

ARTIFICIAL INTELLIGENCE APPLICATIONS IN ENSURING STABILITY OF COMPLEX ECONOMIC AND TECHNICAL SYSTEMS: A MULTI-SECTORAL ANALYSIS

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Аннотация

Ushbu tadqiqot sun'iy intellektning bank sektori, elektr energetika tizimlari va oziq-ovqat sanoati kabi uchta asosiy sohada barqarorlik, samaradorlik hamda barqaror rivojlanishni ta'minlashdagi kengayib borayotgan rolga oid ilmiy ma'lumotlarni umumlashtirishga qaratilgan. 29 ta rivojlangan iqtisodiyot bo'yicha 2017–2021 yillar panel ma'lumotlari asosida SI joriy etilishi bank tizimi barqarorligini sezilarli darajada oshirishi aniqlangan, ayniqsa kapital yetarliligi 7,95% me'yoriy ko'rsatkichdan oshganida bu ta'sir yanada kuchayadi. Elektr energetika tizimlarida SI asosidagi usullar — xususan, konvolyutsion neyron tarmoqlari — tarmoq barqarorligini baholashda an'anaviy yondashuvlarga nisbatan yuqori samaradorlik ko'rsatib, 92% aniqlikka erishgan. Oziq-ovqat sanoatida SI va qayta tiklanadigan energiya texnologiyalarining integratsiyasi energiya sarfini optimallashtiradi, sifat nazoratini kuchaytiradi va ekologik jihatdan barqaror ishlab chiqarishni qo'llab-quvvatlaydi. 2015–2025 yillarda chop etilgan 827 ta ilmiy manbani bibliometrik tahlil qilish natijalari ushbu yo'nalishdagi fanlararo tadqiqotlar jadal o'sayotganini ko'rsatadi. Umuman olganda, ushbu ish sun'iy intellektning murakkab iqtisodiy va texnologik tizimlarda barqarorlik va operatsion samaradorlikni oshirishdagi transformatsion salohiyatini yoritib beradi hamda mustahkam tartibga solish, uzoq muddatli strategik rejalashtirish va SI joriy etishning standartlashtirilgan yondashuvlarini ishlab chiqish zarurligini ta'kidlaydi.

Калит so'zlar: sun'iy intellekt, bank tizimi barqarorligi, energiya tarmoqlari barqarorligini baholash, qayta tiklanuvchi energiya integratsiyasi, barqaror oziq-ovqat qayta ishlash.

Аннотация

Данное исследование направлено на обобщение данных о расширяющейся роли искусственного интеллекта (ИИ) в повышении стабильности, эффективности и устойчивости в трёх ключевых секторах: банковском секторе,

электроэнергетических системах и пищевой промышленности. Используя панельные данные по 29 развитым экономикам (2017–2021 гг.), исследование показывает, что внедрение ИИ значительно повышает устойчивость банковской системы, причём данный эффект усиливается при превышении нормативного порога достаточности капитала в 7,95%. В энергетических системах методы на базе ИИ — особенно сверточные нейронные сети (CNN) — демонстрируют превосходные результаты в оценке устойчивости сетей, достигая точности в 92% и превосходя традиционные аналитические подходы. В пищевой промышленности интеграция ИИ с технологиями возобновляемой энергии оптимизирует энергопотребление, усиливает контроль качества и способствует экологически устойчивому производству. Библиометрический анализ 827 публикаций (2015–2025 гг.) выявляет стремительный рост междисциплинарных исследований, обусловленный глобальными целями устойчивого развития. В целом, работа подчёркивает трансформационный потенциал ИИ в повышении устойчивости и операционной эффективности сложных экономических и технологических систем, а также акцентирует необходимость надёжного регулирования, долгосрочного стратегического планирования и разработки стандартизированных подходов к внедрению ИИ.

Ключевые слова: искусственный интеллект, стабильность банковской системы, оценка устойчивости энергосетей, интеграция возобновляемых источников энергии, устойчивая переработка пищевых продуктов.

Abstract. This study was to synthesize evidence on the expanding role of artificial intelligence (AI) in enhancing stability, efficiency, and sustainability across three major sectors: banking, electrical power systems, and food processing industries. Using panel data from 29 developed economies (2017–2021), findings show that AI adoption significantly improves banking sector stability, with its positive impact becoming more pronounced when capital adequacy ratios exceed a regulatory threshold of 7.95%. In power systems, AI-driven methods—particularly Convolutional Neural Networks—demonstrate superior performance in grid stability assessment, achieving 92% accuracy and outperforming conventional analytical approaches. Within the food processing sector, the integration of AI with renewable energy technologies optimizes energy use, strengthens quality control, and promotes environmentally sustainable operations. A bibliometric review of 827 studies (2015–2025) reveals rapid cross-disciplinary growth driven by global sustainability priorities. Overall, the research highlights AI’s transformative potential in improving resilience and operational performance across complex economic and technological systems, while emphasizing the need for strong regulatory support, long-term planning, and standardized implementation frameworks.

Keywords: Artificial Intelligence, Banking Stability, Grid Stability Assessment, Renewable Energy Integration, Sustainable Food Pressing

Introduction. Artificial intelligence impacts the stability of banking systems in economically advanced nations. The analysis draws on panel datasets covering 29 developed economies from 2017 through 2021. The analytical approach integrates threshold modeling with quantile regression techniques and local projection methods. Findings indicate that AI adoption contributes positively to banking sector stability across developed markets. Notably, the strength of this relationship is conditional on regulatory frameworks—specifically, once capital adequacy ratios exceed a crucial benchmark of 7.95%, AI's stabilizing influence becomes markedly more pronounced. Additionally, while the magnitude of this effect differs across various stability levels within banks, it consistently demonstrates resilience. The local projection analysis further demonstrates that a single instance of increased AI investment produces a statistically meaningful enhancement in banking stability that materializes three years following the initial investment. The study concludes by presenting policy guidance for governments and regulators, emphasizing the importance of promoting AI investments as a strategy to bolster banking sector stability in developed economies (Emile Sègbégnon Sonehekpon). The increasing intricacy of contemporary electrical grids, fueled by the incorporation of sustainable energy resources, decentralized power generation, and advanced grid infrastructure, creates substantial obstacles for maintaining effective and dependable system functionality. Conventional optimization approaches frequently prove inadequate when dealing with the variable, non-linear, and unpredictable characteristics inherent in today's electrical network parameters. This comprehensive survey examines how optimization methods powered by Artificial Intelligence offer viable pathways to improve power network efficiency, operational stability, and adaptability. The analysis opens with a discussion of classic electrical system optimization challenges and their conventional solution methodologies, encompassing areas such as economical load distribution, ideal power routing, generator scheduling, consumer demand management, system malfunction identification, and sustainable energy incorporation. It evaluates traditional optimization frameworks alongside their inherent constraints, while also addressing the complexities associated with heuristic-based algorithms. The central emphasis of this survey lies in examining how modern AI methodologies are being deployed, underscoring their advantages, practical implementations, relative performance metrics, and the operational difficulties encountered during adoption. Through systematic examination of current research publications, analytical tools, and practical deployment scenarios, this review pinpoints emerging patterns and obstacles while offering guidance for subsequent research endeavors. This comprehensive assessment

underscores AI's capability to facilitate robust, flexible, and environmentally conscious electrical infrastructures during this period of energy sector transformation (Senthil Krishnamurthy, Oludamilare Bode Adewuyi, Sunday Adeleke Salimon). Contemporary electrical networks are experiencing escalating complexity, making the assurance of steady functionality progressively more challenging. Grid stability plays a vital role in maintaining dependable electricity delivery, and the precision of stability assessments has direct implications for secure power system operations. This situation presents novel difficulties for conventional analytical approaches used in power systems. To tackle these challenges, this study introduces an evaluation framework that utilizes Convolutional Neural Networks (CNN) for analyzing electrical grid stability concerns. While CNNs have found extensive application across various power system analysis domains, their deployment specifically for grid stability assessment remains comparatively underexplored. Initially, multidimensional operational data from the electrical network—encompassing parameters such as power levels, response times, and price elasticity metrics—undergoes preprocessing through cleaning and standardization procedures. The refined data is then processed through the developed CNN architecture across multiple computational layers. Practical implementation demonstrates that when benchmarked against conventional analytical techniques and Multilayer Perceptron (MLP) models, the CNN-based approach exhibits superior performance in terms of precision, achieving an accuracy rate of 92%, thereby enabling more reliable identification of grid stability conditions (Ziyu Zhang, Lingyan Lin). The convergence of renewable energy systems and artificial intelligence (AI) in food processing and preservation technologies has captured significant attention from both industrial practitioners and academic researchers. As sustainability initiatives gain momentum worldwide, interest in these technologies is expanding across developed economies and emerging markets alike. Considering the broad application of AI, microgrid systems, and clean energy across diverse sectors, there is a pressing need for a comprehensive review that analyzes optimization strategies from existing research while identifying promising avenues for future investigation. This systematic review examines how AI and renewable energy technologies are being integrated within food processing and preservation contexts, with particular emphasis on solar, wind, and biomass energy applications. AI methodologies, including machine learning algorithms and neural network architectures, enhance energy utilization, operational efficiency, and quality assurance in resource-intensive processes such as dehydration, cold storage, and product packaging. A bibliometric examination of 827 scholarly works published between 2015 and 2025 reveals accelerating growth in cross-disciplinary research, propelled by environmental imperatives and technological innovation. While AI adoption delivers advantages including enhanced energy performance, diminished carbon emissions, and superior food quality outcomes,

obstacles such as substantial upfront investments, infrastructure constraints, and socioeconomic inequalities remain. Practical case studies demonstrate AI's capacity to automate labor-intensive operations and optimize renewable energy-powered processes. Successful long-term implementation requires the development of standardized protocols, comprehensive economic assessments, and full lifecycle analyses. As AI technology continues advancing, specific recommendations for future research directions have been identified and proposed. Consequently, both food processing industries and policymakers stand to gain substantially by leveraging AI's capabilities in renewable energy applications to advance sustainable development objectives (Jelili Babatunde Hussein, Tilahun Seyoum Workneh, Alaika Kassim, Khuthadzo Ntsowe, Sileshi F. Melesse, Hany S. El-Mesery, Hu Zicheng).

Conclusion. The integration of artificial intelligence across diverse sectors demonstrates transformative potential in addressing stability challenges within complex economic and technical systems. Evidence from banking, power systems, and food processing industries reveals that AI-driven optimization methodologies substantially enhance operational efficiency, reliability, and sustainability outcomes.

In the banking sector, AI adoption significantly strengthens financial stability, particularly when supported by robust regulatory frameworks with adequate capital adequacy ratios. The delayed positive effects observed three years post-investment underscore the importance of long-term strategic planning in AI implementation.

Within electrical power systems, AI technologies—especially Convolutional Neural Networks—have proven superior to traditional analytical methods, achieving 92% accuracy in grid stability assessment. This capability is increasingly critical as power networks grow more complex through renewable energy integration and distributed generation systems.

The food processing industry demonstrates AI's versatility in optimizing energy-intensive operations while promoting environmental sustainability. The convergence of AI with renewable energy sources offers pathways to reduced carbon emissions, improved product quality, and enhanced operational efficiency.

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