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Measuring Regional Small-Business Competitiveness: A Predictively Validated Composite Index for Uzbekistan

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Abstract: Regional comparisons of small-business competitiveness are often based on aggregate shares that are sensitive to regional scale and to the presence of large firms. This study develops the Regional Small-Business Competitiveness Index (RSNI), a transparent formative composite for the 14 regions of Uzbekistan over 2014-2024. The core index combines equally weighted internal-market (IRNI) and external-market (TRNI) subindices built from standardized, direction-adjusted intensive indicators. Robustness is examined across alternative weighting schemes, while predictive validity is tested with two-way fixed-effects regressions in which the relevant outcome component is removed from the index and the index is lagged one year. The 2024 ranking places Tashkent city first and reveals marked internal-external asymmetries across several regions. The core ranking is virtually unchanged after winsorisation (Spearman $\rho = 0.996$). A 10-point increase in the lagged, component-excluded index is associated with about 5.4% higher next-year sales per active firm and about 18.9% higher odds of a larger small-business export share under Driscoll-Kraay inference. Because the same coefficients are not statistically significant with region-clustered standard errors, the predictive evidence is treated as supportive rather than causal. The resulting framework provides a reproducible basis for differentiated regional diagnosis.

Keywords: Small business; competitiveness; composite index; regional measurement; predictive validity.

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1. Introduction

Comparing small-business competitiveness across regions is difficult when the available measures are dominated by regional size. The small-business share of gross regional product, employment, or exports is easy to communicate, but it can fall simply because a region contains a few very large enterprises. Conversely, a high share can reflect the absence of large firms rather than unusually strong small-business performance. A useful regional measure therefore needs to reduce scale effects while retaining economically meaningful differences in market performance [1].

Composite indicators offer a practical way to combine multiple dimensions into a comparable measure, but their credibility depends on transparent construction and explicit validation. Established international guidance stresses the importance of concept definition, normalization, weighting, aggregation, and sensitivity analysis. Methodological literature similarly shows that uncertainty in design and variable selection choices can materially alter composite rankings. These issues are especially important when an index is intended to support regional diagnosis rather than serve as a purely descriptive scoreboard [2].

The Uzbek case provides a demanding setting for such a measure. Small business accounts for a substantial part of national economic activity, yet the 14 first-level regions differ sharply in industrial structure, firm density, access to finance, human capital, and export orientation. The broader structural literature also indicates that competitive performance reflects several mechanisms at once: market position and competitive pressure, firm-specific resources and capabilities, the ability to reconfigure those resources as conditions change, and more recent forms of digital and organizational capability. Uzbek studies have separately examined enterprise competitiveness, digital adoption, export potential, and production capacity. However, these strands do not by themselves provide a scale-free regional measurement framework [3].

A recent domestic study introduced a regional composite-index approach and reported the initial ranking of small-business competitiveness across Uzbekistan. The present paper extends that earlier application rather than reproducing it: the index is set out as an explicitly formative measurement system, its ranking is subjected to several weighting and outlier checks, and its criterion validity is examined with a predictive panel design that removes the outcome component from the index before estimation. Accordingly, the objective of this study is to construct a transparent two-dimensional RSNI for Uzbekistan's 14 regions over 2014-2024 and to evaluate both its rank stability and its predictive validity [4].

2. Methods

2.1. Data and study design

The analysis covers the Republic of Karakalpakstan, 12 regions, and Tashkent city for 2014-2024. The balanced source panel therefore contains 154 region-year observations before lagging. The statistical base consists of official regional series from the National Statistics Committee, the Central Bank, and the Ministry of Economy and Finance. Monetary indicators are converted to real terms before standardization. Wherever possible, the index uses intensive measures - per active firm, per worker, or shares - so that regional economic scale does not mechanically determine the score.

2.2. Indicator system

RSNI is specified as a formative composite. Its indicators are treated as distinct components that jointly constitute regional small-business competitiveness, not as interchangeable reflections of a single latent variable. Removing an indicator therefore changes the economic meaning of the construct. Two performance subindices form the core index: IRNI captures domestic-market performance, capital depth, and financial soundness; TRNI captures export position, export efficiency, human capital, and the economic weight of small business. A separate institutional-conditions subindex (ISI) is used only in an extended variant because its indicators describe policy exposure rather than realised market performance. The indicator system is reported in Table 1.

Table 1. RSNI subindices and indicator system.

Subindex	Indicator	Direction	Meaning
IRNI	Real sales per firm	+	Current internal-market result
IRNI	Real fixed assets per firm (t-1)	+	Capital base
IRNI	Overdue payables share (t-1)	-	Financial soundness
TRNI	Small-business export share	+	External-market position
TRNI	Exports per worker	+	Export efficiency

TRNI	Human-capital intensity (t-1)	+	Skills and knowledge
TRNI	Small-business share of GDP (t-1)	+	Economic base
ISI	Financial-policy exposure (t-1)	+	Institutional conditions
ISI	Export-policy exposure (t-1)	+	Institutional conditions

2.3. Standardisation and aggregation

Indicators measured in different units are standardized over the full 2014-2024 panel. For region i , indicator j , and year t , the z-score is:

$$Z_{ijt} = (X_{ijt} - \text{mean}(X_{ij})) / \text{SD}(X_{ij})$$

The mean and standard deviation are calculated across all regions and years. Indicators for which higher values represent weaker competitiveness, such as the overdue-payables share, enter with a reversed sign. The three subindices are then formed as simple averages of their standardized components:

$$\begin{aligned} \text{IRNI} &= [Z(\text{sales_pf}) + Z(\text{capital_pf}) - Z(\text{overdue})] / 3 \\ \text{TRNI} &= [Z(\text{export_share}) + Z(\text{export_per_worker}) + Z(\text{human}) + Z(\text{gdp_share})] / 4 \\ \text{ISI} &= [Z(\text{finance_exposure}) + Z(\text{export_exposure})] / 2 \end{aligned}$$

Each subindex is finally rescaled to 0-100 using min-max normalization over the observed panel range. Scores of 0 and 100 therefore identify the lowest and highest values observed among the 14 regions during 2014-2024; they are not absolute international benchmarks.

2.4. Weighting and sensitivity variants

The core specification uses equal weights within each subindex and gives IRNI and TRNI equal weight. This rule is deliberately independent of regression coefficients, which keeps the index transparent and reproducible:

$$\begin{aligned} \text{RSNI-Core} &= 0.50 \times \text{IRNI} + 0.50 \times \text{TRNI} \\ \text{RSNI-Extended} &= 0.40 \times \text{IRNI} + 0.40 \times \text{TRNI} + 0.20 \times \text{ISI} \end{aligned}$$

RSNI-Core is the principal ranking. RSNI-Extended is used only to examine the role of institutional context. Three additional sensitivity variants are calculated: a 1-99% winsorised version, a principal-component version (RSNI-PCA), and a model-signal version using standardized regression coefficients. The latter two are diagnostic alternatives rather than preferred weights because they assign importance according to statistical structure rather than a transparent economic rule.

2.5. Validation strategy

Validation is conducted in two stages. First, rank stability is assessed with Spearman correlations between RSNI-Core and the alternative variants. Second, criterion validity is examined predictively rather than contemporaneously. For each outcome, the component corresponding to that outcome is removed from the index and the resulting index is lagged by one year. The estimating equation is:

$$Y_{i,t+1} = \alpha_i + \lambda_t + \beta \text{RSNI}_{i,t}(-Y) + \varepsilon_{i,t+1}$$

The two outcomes are log real sales per active firm and the logit of the small-business export share. Region fixed effects absorb time-invariant regional heterogeneity, while year fixed effects absorb common shocks. Driscoll-Kraay standard errors are used as the main inference procedure because they are robust to heteroskedasticity, serial correlation, and cross-sectional dependence. Region-clustered standard errors are reported alongside them as a more conservative check. The one-year lag reduces the estimation sample to 140

observations. Following the journal template, statistical significance is marked as * $p < 0.05$ and ** $p < 0.01$. No causal interpretation is attached to beta.

3. Results

3.1. Regional ranking in 2024

The 2024 RSNI-Core ranking is reported in Table 2. Tashkent city records the highest observed score on both subindices and therefore obtains a core score of 100. Jizzakh, Sirdarya, Fergana, and Tashkent region complete the very-high group. At the lower end, Karakalpakstan, Kashkadarya, and Navoi fall in the medium band. Because RSNI-Core is a relative 0-100 measure, these positions indicate performance within the observed Uzbekistan panel rather than distance from an external competitiveness frontier [5].

Table 2. RSNI-Core regional ranking, 2024.

Rank	Region	IRNI	TRNI	RSNI-Core	Level
1	Tashkent city	100.00	100.00	100.00	Very high
2	Jizzakh	86.50	85.39	85.95	Very high
3	Sirdarya	82.78	83.15	82.96	Very high
4	Fergana	80.93	82.30	81.62	Very high
5	Tashkent region	94.91	65.27	80.09	Very high
6	Surkhandarya	66.58	93.18	79.88	High
7	Khorezm	65.43	87.65	76.54	High
8	Namangan	78.55	74.07	76.31	High
9	Bukhara	68.43	83.31	75.87	High
10	Samarkand	74.82	73.70	74.26	High
11	Andijan	78.04	67.49	72.77	High
12	Karakalpakstan	52.00	62.49	57.24	Medium
13	Kashkadarya	59.15	44.10	51.63	Medium
14	Navoi	74.34	27.20	50.77	Medium

3.2. Internal-external asymmetry

The composite ranking conceals substantial differences in how regional competitiveness is formed. Table 3 isolates four illustrative cases. Tashkent region combines a very strong internal-market score with a weaker external position, whereas Surkhandarya shows the opposite pattern. Navoi has the largest gap among the cases shown: its internal score remains above the middle of the distribution, but its relative export score is low. Jizzakh, by contrast, is balanced across both dimensions. These contrasts justify reporting IRNI and TRNI together with the composite rather than treating the final rank as a complete diagnosis [6].

Table 3. Regions with divergent subindices (internal-external asymmetry)

Region	IRNI	TRNI	Interpretation
Tashkent region	94.91	65.27	Strong internal base; weaker external position
Surkhandarya	66.58	93.18	External performance well above internal

Navoi	74.34	27.20	Above-average internal; weak relative export position
Jizzakh	86.50	85.39	Balanced; high on both margins

3.3. Rank stability

The core ordering is most robust to outlier treatment and remains strongly related to the extended institutional specification. The correlation with the winsorised variant is 0.996, indicating that extreme observations have almost no influence on the regional ordering. Adding the institutional block lowers the correlation to 0.802. The PCA and ModelSignal variants produce only moderate correspondence with the core ranking because their weights are determined by statistical covariance or model coefficients rather than by equal contribution to the economic construct. This divergence is informative: it shows that a statistically optimized weighting rule can change the object being measured [7].

Table 4. Stability of the RSNI-Core ranking across weighting variants (Spearman ρ)

Comparison	Spearman ρ	Assessment
Core - Winsorised	0.996	Very high
Core - Extended	0.802	High
Core - ModelSignal	0.565	Moderate
Core - PCA	0.508	Moderate

4. Discussion

4.1. Interpreting the two-dimensional regional structure

The main substantive result is not the league table itself but the separation of domestic and external competitiveness. A region can possess a relatively strong capital and sales base while remaining weak in export penetration, or it can achieve strong external outcomes despite a less developed internal base [8]. That pattern is consistent with resource-based and dynamic-capability arguments, which distinguish the possession of productive resources from the capability to redeploy them toward changing market opportunities [9]. It also fits recent international evidence that export performance increasingly depends on organizational and digital capabilities in addition to conventional production resources. In the Uzbek setting, this distinction is important because regional industrial structure can depress the small-business share of exports even where individual small firms perform reasonably well [10]. The two-subindex design therefore avoids interpreting a single low share as proof of uniformly weak competitiveness [11].

4.2. Predictive validity and robustness of inference

The predictive test asks a stricter question than the contemporaneous ranking: after removing the criterion itself from the index, does a stronger regional competitiveness state contain information about next-year performance? Table 5 reports the answer. The coefficient for sales is 0.0053, implying that a 10-point increase in the lagged, component-excluded RSNI is associated with a 0.053 increase in next-year log sales per active firm, or approximately 5.4%. For exports, the coefficient of 0.0173 implies a 0.173 increase in log-odds for a 10-point change in the index; $\exp(0.173)$ is about 1.189, corresponding to approximately 18.9% higher odds of a larger small-business export share. These effect translations make the scale of the coefficients easier to interpret, but they remain associations rather than causal effects [12].

Table 5. Predictive validity of RSNi (outcome component removed; index lagged one year)

Next-year outcome	Coef.	Cluster SE	Driscoll-Kraay SE	N	Within R ²
ln sales per active firm (t+1)	0.0053	0.0031	0.0011**	140	0.7812
logit small-business export share (t+1)	0.0173	0.0167	0.0076*	140	0.2345

Notes: * $p < 0.05$, ** $p < 0.01$ under Driscoll-Kraay inference. Neither coefficient is statistically significant with region-clustered standard errors. Region and year fixed effects are included.

The difference between the two inference procedures is central to the interpretation. Driscoll-Kraay standard errors indicate statistical significance for both outcomes, whereas region-clustered standard errors do not. With only 14 regional clusters, the latter comparison is not a minor technical detail; it limits how strongly the predictive result can be stated. The evidence therefore supports criterion validity in the sense that the index contains forward-looking information, but it does not establish a stable causal effect. This cautious reading is also consistent with the original purpose of RSNi as a measurement instrument rather than a structural model of growth [13].

4.3. Methodological contribution and relation to earlier work

The findings reinforce two principles emphasized in the composite-indicator literature: transparent weighting and sensitivity analysis are part of the measurement result, not merely appendices to it. Equal weighting is especially defensible here because the index is formative and policy-facing. PCA weights reward variance and covariance, while model-derived weights reward predictive fit; neither criterion necessarily represents the economic importance of a competitiveness component. The moderate rank correlations of the PCA and ModelSignal variants therefore do not invalidate the core index. Instead, they show that different weighting philosophies answer different questions [14].

The 2024 ranking and internal-external structure are consistent with the earlier domestic application of the regional composite index. The present study adds two elements that were not the focus of that publication: a formal multi-variant sensitivity assessment and predictive validation using lagged, outcome-excluded indices. This distinction is important because a ranking can be descriptively plausible yet still be fragile to weighting choices or fail to relate to subsequent performance. The present robustness and validation exercises make the measurement claim narrower but stronger [15].

4.4. Policy interpretation and limitations

The practical implication is a diagnostic rather than a one-size-fits-all ranking. Regions with strong IRNI but weaker TRNI require attention to the external-market channel - for example, export market access, certification, logistics, and the organizational capabilities needed to convert domestic strength into external sales. Regions with strong TRNI but weaker IRNI call for a different mix, centred on capital depth, financial soundness, productivity, and the resilience of the domestic operating base. This differentiated reading is more consistent with the heterogeneous mechanisms identified in the SME competitiveness literature than a uniform intervention tied to the final rank alone.

Several limitations remain. RSNi does not directly measure product quality, innovation output, digital adoption, profitability, or firm survival because consistent regional series are unavailable for the full period. IRNI and TRNI combine realised outcomes with enabling conditions, so the index is not a pure outcome measure. The

institutional indicators capture policy exposure rather than realised disbursement and are therefore excluded from the core ranking. The 0-100 normalization is relative to the 2014-2024 sample and must be recalculated when new years are added. Finally, the predictive regressions rely on a small number of regional clusters and are reported without wild-cluster bootstrap inference; the econometric evidence should therefore be treated as provisional until it is replicated with a longer panel or more granular units.

5. Conclusion

The study set out to construct a transparent regional measure of small-business competitiveness for Uzbekistan and to test whether that measure is stable and economically informative. The resulting RSNI combines intensive, scale-reduced indicators into equally weighted internal- and external-market subindices. In 2024, Tashkent city ranks first, but the more important finding is the pronounced divergence between IRNI and TRNI in several regions. The core ranking is almost unchanged by winsorisation and remains strongly related to the institutional extension, while statistically determined weighting schemes generate materially different orderings.

The predictive regressions provide additional, though qualified, validation: a higher lagged index is associated with stronger next-year sales and export performance under Driscoll-Kraay inference, but the same relationships are not statistically significant under region-clustered standard errors. RSNI should therefore be used as a transparent regional diagnostic rather than as a causal policy score. Its main value lies in showing whether a region's weakness is primarily internal or external, which creates a clearer empirical basis for differentiated support. Future extensions should incorporate realised policy disbursements, innovation and digital indicators, and few-cluster-robust inference as longer regional series become available.

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