 and 2025 and identified through Renaissance Capital's IPO Pro database. Registration statements and final prospectuses are collected from the SEC's EDGAR archive. The approach involves the application of a large language model to analyze AI-related statements in the prospectuses, and the classification of each statement according to its intensity, specificity, verifiability, and business relevance. These dimensions are then aggregated into an AI Narrative Credibility Score. Subsequently, cross-sectional models of first-day underpricing, six- and twelve-month returns, and post-IPO volatility are estimated. The specifications control for offer size, firm age, profitability, industry, market conditions, underwriter reputation, and listing-year fixed effects. Preliminary evidence suggests a link between more intensive AI narratives and stronger first-day returns. However, this association is weaker when disclosures are broad, generic, or weakly linked to identifiable products, business models, or operational capabilities. It has been demonstrated that firms which make more specific and verifiable disclosures regarding artificial intelligence demonstrate more stable aftermarket performance. Conversely, issuers which are narrative-heavy exhibit greater volatility and weaker medium-term returns. The findings indicate that investors may initially reward AI-related positioning but subsequently differentiate substantive technological disclosure from symbolic claims. The study contributes to research on AI in finance by applying LLM-based text analysis to IPO prospectuses. It also offers governance implications for issuers, underwriters, and regulators, emphasizing the importance of transparent, specific, and verifiable AI communication in capital-market transactions.



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Sciforum-204383: Modeling Agentic Crime: A Proposed ROSI Framework for Deepfake and AI-Enabled Financial Risk

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AI-enabled fraud, including deepfake-assisted identity attacks and synthetic identity schemes, is increasing pressure on financial KYC and fraud controls. To conceptualize this shift, this paper proposes the original analytical construct of "agentic crime," defined as autonomous or semi-autonomous algorithmic illicit activity operating with minimal human oversight. The objectives of this study are to define agentic crime as a distinct threat category and develop a framework to quantify its financial risk. As a proposed model term, this agentic capability may theoretically scale and automate financial fraud, compounding the institutional attack surface. Concurrently, synthetic media, particularly deepfakes, has emerged as a major and growing tactical vector for bypassing biometric identity verification protocols. As these AI-assisted schemes evolve, traditional risk management models struggle to quantify the changing threat landscape.

Methodologically, the study extends the standard Annualized Loss Expectancy (ALE) with an "agentic amplification factor," integrating it into a Return on Security Investment (ROSI) framework to model technical, procedural, and regulatory controls. Building on standard Annualized Loss Expectancy (ALE) calculations, the methodology introduces a novel "agentic amplification factor." Rather than an established metric, this design construct proposes how automation and adversarial adaptation may theoretically alter both expected loss and control value. The framework evaluates the potential mitigating effects of technical detection, procedural workflows, and regulatory controls under these modeled assumptions. Furthermore, adjustments for underreported synthetic fraud and the temporal degradation of countermeasures against evolving evasion tactics are presented as empirical calibration choices, allowing institutions to test scenarios rather than relying on factual universals.

In conclusion, this translational research bridges theoretical criminology with applied financial modeling. By proposing a framework to convert abstract AI threats into decision-ready metrics, the presentation offers fintech institutions, risk modelers, and policymakers a conceptual tool to evaluate cybersecurity investments and regulatory design against the emerging realities of AI-enabled fraud.



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Sciforum-207740: FA-HGNN: A Fairness-Aware Heterogeneous Graph Neural Network for Credit Risk Control in Small and Micro Enterprises

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Small and micro enterprises are the main players in inclusive finance, but their credit risk management has long faced real challenges like sparse data and complex risk transmission relationships. Traditional AI risk control models rely on historical data for training, which can easily reinforce group biases and worsen credit exclusion, making it hard to meet both risk detection accuracy and lending fairness. Existing research on graph neural network (GNN) risk control mostly focuses on improving model performance, paying little attention to algorithm fairness, and hasn't fully tapped into the risk transmission value of diverse connections between small and micro enterprises, such as equity, guarantees, and supply chains.

This paper builds a heterogeneous information network for small and micro enterprises that integrates equity ties, guarantee relationships, supply chain transactions, and executive cross-appointments. It proposes a fairness-aware heterogeneous graph neural network risk control model (FA-HGNN): it uses a heterogeneous graph attention mechanism to measure the risk transmission strength of different relationship types differently, while embedding group fairness constraints into a multi-objective loss function to calibrate credit biases across different groups during model training.

Empirical results based on publicly available US SBA small business lending datasets show that, compared with baseline models like GCN, GAT, and HAN, our model significantly reduces fairness biases across enterprise size and region while maintaining competitive core risk control metrics like AUC, KS, and F1. This achieves an effective balance between risk prevention efficiency and fair lending services, offering a practical technical approach and empirical support for the digital transformation of inclusive finance.

Author contributions: Conceptualization, jinyao huang; Methodology, jinyao huang; Software, Zhihui Liu; Validation, jinyao huang; Formal analysis, jinyao huang; Project administration, Zhihui Liu.



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Sciforum-208045: Ethical Governance of Artificial Intelligence and Its Impact on the Efficiency of Zakat Collection: An Empirical Study

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The rapid integration of artificial intelligence (AI) into Islamic financial services has created new opportunities to improve the governance and operational efficiency of Zakat institutions. However, empirical evidence on how ethical AI governance influences Zakat collection remains limited. This study examines the impact of ethical AI governance on the effectiveness of Zakat collection by investigating the mediating roles of perceived transparency and taxpayers' trust. Drawing on the principles of Islamic governance, Responsible AI, and Trust Theory, a conceptual model was developed and empirically tested. A quantitative research design was adopted using a structured questionnaire administered to 412 Moroccan Muslim taxpayers familiar with digital financial services. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The measurement model demonstrated satisfactory reliability and validity, while the structural model was assessed through bootstrapping procedures to test the proposed hypotheses.

The findings reveal that ethical AI governance—characterized by transparency, fairness, accountability, privacy protection, and human oversigh has a significant positive effect on the effectiveness of Zakat collection. Furthermore, perceived transparency and taxpayers' trust partially mediate this relationship, indicating that ethically governed AI systems enhance citizens' confidence in institutional Zakat management, thereby increasing their willingness to contribute through formal channels. The results also suggest that AI-enabled governance can reduce information asymmetry, improve operational transparency, and strengthen institutional credibility. This study contributes to the emerging literature on Islamic FinTech by providing one of the first empirical investigations into the role of ethical AI governance in institutional Zakat collection. It offers practical implications for policymakers, Zakat institutions, and Islamic financial organizations seeking to implement AI technologies in a manner that is ethically responsible, Sharia-compliant, and capable of improving the sustainability and efficiency of Zakat systems.



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Sciforum-208296: Systemic Vulnerabilities in Digital Finance: Assessing Governance and UPI Fraud in Rural India

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India's digital financial inclusion drive has brought millions of previously unbanked rural households into the formal payment system through the Unified Payments Interface (UPI). This expansion, however, has outpaced the ethical and governance safeguards required to protect low-literacy users, producing a paradox in which inclusion itself becomes a vector of financial harm. This study examines the structural determinants of digital fraud victimisation among rural UPI users in Uttar Pradesh, India. Primary data were collected from 214 active digital payment users in Lucknow District using a structured Hindi-language instrument, and analysed with IBM SPSS 26 for descriptive statistics and SmartPLS 4 for partial least squares structural equation modelling. Four constructs (digital literacy, scam awareness, formal education, and trust in banking institutions) were tested as predictors of victimisation. Results show that 29.5% of respondents had suffered monetary loss, with UPI phishing accounting for 66.7% of reported incidents. Scam awareness exerted the strongest protective effect, followed by digital literacy and formal education. Critically, trust in banks positively predicted victimisation, evidencing a paradox of trust in which institutional confidence induces a compliance bias that fraudsters exploit. The model explains 53.8% of the variance in victimisation. The paper argues that responsible financial technology governance must shift from adoption metrics toward protection-centred design, encompassing AI-based anomaly detection calibrated to rural transaction behaviour, mandatory plain-language risk disclosure within payment interfaces, and accountability standards that treat fraud exposure as a design failure rather than user error. Fraud vulnerability is thus a governance deficit, not an individual literacy gap.



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Sciforum-208592: Governing Risk at Machine Speed: Operationalizing Model-Risk Management, Fairness Testing, and Explainability for Machine-Learning Credit Models

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Machine learning now underwrites a growing share of credit decisions, yet governance practice has not kept pace with deployment. Model risk, fair-lending and algorithmic-bias exposure, explainability for non-technical decision-makers, and post-deployment monitoring are typically managed as separate workstreams, leaving risk and credit-policy functions without an integrated view of how automated decision systems behave in production. This paper synthesizes the model-risk-management, fair-lending, and explainable-AI (XAI) literatures with practitioner experience in fintech lending to propose an integrated governance framework spanning the machine-learning credit-model lifecycle: development, validation, deployment, monitoring, and decommissioning. For each stage, the framework specifies the decisions, controls, and evidence that keep automated lending decisions auditable and defensible — including cohort-level disparate-impact and fair-lending testing, stakeholder-differentiated explainability that serves borrowers, validators, and executives with different explanation products, and reconciliation controls that prevent automated pipelines from silently distorting the executive view of portfolio performance and loss forecasts. The central argument is that governance — not predictive accuracy — is now the binding constraint on scaling machine learning in lending: once a model clears a reasonable performance bar, its risk-adjusted value depends less on marginal accuracy gains than on whether the institution can demonstrate the absence of illegal disparate impact, explain individual decisions, and detect when the deployed system stops behaving like the validated one. The paper closes with a governance-maturity model for measuring institutional readiness and implications for credit policy and loss forecasting.



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Sciforum-208651: Responsible AI Management in Financial Regulation: Organizational Capabilities and Governance in FinTech Adoption

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Financial authorities are deploying artificial intelligence in supervisory technology, yet operational adoption remains sharply uneven. This study asks which dimensions of organizational readiness differ most between advanced economies and emerging market and developing economies. SupTech is treated as the regulatory branch of the FinTech ecosystem. A comparative secondary analysis used published tabulations from the State of SupTech Report 2025. Operational AI adoption was defined as limited deployment, widespread deployment, or full integration within SupTech applications. Readiness indicators covered senior-endorsed strategy, cloud infrastructure, internal training, formal data-science organization, and multilateral collaboration. Contingency counts were reconstructed for the two economic groups. Comparisons used percentage-point gaps, odds ratios, 95% confidence intervals, and two-sided Fisher exact tests. Benjamini-Hochberg adjustment addressed multiple comparisons, and a plus-or-minus-one-count analysis tested sensitivity to rounded percentages. Operational AI adoption was 53.0 percentage points higher among advanced-economy authorities (68.0%, 17/25) than among emerging-market and developing-economy authorities (15.0%, 16/107; OR = 12.09, 95% CI [4.47, 32.66], adjusted $p < 0.001$). Internal training differed by 26.6 points (OR = 3.68, adjusted p = 0.015), and multilateral collaboration differed by 32.1 points (OR = 3.86, adjusted p = 0.006). The absence of formal data-science capabilities was 30.7 points more common in the emerging-market and developing-economy group (adjusted p = 0.006). All four contrasts remained significant in the rounding sensitivity test. Differences in senior-endorsed strategy and cloud adoption were smaller and statistically indistinguishable. The largest disparities therefore concern workforce development, formalized analytical capacity, and international cooperation rather than strategy or cloud infrastructure. These findings identify organizational readiness gaps relevant to responsible AI governance in financial supervision. Because the source provides aggregate tabulations, the analysis does not support institution-level or causal inference.

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Sciforum-208703: Governing Agentic Finance: A Framework for EU AI Act Compliance in Autonomous Algorithmic Trading

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Large language models (LLMs) and multi-agent reinforcement learning (MARL) are enabling systems that interpret information, formulate strategies, execute trades, and manage risk. These systems create challenges involving transparency, traceability, human oversight, operational resilience, and destabilizing interactions among trading agents. This paper proposes an Agentic Compliance Architecture that translates legal obligations and governance principles into controls for LLM-enabled, MARL-based trading systems. The paper does not assume that trading agents are categorically classified as high-risk systems under the European Union Artificial Intelligence Act (EU AI Act). Applicability depends on intended purpose and deployment context. For systems falling within the high-risk framework, the architecture maps requirements under Articles 9, 12, 13, 14, and 15 to controls; where provisions are not directly binding, principles are treated as normative governance-by-design requirements. The analysis also considers DORA requirements applicable to financial entities, particularly ICT risk management, operational resilience, monitoring, and resilience testing. The empirical design uses a simulated electronic market with 20 agents across five strategies, five equity instruments, and five market regimes. Thirty replications for each condition-regime combination yield 300 simulation runs. For each strategy type, two agents operate without the compliance layer and two agents use the trading process with pre-trade risk limits, decision logging, explanation requirements, human-intervention thresholds, and compliance monitoring. Performance is evaluated using Sharpe ratio, maximum drawdown, profitability, volatility, transaction costs, and execution latency. Governance is operationalized through explanation quality, traceability coverage, intervention responsiveness, and compliance-violation rates. Systemic-risk dynamics are proxied using volatility stress, liquidity deterioration, price dislocation, cross-agent return correlation, drawdown contagion, and cascading-loss events, forming a Systemic Risk Index. The framework tests whether governance controls reduce compliance violations and agent destabilization while preserving performance and execution speed. The study provides a design for evaluating trade-offs between trading performance and responsible AI governance without completed findings.

Author contributions: Conceptualization, Puneet Redu and Mohit Bhandari; Methodology, Puneet Redu and Mohit Bhandari; Validation, Puneet Redu and Mohit Bhandari; Formal analysis, Puneet Redu and Mohit Bhandari; Investigation, Puneet Redu and Mohit Bhandari; Resources, Puneet Redu and Mohit Bhandari; Data curation, Puneet Redu and Mohit Bhandari; Writing - original draft, Puneet Redu and Mohit Bhandari; Writing - review and editing, Puneet Redu and Mohit Bhandari; Supervision, Puneet Redu; Project administration, Puneet Redu.



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Session 6. Emerging Tech Convergence: Future Financial Infrastructure

Sciforum-156043: Mobile Financial Service: Enhancing the Inclusion for the Informal Workers in Dhaka, Bangladesh

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Financial services through a cell phone are changing the way people in developing countries handle their money. In Bangladesh, mobile banking is an important instrument to support financial inclusion of informal workers mainly in Dhaka s North City Corporation. There is a substantial amount of literature on the factors affecting mobile banking adoption among farmers, rural households, micro-businesses (M-Business) and SMEs. Based on information gathered through 300 respondents, the study employs descriptive and econometric analyses (Logistic Regression and Perception Index) to pinpoint possible drivers of mobile banking adoption. It also takes into account socio-economic factors such as age, sex, education level, income, number of people in the household and occupation. The results reveal that age, education, household size and income are positively related to adoption but gender, marital status and number of dependents have no effect. Evening out mobile banking — half of informal workers use mobile banking, but they are more likely to use it for transactions than savings which also suggests limited long-term financial engagement. The study concludes that mobile banking can enhance financial security and savings, but such barriers as digital illiteracy, fear of fraud and lack of awareness prevent more widespread use. The research emphasizes the need for tailored financial education programmes, design of intuitively simple user interfaces and trust-building measures by policymakers, NGOs, mobile providers to increase financial inclusion and support sustainable economic growth among urban informal workers in Bangladesh.



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Sciforum-187623: TAP-i: A Prototype Platform for AI-Assisted Bank Guarantee Processing in Emerging Markets

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Bank guarantee processing in emerging markets remains a document-intensive and largely manual workflow, relying on source documents, internal templates, standard clauses, and specialist judgment. This creates operational inefficiencies, duplicate data entry, and risks of inconsistency or human error. In smaller and highly competitive financial markets, service quality and response speed are critical differentiators.

Drawing on business process reengineering processing, this study positions TAP-i as a prototype-based conceptual model for redesigning document-intensive bank guarantee workflows through structured data capture, reusable templates, rule-based validation, AI-assisted drafting, and human-in-the-loop control. The platform concept is based on a practice-based analysis of guarantee workflows, recurring guarantee types, standard data fields, and validation requirements. TAP-i is designed to allow users to select the relevant guarantee type and choose between paper-format wording and SWIFT-based guarantee preparation.

The prototype demonstrates how selected steps in bank guarantee processing could be supported through AI-assisted and rule-based functionality. TAP-i is intended to extract information from source documents, such as pro-forma invoices or contracts, generate draft guarantee wording, and present the output for maker validation. Once confirmed, it would automatically generate the customer application together with the guarantee text. The platform is also intended to support amendment generation and assist in reviewing demands received under guarantees by checking formal requirements, deadlines, guarantee references, claimed amounts, and consistency with guarantee terms.

The study contributes to the discussion on digital transformation in trade finance by showing how business process reengineering, intelligent document extraction, and human-in-the-loop can be combined in a controlled guarantee-processing workflow. Although focused on bank guarantees, TAP-i provides a foundation for future extension to documentary credits and other trade finance instruments. For emerging-market banks, the prototype offers a lightweight and adaptable model for improving efficiency, auditability, service speed, and client relationship management.



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Sciforum-200596: Leapfroggning Legacy Finance: Fintech Infrastructure Transformation in Central Asia (Evidence from Uzbekistan and Kazakhstan)

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Countries without a well-established financial infrastructure find themselves in an atypical situation: technological convergence transforms the lack of legacy systems from a structural disadvantage into a competitive advantage. Central Asia is building a new generation of financial systems from scratch, being at the intersection of competing payment architectures: e-CNY, SWIFT and emerging CBDC initiatives. A comparative analysis of two fundamentally different strategies in a single region makes a significant contribution to the global debate on decentralization and technological convergence of financial infrastructure.

The study is based on a comparative analysis of data from the central banks of both countries, the IMF and the World Bank for 2017-2025. For a structured comparison, the author's Financial Infrastructure Convergence Index has been introduced, covering the digitalization of payments, the depth of the credit market, regulatory readiness for CBDC and DeFi, cross-border integration and sustainability of financing.

Kazakhstan and Uzbekistan are moving in different ways. The first one builds an institutional model through a specialized financial jurisdiction and developed capital markets. The second one demonstrates high-speed leapfrogging — the rapid formation of a retail fintech ecosystem with an institutional base still being formed. Both countries face the same structural limitation: the lack of a regulatory sandbox blocking next-generation DeFi protocols and services. The geopolitical fragmentation of global payment systems turns this barrier into a strategic issue and at the same time opens a window for the formation of an independent Central Asian payment corridor.

The study offers a roadmap for regional convergence: compatible CBDC standards, DeFi integration into the regulatory environment, a single Open Banking API, and a harmonized ESG taxonomy. The Kazakh and Uzbek models represent complementary trajectories rather than alternative ones. Their convergence forms the basis for building a new generation of regional financial infrastructure, without the structural constraints typical of mature markets.



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Sciforum-203364: Issuance Design and Benchmark Accumulation in Sovereign Green Bond Markets: Evidence from Canada

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This paper examines how legally and credit-equivalent sovereign bonds can develop different benchmark roles within the same government bond market. Existing research on sovereign green bonds mainly focuses on yield differentials and green premia, but pricing equivalence does not necessarily imply benchmark-role equivalence. Using the Canadian sovereign bond market as the empirical setting, this study analyses benchmark formation as an observable issuance-based accumulation process. The analysis uses bond-level issuance-event data and compares outstanding amounts with published benchmark target ranges across maturity segments. The results show that conventional Government of Canada bonds systematically accumulate toward benchmark scale, with clear heterogeneity across maturity buckets. Green and conventional bonds do not show statistically robust differences in relative convergence dynamics, but descriptive issuance-design evidence suggests that green bonds remain smaller in absolute scale, with lower initial issue sizes, fewer reopenings, and lower final outstanding amounts. The Danish twin-bond framework is used as an institutional contrast, showing how green bond integration can be supported by design when financial characteristics and liquidity access are aligned. The findings suggest that sovereign green bond market integration depends not only on investor demand or pricing, but also on issuance strategy, reopening intensity, and benchmark-scale accumulation. The paper contributes to sovereign debt management and sustainable finance by showing that green bond programmes should be evaluated not only through greenium evidence, but also through their ability to build benchmark market function.



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Sciforum-203435: Sustainable Future Fnancial Infrastructure: Empowering Micro, Small, and Medium Enterprises (MSMEs)

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Micro, Small, and Medium Enterprises (MSMEs) constitute over 90% of global businesses, employ half the world's workforce, and drive significant economic growth - yet they remain underserved by financial systems designed for larger corporations. As the global community confronts interconnected challenges of inequality, and economic resilience, MSMEs are both critical to delivering sustainable development and uniquely vulnerable to unsustainable practices. This paper presents a comprehensive framework for sustainable future financial infrastructure tailored to empower MSMEs, integrating environmental stewardship, social equity, and economic viability into core system design.

Drawing on case study from emerging and developed economies, the research analyzes current barriers including limited access to sustainable finance, high transaction costs, lack of tailored tools, and fragmented systems. It proposes five interconnected components: digital enabling platforms, simplified sustainability metrics for small businesses, collaborative finance networks, supportive regulatory frameworks, and integrated capacity building. The analysis demonstrates that such infrastructure not only addresses MSME needs but also creates value for financial institutions, and society at large.

The paper concludes that transitioning to sustainable financial infrastructure for MSMEs requires cross-sector collaboration, targeted investment in pilot initiatives, and policy reforms that align financial incentives with long term sustainability goals. By centering MSMEs in the design of future financial systems, hopefully we can build an inclusive, resilient economy that advances both business prosperity and well being.



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Sciforum-203621: “Strategic Funding Models for Financial Sustainability of Private Universities in India: A Systematic Review”

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Objectives: To systematically identify, evaluate, and synthesize evidence on strategic funding models adopted by private universities in India and assess their contribution to financial sustainability and long-term institutional resilience.

Eligibility Criteria: Peer-reviewed studies published in between 2015 and 2026 addressing strategic funding models, revenue diversification, financial management, or financial sustainability in Indian private universities etc.

Information Sources: Literature was searched in Scopus, Web of Science, ERIC, ScienceDirect, Google Scholar, and ProQuest. The final search was conducted in July 2026

Risk of Bias: The methodological quality of included studies was independently assessed by two reviewers using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist. Disagreements were resolved through consensus.

Synthesis of Results: A narrative synthesis was performed due to heterogeneity in study designs, outcome measures, and institutional contexts.

Included Studies: Twenty-seven studies met the inclusion criteria after screening and quality assessment. The studies included qualitative, quantitative, and mixed-method research conducted across private higher education institutions in India.

Synthesis of Results: Evidence indicates that revenue diversification through industry partnerships, research grants, consultancy services, executive education, alumni contributions, endowment funds, and digital learning initiatives significantly enhances financial sustainability. Universities relying primarily on tuition fees were found to be more financially vulnerable.

DISCUSSION – Limitations of Evidence: The review was limited to English-language publications and studies conducted in India. Variations in research design and outcome measures limited quantitative comparison across studies.

DISCUSSION – Interpretation: Strategic funding models play a vital role in improving the financial sustainability of private universities. Diversifying revenue sources and strengthening industry collaboration can reduce financial dependence on tuition fees and support long-term institutional growth. Future research should evaluate the effectiveness of these models across different institutional contexts.

Funding: No external funding was received for this study.

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Sciforum-203875: Smart and Secure: Leveraging AI-Blockchain Convergence to Transform Banking Infrastructure

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Introduction: This study examines how artificial intelligence (AI) and blockchain technology converge to shape the future architecture of banking infrastructure. As banks seek to enhance efficiency, security, and customer trust, integrating AI-driven analytics with blockchain ledger systems presents a transformative opportunity for core banking functions. This study addresses research gaps by exploring how the combined deployment of AI and blockchain can redefine trust, transparency, and automation.

Methodology: We started with a systematic review of literature, industry reports, and case studies regarding AI-powered blockchain in banking. The comparative analysis focused on assessing the capabilities of AI and blockchain technologies, with an emphasis on transaction security, fraud-detection accuracy, and customer trust. Examples of smart contract-based lending platforms, AI-based anti-money laundering (AML) solutions, and blockchain-based know-your-customer (KYC) systems were studied to assess implementation outcomes. A framework was developed to chart the interdependencies between AI-driven decision-making and blockchain-based transaction verification.

Findings: The results show that the combination of AI and blockchain has a profound impact on fraud detection, with ML algorithms accurately detecting anomalies. Smart contracts with AI functionality demonstrated efficiency in loan approval and credit risk evaluation. AI-enabled identity verification in blockchain KYC systems streamlined the onboarding process and improved regulatory compliance. The findings show that the combination of AI and blockchain is more effective and secure than using technology alone in terms of security and customer confidence.

Conclusion: The interaction between AI and blockchain technology has the power to revolutionise bank infrastructure, making it secure, efficient, and transparent. This integrated approach enhances fraud prevention, streamlines regulatory compliance, and improves customer trust through automated and intelligent transaction processing. This research goes beyond the boundaries of technology analysis by providing novel perspectives on AI-blockchain integrated banking ecosystems, laying the groundwork for further research in regulatory design and digital banking transformation.



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Sciforum-204226: From financial Primitives to regulatory Frameworks: what lessons for Morocco?

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Decentralized finance (Defi) is considered a paradigm shift in the provision of financial services by replacing the traditional intermediation with self-executing smart contracts on permissionless blockchains. In emerging and frontier economies like Morocco, DeFi presents both potential and considerable risks. On one hand, technology can enhance financial inclusion, decrease remittance expenses, optimize SME financing, and eliminate traditional baking intermediaries. On the other hand, it presents legal ambiguity, deficiencies in consumer protection, weaknesses in smart contracts, issues in antimony laundering as well as possible risks to financial stability. The definitions of decentralized finance are conceptually ambiguous, encompassing everything from peer-to-peer settlement protocols to intricate automated market maker and yield aggregation systems, hence compilating the formulation of unique legal classifications. Limited academic literature has investigated the manifestation of these dynamics across North African and MENA economies. These later are characterized by bank centric financial frameworks and conservatives crypto-asst regulations. Our article is meant to fill the gap by offering a qualitative synthesis of recent DeFi literature and delineating the fundamental financial primitives stablecoins, decentralized exchanges, lending protocols, derivatives, insurance and governance tokens and extracting regulatory implications that could be specific to the Moroccan context. This article is using theme analysis and descriptive statistics on a selected corpus of academic and policy documents to assess potential, hazards and worldwide regulatory responses. The results indicate that a strategy of completing a ban is neither viable nor safeguarding in the long term. In the case of a developing economy context, such the Moroccan one , it is supposed from the government to implement a meticulously calibrated, risk-oriented framework that integrates disclosure mandates, technical assessments, experimental sandboxes and incremental supervision. Thus, harmonizing financial innovation with investor safeguarding, systematic robustness and sustainable market expansion.

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Sciforum-206447: Regulating Bancassurance in Nepal: Nepal Rastra Bank's Intervention and Its Implications for Financial Innovation and Financial Market Development

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Bancassurance has played a significant role in expanding insurance penetration in Nepal by integrating banking and insurance services through banks' extensive branch networks and established customer relationships. During the period from 2010 to 2019, Nepal adopted a permissive multi-agency corporate agency model that accelerated premium growth and broadened insurance accessibility. However, weak regulatory coordination between the banking and insurance sectors, inadequate market-conduct supervision, and aggressive sales practices gave rise to widespread governance concerns, including coercive tied selling, product mis-selling, conflicts of interest, and compromised consumer choice. Recognizing these systemic deficiencies, Nepal Rastra Bank (NRB) prohibited Banks and Financial Institutions (BFIs) from acting as corporate agents for third-party insurance companies through the Monetary Policy 2019/20 and subsequent supervisory directives. This study evaluates the rationale, implementation, and implications of NRB's regulatory intervention within the broader context of financial innovation, consumer protection, and financial market development.

The study adopts an institutional governance perspective supported by agency theory and market-conduct theory to examine the causes and consequences of Nepal's bancassurance reform. It employs a qualitative case study approach based on the analysis of regulatory policies, supervisory directives, annual reports, industry publications, media reports, and other secondary sources. The findings suggest that the regulatory intervention addressed persistent governance failures, strengthened consumer protection, reduced unethical sales practices, and encouraged insurers to diversify their distribution strategies while prompting banks to refocus on their core financial intermediation functions and digital service delivery. The study concludes that a carefully designed, risk-based, and jointly supervised bancassurance framework—supported by professional certification, enhanced disclosure standards, consumer-centric safeguards, and coordinated oversight between Nepal Rastra Bank and the Nepal Insurance Authority—could enable Nepal to reintroduce bancassurance in a manner that balances financial innovation, market efficiency, and consumer protection.



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Sciforum-208305: Does Digitalisation Reduce Youth Unemployment in the Western Balkans? The Role of Economic Growth and Foreign Investment

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This study investigates whether digitalisation contributes to reducing youth unemployment in the Western Balkans. The empirical analysis uses balanced panel data for Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia over the period 2005–2024. Internet usage is employed as the main indicator of digitalisation, while economic growth, foreign direct investment, inflation, tertiary education, and trade openness are included as control variables. The study applies Fixed Effects and Random Effects panel estimations, with the Hausman test used to select the most appropriate specification. Additional robustness checks are conducted using Driscoll–Kraay standard errors and System Generalised Method of Moments to address cross-sectional dependence, heteroskedasticity, serial correlation, and potential endogeneity.

The results indicate that higher levels of internet usage are associated with lower youth unemployment in the Western Balkan economies. Economic growth and foreign direct investment also contribute positively to youth labour-market outcomes by supporting job creation and expanding productive capacity. Inflation is generally associated with weaker employment prospects, while the effects of tertiary education and trade openness differ across model specifications. These findings suggest that digitalisation can improve access to employment information, remote work opportunities, digital entrepreneurship, and new forms of economic activity. However, its benefits depend on complementary investments in digital infrastructure, education, labour-market policies, and private-sector development. The study provides updated regional evidence and offers policy recommendations for promoting inclusive digital transformation and sustainable youth employment in the Western Balkans.



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Sciforum-208717: Artificial Intelligence in Finance: A Comprehensive Systematic Review of Generative AI, Large Language Models, Applications, Challenges, and Future Research Directions

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Artificial intelligence (AI), particularly generative AI and large language models (LLMs), is rapidly transforming the financial sector by reshaping decision-making, risk management, and service delivery. This review synthesizes current knowledge on AI applications in finance, identifies emerging research trends, and highlights future opportunities and challenges. **We conducted a comprehensive review of recent literature in Scopus, Web of Science, ScienceDirect, Google Scholar, and SSRN from 2015 to 2025 using related keywords. Only documents in English were selected; then, duplicate records, conference abstracts, editorials, book chapters, and studies lacking empirical or theoretical relevance were excluded. In the results, 399 documents were selected, belonging to six thematic areas: generative AI and LLMs, corporate finance, asset pricing, household finance, labor economics, and AI-related risks. The synthesis reveals that AI enhances financial forecasting, portfolio optimization, fraud detection, customer service, and financial inclusion while improving operational efficiency and analytical capabilities. However, concerns regarding algorithmic bias, transparency, cybersecurity, privacy, governance, and regulatory compliance remain significant barriers to widespread adoption. Moreover, new patterns reveal a shift toward generative AI and LLMs, while contradictions persist between efficiency gains and governance risks, and gaps remain concerning explainability, regulation, and long-term impacts. This review uniquely maps emerging AI-finance patterns, proposing cross-disciplinary research on responsible, adaptive, and sustainable AI.**



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