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Article

Composite Index and Dynamic Assessment of Enterprise Competitiveness: A Comparative Study of Chemical and Textile Industries in Uzbekistan

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Abstract: Evaluating enterprise competitiveness in transition economies necessitates a balanced multi-criteria approach that accounts for industry-specific dynamics. This research proposes a standardized, reproducible methodology for assessing integral competitiveness using a panel of normalized financial and economic metrics. The model employs a block-weighted additive aggregation scheme across five core pillars: profitability, cost efficiency, liquidity, financial stability, and business activity. The methodology was empirically tested on two major industrial enterprises in Uzbekistan—AO "Farg'onaAzot" (chemical industry) and AO "Narimtex" (textile industry)—over a biennial panel spanning 2020 to 2024. The empirical findings reveal that while both enterprises experienced a parallel decline in overall competitiveness (with integral indices dropping from ~64 to ~32 points), their underlying competitive structures are fundamentally divergent. AO "Farg'onaAzot" derives its core strength from scale-driven profitability, whereas AO "Narimtex" maintains higher capital mobility and liquidity. The proposed framework demonstrates high analytical stability and serves as a strategic decision-support tool for industrial policy and corporate governance.

Keywords: Enterprise competitiveness, integral index, financial normalization, chemical industry, textile sector, block weighting, economic transformation, Uzbekistan.

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1. Introduction

Industrial enterprises in emerging and transforming economies operate in volatile macroeconomic environments characterized by structural shifts, supply chain realignments, and shifting input costs. Assessing an enterprise's competitive position under these conditions requires quantitative frameworks capable of synthesizing heterogeneous financial metrics into actionable insights.

The study aims to develop and apply a standardized composite assessment methodology for comparing the competitiveness of industrial enterprises in Uzbekistan. Specifically, it evaluates AO "Farg'onaAzot" and AO "Narimtex" over 2020, 2022, and 2024, compares alternative profit specifications, and identifies the financial dimensions that explain differences in their competitive positions.[1]

While traditional competitiveness evaluations often rely either on purely qualitative expert assessments or on unweighted financial ratios, these approaches frequently mask underlying structural vulnerabilities or bias results toward raw scale. To address these methodological limitations, this study develops and validates a standardized,

reproducible methodology for integral competitiveness assessment. By applying a block-weighted additive convolution model to normalized financial indicators, this paper evaluates the dynamic competitive positions of two benchmark enterprises in Uzbekistan—AO "Farg'onaAzot" (chemical sector) and AO "Narimtex" (textile sector)—across the 2020–2024 period.[2]

The literature on enterprise competitiveness assessment has developed several methodological approaches for combining financial, managerial, and market indicators into an integrated evaluation. Taxonomy-based methods construct composite indicators from multiple dimensions of enterprise performance. Block-structured approaches organize indicators into related functional groups and enable comparison between enterprises operating within the same industrial complex [3]. Other studies use point-standardization and geometric-averaging techniques to build integral measures that can be applied under conditions of market uncertainty [4].

A related strand of research examines the financial determinants of firm-level competitiveness. Evidence from emerging markets identifies liquidity, firm size, and leverage among the factors associated with enterprise financial performance [5]. This perspective is relevant to the present study because the comparison of chemical and textile enterprises requires attention not only to the scale of financial results but also to the structure of liquidity, debt, profitability, and asset utilization.

Research on industrial enterprises also emphasizes the importance of sectoral context. Existing assessments address competitiveness in industrial and engineering complexes [6], while other works consider enterprise competitiveness and financial-economic security in manufacturing settings [7]. These studies provide a methodological basis for selecting comparable indicators; at the same time, their differing industrial contexts underline the need to account for the specific operating characteristics of each sector when interpreting an integral score.[8]

The construction of a composite index requires transparent procedures for normalization, weighting, and aggregation. The OECD methodological guidance on composite indicators recommends explicit treatment of heterogeneous units and careful documentation of the aggregation procedure [9]. This is particularly important when absolute financial values and relative financial ratios are combined in one assessment model. The present study draws on this guidance by applying min–max normalization and a two-level block-weighting scheme.

Despite the availability of these approaches, the literature reviewed here leaves room for additional comparative applications to Central Asian transition economies and to enterprises from structurally different industrial sectors. The present research addresses this gap by applying a reproducible block-weighted composite index to a chemical enterprise and a textile enterprise in Uzbekistan, and by examining how similar aggregate scores may reflect different underlying competitive structures.[10]

2. Methodology

This study The proposed framework follows a five-stage evaluation protocol designed to handle multi-attribute industrial panel data.

Metric Selection and Categorization

The Table 1. indicator system integrates seven core financial ratios organized into five distinct operational blocks: Profitability, Cost Efficiency, Liquidity, Financial Stability, and Business Activity. Each metric is classified as either a stimulator (positive vector) or a destimulator (negative vector) based on its operational directionality.

Table 1. Structure of the Indicator System and Block-Weighted Scheme[11]

Indicator (Index)	Analytical Block	Vector	Unit	Block Weight	Indicator Weight (wi)
Gross Profit	Profitability	Stimulator	thousand UZS	0.20	0.10
Operating Profit (Var. A) / Net Profit (Var. B)	Profitability	Stimulator	thousand UZS	0.20	0.10
Cost of Goods Sold (COGS)	Cost Efficiency	Destimulator	thousand UZS	0.20	0.20
Current Ratio	Liquidity	Stimulator	ratio	0.20	0.10
Quick Ratio	Liquidity	Stimulator	ratio	0.20	0.10
Debt Ratio	Financial Stability	Destimulator	ratio	0.20	0.20
Asset Turnover	Business Activity	Stimulator	ratio	0.20	0.20

Note: Depreciation expense serves as an auxiliary proxy metric for fixed asset renewal in extended diagnostic checks.

3.2 Normalization Procedure

To eliminate dimensional differences between absolute monetary values (thousand UZS) and relative coefficients, linear min-max normalization is applied to restrict all metrics within a bounded interval of [0, 1]. The boundary parameters (xmin and xmax) are established globally across the entire observation panel (2 firms × 3 time points).

• For Stimulators (Positive Impact):

$$x'_{i,j,t} = (x - x_{min}) / (x_{max} - x_{min}) \quad (1)$$

• For Destimulators (Negative Impact):

$$x'_{i,j,t} = (x_{max} - x) / (x_{max} - x_{min}) \quad (2)$$

This min-max approach follows standard international guidance on the construction of composite indicators, which recommends bounded normalization when sub-indicators are measured in heterogeneous units and are subsequently aggregated through a linear weighting scheme [12].

Weight Allocation and Aggregation

A two-level block-weighting strategy is implemented. Each of the five analytical blocks is assigned an equal structural weight of 0.20. Within each block, weights are distributed equally among constituent indicators, strictly satisfying the non-negative weight normalization constraint:

$$\Sigma w_i = 1, \text{ where } w_i \geq 0 \quad (3)$$

where wi denotes the individual weighting coefficient assigned to the i-th sub-indicator (i = 1, 2, ..., n), establishing that all constituent weights are non-negative and sum to unity (100%) to prevent structural scale distortion.

This two-level, equal-weighting structure is consistent with block-based competitiveness models applied to industrial complexes, where structural components are first weighted at the block level and only then decomposed into constituent indicators as well as with integral-indicator approaches that combine several sub-indices into a single dynamic competitiveness measure through averaging techniques [13].

The integral competitiveness index (Ij,t) for enterprise j in year t is subsequently computed via additive synthesis:

$$I_{j,t} = \Sigma (w_i \bullet x'_{i,j,t}) \quad (4)$$

where Ij,t represents the composite integral competitiveness index of the j-th enterprise (j = 1, 2, ..., m) during time period t expressed in relative units within the interval [0, 1], and x'i,j,t signifies the standardized (normalized) value of the i-th sub-indicator for enterprise j at time t derived from equations (1) and (2).

For intuitive empirical reporting, strategic benchmarking, and rating scale construction, the aggregate index is rescaled onto a standardized 100-point scale:

$I^*_{j,t} = 100 \bullet I_{j,t}$ (5)

where I*j,t represents the final linear-scaled composite competitiveness score bounded within [0, 100], and 100 serves as the scaling multiplier to enhance management interpretation across comparative industry panels.

Rating Scale Definition

To Table 2. interpret the scaled index (I*), a quintile-based rating system categorizes competitiveness levels and aligns them with recommended strategic responses.

Table 2. Competitiveness Grading Scale and Strategic Guidelines[14]

Index Range (I*)	Competitiveness Level	Priority Strategic Orientation
0–20	Low	Crisis management, comprehensive debt restructuring, operational bailout.
20–40	Reduced	Cost optimization, strict liquidity management, non-core asset divestment.
40–60	Moderate (Normal)	Equipment modernization, asset return enhancement, capital structure optimization.
60–80	Elevated	Market share expansion, sales acceleration, adoption of resource-efficient tech.
80–100	High	Aggressive R&D investment, global scaling, entry into international export markets.

3. Results

In The table 3. panel data was processed under two profit specifications: Variant A (using Operating Profit) and Variant B (using Net Profit).

Table 3. Normalized Metric Panel Across Benchmark Enterprises (2020–2024)[15]

Metric	Farg'onaAzot 2020	Farg'onaAzot 2022	Farg'onaAzot 2024	Narimtex 2020	Narimtex 2022	Narimtex 2024
Gross Profit (Stim.)	0.694	1.000	0.794	0.000	0.019	0.016
COGS (Destim.)	0.483	0.439	0.000	0.914	1.000	0.933
Operating Profit [Var A] (Stim.)	1.000	0.864	0.312	0.000	0.046	0.028
Net Profit [Var B] (Stim.)	1.000	0.796	0.248	0.009	0.048	0.000
Debt Ratio (Destim.)	0.951	1.000	0.898	0.435	0.298	0.000

Current Ratio (Stim.)	1.000	0.000	0.062	0.697	0.597	0.254
Quick Ratio (Stim.)	0.822	0.000	0.013	1.000	0.881	0.295
Asset Turnover (Stim.)	0.000	0.149	0.115	1.000	0.448	0.379

Table 4. Comparative calculations between an unweighted simple arithmetic average (Iequal) and the weighted block model (Iweighted) underscore the necessity of the weighting scheme.

Table 4. Aggregate Competitiveness Ratings (Variant A vs. Variant B)[16]

Enterprise / Year	Iequal (Var A)	Iweighted* (Var A)	Iequal (Var B)	Iweighted* (Var B)	Position (Table 2)
Farg'onaAzot 2020	0.707	63.8	0.707	63.8	Elevated
Farg'onaAzot 2022	0.493	50.4	0.483	49.7	Moderate
Farg'onaAzot 2024	0.313	32.1	0.304	31.4	Reduced
Narimtex 2020	0.578	63.9	0.579	64.0	Elevated
Narimtex 2022	0.470	50.4	0.470	50.4	Moderate
Narimtex 2024	0.272	32.2	0.268	31.9	Reduced

4. Discussion

Structural Parity vs. Operational Disparity

An unweighted model creates a methodological distortion, suggesting that the chemical enterprise ("Farg'onaAzot") drastically outpaces the textile enterprise ("Narimtex") across all periods. However, applying the block-weighted convolution (I*) demonstrates that both enterprises achieved nearly identical aggregate competitiveness scores across all three timeframes (e.g., 63.8 vs. 63.9 in 2020; 32.1 vs. 32.2 in 2024, with variance ≤0.2 points).[17]

Despite identical composite scores, the underlying structural drivers are completely divergent:

• AO "Farg'onaAzot" maintains a dominant position in profitability and scale, driven by high production volume and market coverage.

• AO "Narimtex" counterbalances its lower absolute profit margins with significantly superior liquidity and asset turnover, reflecting the higher capital agility characteristic of light industry.

This pattern—where a composite index converges across firms despite divergent underlying drivers—echoes findings from studies of large industrial complexes, where comparative assessment methods have similarly distinguished between an enterprise's current competitiveness level and its structural competitive potential, treating them as related but analytically separate dimensions [18]. It also reinforces earlier evidence that financial-ratio-based competitiveness proxies capture fundamentally different mechanisms depending on firm-specific characteristics such as leverage, liquidity, and scale, even when aggregate outcomes appear similar. A comparable divergence between valuation methodology and the realities of firm-level competitive positioning has also

been noted in critical assessments of integral competitiveness models applied to the broader industrial economy [19].

Macroeconomic Sensitivity and Model Stability

Both enterprises experienced a synchronized contraction in competitiveness between 2020 and 2024, with composite scores dropping by approximately 50%. This parallel decline reflects broader macroeconomic pressures in the transition economy, including rising primary input costs, supply chain bottlenecks, and tightening credit conditions.

Furthermore, testing the framework under alternate profit indicators (Variant A vs. Variant B) yielded a maximum deviation of only 0.7 points. This demonstrates that the model is invariant to minor metric substitutions, proving its methodological robustness for policy design and industrial monitoring.

This macroeconomic sensitivity is consistent with broader assessments of Uzbekistan's industrial sector, which highlight structural exposure to energy inefficiency, rising input costs, and uneven access to export markets as persistent constraints on enterprise-level competitiveness. At the same time, sector-specific evidence from Uzbekistan suggests that benchmarking-based integral index approaches are increasingly viewed as viable decision-support tools across diverse industries, from tourism to manufacturing, reinforcing the transferability of the present framework beyond the chemical and textile sectors examined here. More broadly, the diffusion of Industry 4.0 technologies has been identified as a key enabler of enhanced competitiveness among industrial enterprises operating under resource and macroeconomic constraints, suggesting a complementary policy lever alongside the financial-diagnostic approach proposed in this study [20].

Limitations

Several limitations should be acknowledged when interpreting the results of this study. First, the empirical panel is restricted to two enterprises observed at three biennial time points while this design is sufficient to establish global min-max normalization boundaries and to demonstrate the internal consistency of the block-weighted model, it limits the statistical generalizability of the findings to the broader population of chemical and textile enterprises in Uzbekistan. Second, the equal-weighting scheme applied at both the block level (0.20 for each of the five blocks) and within blocks was adopted for methodological transparency and reproducibility rather than derived from expert elicitation, Analytic Hierarchy Process (AHP), or econometric weight estimation; alternative weighting structures could plausibly shift the relative ranking of specific sub-periods, even if the overall convergence pattern between the two enterprises is likely to persist given its robustness across profit variants (Section 4.2). Third, the model relies exclusively on financial-statement-derived indicators and does not incorporate non-financial dimensions of competitiveness—such as innovation intensity, human capital, environmental performance, or digital-technology adoption—that are increasingly recognized as material to enterprise competitiveness in the literature. Finally, the analysis is confined to a single transition-economy context; cross-country comparisons with enterprises operating under different regulatory and macroeconomic regimes were beyond the scope of this study.

Future Research

Future research could extend the proposed framework in several directions. Expanding the panel to a larger cross-section of enterprises within each sector would allow for statistical robustness checks, including sensitivity and uncertainty analysis of the weighting scheme, consistent with established practice in composite-indicator construction [21]. Incorporating expert-elicited or data-driven weighting methods, such as AHP or principal component analysis, would allow direct comparison against the equal-weighting baseline used here. Given the growing relevance of digitalization for industrial

competitiveness future iterations of the model could integrate a dedicated digital-readiness block alongside the five financial pillars. Finally, applying the framework to additional sectors and to other Central Asian transition economies would help establish whether the structural-parity phenomenon documented in Section 4.1 generalizes beyond the chemical–textile comparison examined in this study.

5. Conclusion

The proposed block-weighted competitiveness assessment model effectively bridges the gap between raw financial diagnostics and strategic planning. By normalizing multidimensional indicators and applying balanced block weights, the framework prevents scale-induced distortion while preserving industry-specific operational characteristics. The empirical application to Uzbekistan's chemical and textile sectors demonstrates that identical composite ratings can stem from fundamentally different competitive advantages. Consequently, industrial interventions must be tailored: capital-intensive chemical enterprises require energy-efficiency and modernization strategies, whereas light-industry firms require supply-chain optimization and market expansion. The standardized 0–100 scale and its block-level decomposition offer both policymakers and investors a reproducible diagnostic tool for cross-sectoral monitoring and risk differentiation, particularly as digital-transformation initiatives become an increasingly relevant complement to traditional financial diagnostics in transition economies. These findings resonate with Uzbekistan's current sectoral development priorities. Textile policy targets 100% cotton yarn processing depth, a 70% share of finished goods in exports, and $7 billion in textile exports by 2027, supported by customs exemptions and export logistics subsidies. Chemical industry priorities focus on energy-efficiency modernization, "green chemistry" adoption, and expanding the domestic raw material base to reduce phosphate fertilizer import dependency. Planned growth in chemical fibers, polyester, and dyes for textile production reflects an emerging cross-sectoral synergy that the proposed framework is well-suited to monitor.

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