

Trade Automation, Market Efficiency, Transaction Costs and Performance of Securities Markets in East African Community, Within Member States

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Abstract:

Background: Securities markets in the East African Community (EAC) continue to face persistent performance constraints, including low liquidity, high transaction costs, and operational inefficiencies. Although trade automation has been adopted to improve trading processes and enhance market efficiency, its impact on overall market performance remains inconclusive. These challenges are compounded by fragmented market structures, limited real-time information access, and deviations from efficient market conditions. In particular, high transaction costs such as brokerage and settlement fees continue to suppress trading activity and offset potential gains from automation. Consequently, this study evaluated the joint effect of trade automation, market efficiency, and transaction costs on securities market performance in the EAC.

Materials and Methods: The study employed a panel data design using secondary data from the four EAC securities exchanges over the period 2015–2024. To examine the combined influence of the explanatory variables, a panel random-effects regression model was estimated, with model selection guided by the Hausman specification test. The analysis focused on a joint-effect specification, where trade automation, market efficiency, and transaction cost components were simultaneously included in the model to assess their collective impact on securities market performance. Estimation was conducted using Stata version 16 with robust standard errors.

Results: The findings reveal that trade automation, market efficiency, and transaction costs jointly exert a statistically significant influence on securities market performance in the EAC. However, trade automation exhibits a negative and statistically insignificant effect when considered independently, while market efficiency shows a positive but marginal effect. Transaction costs (particularly brokerage fees) have a significant negative impact, indicating that cost-related frictions play a dominant role in shaping market outcomes.

Conclusion: The results demonstrate that the impact of trade automation on market performance is conditional on the broader efficiency and cost environment. Policy efforts should prioritize reducing transaction costs, especially brokerage fees, while strengthening market efficiency through improved trading infrastructure and information dissemination systems. Trade automation initiatives must be contextually aligned with the structural characteristics of EAC markets to ensure that technological adoption translates into meaningful and sustainable performance improvements.

Key Word: Trade Automation, Market Efficiency, Transaction Costs, Performance of Securities Markets, East African Community.

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I. Introduction

The interplay between trade automation, market efficiency, transaction costs, and securities market performance has gained growing attention in recent financial literature, especially in the context of emerging and frontier markets. Trade automation is widely recognized as a mechanism for improving operational efficiency, facilitating real-time price discovery, and enhancing market liquidity. It refers to the application of computer-driven systems to execute trading instructions in financial markets, based on pre-programmed parameters such as timing, price, and volume. As defined by Dimov^[1], trade automation encompasses the digital infrastructure and algorithmic logic that support electronic trading, thereby reducing human intervention and enabling high-frequency trading. Bouchaud and Potters^[2] extend this definition by viewing trade automation as the transition from discretionary trading to data-driven execution supported by real-time analytics and low-latency platforms. Similarly, Abdullahi and Peters^[3] define trade automation as the deployment of automated trading systems to execute buy and sell orders across multiple trading venues with minimal human input.

According to Oyeniyi *et al.*^[4] algorithmic trading has significantly reduced latency and bid-ask spreads, improving execution quality in both developed and developing economies. Similarly, Herman and Oliver^[5] found that digital trade rules and automation have had a statistically significant effect on trade costs and efficiency, especially in low- and middle-income countries. However, while automation contributes to price accuracy and market dynamism, its influence on volatility and systemic risk remains contested.

On the other hand, market efficiency refers to the extent to which asset prices in financial markets accurately and promptly reflect all available information. It is a central tenet in financial economics, foundational to understanding investor behavior, asset valuation, and market predictability. According to recent empirical work, an efficient market incorporates new data into asset prices quickly, limiting opportunities for investors to earn abnormal profits without assuming proportional risk^[6,7]. The concept underscores the idea that when markets operate efficiently, prices function as reliable signals for capital allocation, guiding investors towards value-generating opportunities and facilitating optimal resource distribution. In contemporary financial systems, market efficiency is not just a theoretical ideal but a practical necessity, particularly in developing economies where capital markets are evolving. Efficient markets support investor confidence, reduce arbitrage opportunities, and improve the transparency and competitiveness of financial systems.

According to Aspris *et al.*^[8] the structural design of trading platforms and the regulatory environment also determine the magnitude and distribution of various transaction costs across different classes of investors. Transaction costs are direct and indirect expenses incurred in the process of executing financial trades. They include brokerage commissions, bid-ask spreads, clearing and settlement fees, exchange levies, and custodial charges, all of which affect the net returns realized by investors. In modern financial systems, transaction costs are recognized as a central determinant of market behavior, influencing investor participation, trade frequency, and portfolio strategies. As noted by Bozic and Bozic^[9], these costs can either facilitate or impede efficient capital flows, depending on how effectively they are managed and minimized.

This study is anchored on Trade Automation Theory, which posits that the integration of digital technologies in trading processes (such as algorithmic systems, electronic platforms, and real-time data analytics) reduces transaction friction, enhances execution speed, and promotes transparency in financial markets^[10,11]. To explain the price discovery and efficiency aspects, the study adopts the Efficient Market Hypothesis (EMH) as refined by Zhang and Wang^[7], which asserts that security prices fully reflect all available information, thus minimizing the potential for consistent abnormal returns. Further support is drawn from Transaction Cost Economics (TCE), a framework advanced by Singireddy *et al.*^[12] which conceptualizes market structures as evolving mechanisms that minimize the cost of exchanges, including brokerage fees, custodial charges, and enforcement expenses. Finally, the study integrates Market Microstructure Theory, originally formalized by O'Hara^[13] and empirically extended by Menkveld^[14], which emphasizes the role of heterogeneous agents, trading mechanisms, and order flow in shaping liquidity, spreads, and volatility. Together, these theories form a comprehensive foundation for examining the interaction between trade automation, market efficiency, transaction costs, and the performance of securities markets in the EAC region.

Empirical literature has emphasized that trade automation enhances execution speed and minimizes human error. Mugo and Kiragu^[15] found that electronic trading systems in Kenya and Rwanda improved transparency and investor confidence, while Mutua and Kaburu^[16] highlighted the influence of technological integration on liquidity and market depth. Yet, structural and regulatory bottlenecks persist in the EAC. Despite the automation of clearing and settlement systems, challenges such as information asymmetry, inconsistent investor protections, and varying levels of technological adoption continue to hinder integration and efficiency^[17,18]. Moreover, variations in transaction costs such as brokerage fees, clearing charges, and exchange levies contribute to unequal market participation and suboptimal price discovery, issues that are particularly acute in thinly traded markets like the Uganda Securities Exchange (USE).

The performance of securities markets is a multifaceted concept that reflects the ability of financial markets to facilitate capital formation, liquidity provision, and efficient pricing of securities. A well-performing securities market enables investors to buy and sell financial assets with minimal friction, fostering both investor confidence and economic stability. In evaluating market performance, key indicators include trading volume, stock market index returns, and market capitalization. According to Kumar and Sinha^[19], trading volume is an essential metric because it reflects the level of investor participation and market activity, which are critical for ensuring liquidity and efficient price discovery.

Within this evolving regional context, the Nairobi Securities Exchange (NSE) has implemented several technological innovations, including the Automated Trading System (ATS) and the Broker Back Office system. While these tools have improved market operations, their impact has not been uniform across the region. Bukenya and Odhiambo^[20] assert that Rwanda's RSE and Tanzania's DSE have made strides in automation, but they still face challenges in attracting liquidity and achieving scale. Furthermore, the implementation of the East African Capital Markets Infrastructure Project (EACMIP) seeks to integrate trading platforms and harmonize

regulatory regimes across member states. Nevertheless, evidence on the effectiveness of such integration remains limited and warrants empirical investigation.

However, efforts to harmonize securities markets within the EAC are ongoing, spearheaded by initiatives such as the East African Securities Regulatory Authorities (EASRA). This platform aims to foster collaboration among national regulators, standardize trading practices, and enhance cross-border investments^[21]. One of the key interventions under this framework is the promotion of trade automation, which includes the deployment of electronic trading systems and automated clearing and settlement platforms. Automation has led to improvements in market transparency, execution speed, and cost efficiency^[22]. Furthermore, challenges such as high transaction costs, low internet penetration in some areas, and uneven technological capabilities remain significant barriers to efficiency and market integration.

Despite automation's theoretical potential, the realities of low institutional capacity, fragmented regulation, and infrastructure disparities across the EAC suggest that these benefits may not be fully realized. Empirical studies have produced mixed findings on the impact of trade automation. In developed economies, research has consistently shown that algorithmic trading enhances liquidity and reduces transaction costs^[23]. The effect of automation is thus highly context-dependent, influenced by underlying market maturity and regulatory readiness^[24,25].

Market efficiency outcomes are similarly inconsistent. While the efficient market hypothesis posits that automation should improve informational efficiency, several African market studies reveal persistent price anomalies and delayed adjustments, especially in low-liquidity settings^[26,27]. The influence of transaction costs further complicates the automation-performance nexus. While automation is assumed to lower transaction costs, findings vary significantly depending on the market and cost component examined^[28,2,30]. In addition to these conceptual and empirical inconsistencies, methodological limitations remain. Many studies rely on cross-sectional data or single-year case studies, limiting the ability to observe evolving market behavior or disentangle causal effects. Few studies have adopted a holistic framework that accounts for the joint and interactive effects of automation, market efficiency, and transaction cost^[31,32]. This fragmented evidence base hampers the development of sound policy responses tailored to the EAC context. Hence, this study sought to address the following research question: How does trade automation, market efficiency, and transaction costs impact the East African Community's securities markets' performance?

II. Material And Methods

Study Design: The study adopted a descriptive cross-sectional research design using a panel data approach. This design was appropriate as it enabled the examination of relationships among trade automation, market efficiency, transaction costs, and securities market performance across multiple markets over time without manipulation of variables.

Study Area and Population: The study focused on the securities markets within the East African Community (EAC), specifically the four operational stock exchanges: Nairobi Securities Exchange (Kenya), Dar es Salaam Stock Exchange (Tanzania), Uganda Securities Exchange (Uganda), and Rwanda Stock Exchange (Rwanda). These exchanges constituted the unit of analysis and provided a comprehensive representation of securities market dynamics within the region.

Study Period: The study covered a ten-year period from 2015 to 2024, allowing for the assessment of trends and relationships over time.

Data Sources and Collection: Secondary data were collected from annual audited financial reports, capital markets authority publications, and daily trading reports of the respective securities exchanges. The data included trading volumes, market capitalization, transaction cost components (brokerage, exchange, custodial, clearing and settlement fees), bid-ask spreads, and other market performance indicators.

Measurement of Variables: Trade automation was proxied by the percentage change in trading volume attributed to automated trading systems. Market efficiency was measured using annual stock market returns, while transaction costs were captured through brokerage, exchange, custodial, and clearing and settlement fees. Securities market performance was measured using the market turnover ratio, defined as the ratio of total value traded to average market capitalization.

Data Analysis: Data were analyzed using **Stata version 16.1**. Panel regression techniques were employed to examine the relationships among the study variables. Both fixed-effects and random-effects models were considered, with the Hausman test used to determine the most appropriate model specification.

The joint effect model estimated the combined influence of trade automation, market efficiency, and transaction costs on market performance

Diagnostic Tests: To ensure robustness of the results, diagnostic tests including multicollinearity, heteroscedasticity, autocorrelation, stationarity, and cross-sectional dependence were conducted. Appropriate corrections, such as robust standard errors, were applied where necessary.

Statistical Significance: All statistical tests were conducted at a 5% level of significance ($p < 0.05$).

III. Result

This section presents the empirical findings of the study, beginning with descriptive statistics to provide an overview of the distribution and characteristics of the study variables across the EAC securities markets. This is followed by hypothesis testing using panel regression analysis, with particular emphasis on the joint effect of trade automation, market efficiency, and transaction costs on securities market performance.

Table 1: Descriptive Statistics of Study Variables (n=40)

Variable	Mean	Std. Dev.	Minimum	Maximum
Average Total Market Capitalization	6.2999	2.4208	2.2979	11.7974
Percentage Change in Volume Traded	0.0486	0.0170	0.0200	0.0900
Annual Bid-Ask Spreads	0.9345	0.9560	0.0242	3.2124
Brokerage Fees	0.5035	0.1350	0.2300	0.7500
Exchange Fees	0.5259	0.1512	0.2570	0.8055
Custodial Fees	0.4669	0.1211	0.2600	0.6900
Clearing & Settlement Fees	0.5088	0.1164	0.3100	0.7092

Table 1 presents the summary statistics of the study variables across the EAC securities markets over the period 2015–2024. The results indicate moderate variation in market performance, proxied by average total market capitalization, with a mean of 6.2999 and a standard deviation of 2.4208. The observed range suggests notable disparities in market size and activity across the four exchanges. On the other hand, trade automation, measured by the percentage change in trading volume, exhibits relatively low dispersion around the mean (0.0486), indicating gradual and consistent adoption of automated trading systems across the markets. In contrast, market efficiency, proxied by bid-ask spreads, shows considerable variability, reflecting uneven liquidity conditions and differences in price discovery mechanisms within the region. Further, transaction cost components including brokerage, exchange, custodial, and clearing and settlement fees, remain relatively high and heterogeneous across markets. The magnitude and variation of these costs suggest persistent structural constraints that may limit trading activity and dampen the potential efficiency gains from automation.

The regression results in Table 2 indicate that trade automation, market efficiency, and transaction costs jointly exert a statistically significant influence on securities market performance in the EAC, as shown by the overall Wald statistic and model fit. This suggests that market performance in the region is shaped less by any single factor in isolation than by the broader interaction between technological adoption, the quality of price discovery, and the cost of transacting. In substantive terms, the findings imply that automation reforms cannot be evaluated independently of the institutional and cost environment in which they are embedded. This interpretation is consistent with the broader framing of the study, which emphasizes that the automation–performance nexus in emerging markets is conditional rather than automatic.

Table 2: Joint Effect of Trade Automation, Market Efficiency, and Transaction Costs on Market Performance

	Coefficient	Std. Error	z-statistic	P value
Trade Automation	-11.7309	7.4281	-1.58	0.114
Market Efficiency	0.1092*	0.0618	1.77	0.077
Transaction Costs				
Brokerage Fees	-4.6887***	1.5849	-2.96	0.003
Exchange Fees	-0.2022	1.4446	-0.14	0.889
Custodial Fees	-0.0625	0.0562	-1.11	0.266
Clearing & Settlement Fees	0.0298	0.0578	0.52	0.606
Constant	-0.4844	0.3494	-1.39	0.166
Observations	36	R ² (within)	0.3412	
Groups	4	R ² (between)	0.9229	
Wald χ^2 (6)	16.10	R ² (overall)	0.3570	
Prob > χ^2	0.0132	Hausman χ^2 (6)	2.32	
		Prob > χ^2	0.8880	

The coefficient on trade automation is negative and statistically insignificant, indicating that greater automation, as proxied by changes in trading volume, did not translate into measurable improvements in market

performance once market efficiency and transaction costs were simultaneously controlled for. This result challenges the common presumption that automation necessarily improves liquidity and performance. A plausible interpretation is that, in the EAC context, automation may have improved operational speed without sufficiently resolving deeper structural constraints such as shallow market depth, fragmented regulation, or limited investor participation. This is in line with Menkveld's argument that while algorithmic trading can improve market operations, it may also intensify fragmentation and liquidity concerns in less mature settings, and with studies noting that gains from digital trading systems are more robust in markets with stronger infrastructure and regulatory readiness.

The result also contrasts with literature that reports positive effects of automation on liquidity and lower trading frictions. Studies such as Angelidis et al.^[6] and Degryse and Nguyen^[28] suggest that automation can narrow bid-ask spreads and improve market quality, but these findings are largely derived from more developed or institutionally stronger markets. The divergence observed here points to the contextual nature of automation outcomes. In the EAC, the benefits of automation appear to be muted where market integration remains incomplete and where technological reforms are not matched by complementary improvements in governance, information systems, and investor protection. The implication is that policymakers should avoid treating automation as a stand-alone reform; instead, it should form part of a wider package aimed at strengthening market architecture.

Market efficiency enters the model with a positive coefficient and marginal significance, suggesting that better pricing conditions and stronger information incorporation are associated with improved market performance, even though the effect falls slightly short of the conventional 5 percent threshold. This pattern is theoretically consistent with the Efficient Market Hypothesis, which posits that markets perform better when prices reflect available information more quickly and accurately. In practical terms, the result implies that improving transparency, information dissemination, and trading system responsiveness may be more consequential for market performance than automation alone. The finding aligns with recent literature emphasizing that automation yields stronger gains when it operates within a transparent and efficient market environment. Easley and O'Hara^[32], for example, argue that technological efficiency is conditional on the quality of the surrounding market ecosystem.

Among the transaction cost variables, brokerage fees emerge as the dominant and statistically significant determinant of market performance. The negative coefficient indicates that higher brokerage charges materially reduce market performance, most likely by discouraging trading activity and limiting participation, particularly among smaller and more cost-sensitive investors. This finding is especially important because it shows that transaction costs can directly offset the intended gains from automation. It supports the argument in the literature that even where automated systems reduce latency and improve execution, excessive cost structures can neutralize these advantages. Degryse and Nguyen^[28], Jiang and Wang^[33], and Easley and O'Hara^[32] all point to transaction costs as a central constraint on the effectiveness of automated trading systems.

The policy implication of the brokerage fee result is direct and substantial. If EAC regulators are serious about improving market performance, then cost rationalization should be treated as a first-order reform priority rather than a secondary administrative issue. Streamlining brokerage charges, improving competition among intermediaries, and reducing duplicative fee layers may generate more immediate performance gains than further automation investment alone. This also implies that the success of digital market reforms should be evaluated not only by speed and system sophistication, but also by whether they reduce the effective cost of market participation. In other words, affordable access remains central to market deepening.

By contrast, exchange fees, custodial fees, and clearing and settlement fees do not show statistically significant effects in the joint model. This does not necessarily mean that these cost components are irrelevant. Rather, it suggests that within the EAC setting their independent marginal effects are weaker than that of brokerage fees once all variables are considered together. One possible explanation is that some of these charges may be more stable, more institutionalized, or less visible to traders than brokerage fees, and therefore less influential in shaping day-to-day market participation decisions. Another possibility is that their effects are indirect and may operate through efficiency, liquidity, or investor confidence rather than through immediate performance changes. This interpretation is consistent with the study's broader conclusion that not all transaction costs constrain markets in the same way; some frictions appear more binding than others.

IV. Conclusion

This study examined the joint effect of trade automation, market efficiency, and transaction costs on securities market performance in the EAC. The findings indicate that while the combined model is statistically significant, trade automation on its own does not exert a significant positive effect on market performance. Market efficiency shows a positive, though marginal, influence, whereas transaction costs, particularly brokerage fees, emerge as a significant constraint, negatively affecting market outcomes. These results suggest

that the anticipated benefits of automation are not automatically realized in environments characterized by structural inefficiencies and high-cost burdens.

The study therefore concludes that the effectiveness of trade automation in improving market performance is conditional on the broader institutional and cost environment. Policy efforts should prioritize reducing transaction costs, enhancing market efficiency through improved information systems, and aligning automation initiatives with the structural realities of EAC markets. A coordinated approach that integrates technological advancement with cost rationalization and regulatory strengthening is essential for achieving sustained improvements in securities market performance within the region.

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