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Article

Digital Convergence without Retail Convergence: Regional Marketing Strategic Potential and Determinants of Retail Development in Uzbekistan

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Abstract: The article aims to explain why the rapid equalisation of digital access across Uzbekistan's regions has not equalised retail development. On a balanced panel of 14 regions for 2015-2024 (140 observations), we measure regional inequality, test sigma- and beta-convergence, build an index of regional marketing strategic potential (IMSS) and estimate panel models. The Theil index of real retail turnover per capita rose by 22.3%. Internet coverage converged strongly ($\beta = -0.0523$; $p < 0.001$; half-life 13.3 years), retail did not ($\beta = +0.00012$; $p = 0.987$). The IMSS (Cronbach's $\alpha = 0.8148$; criterion $R^2 = 0.8375$) shows five regions, Khorezm among them, 8-16% below potential; the fixed-effects internet elasticity of retail turnover is 0.2894.

Keywords: retail trade; regional inequality; sigma-convergence; beta-convergence; digital infrastructure; marketing strategic potential; composite index; panel data; Uzbekistan.

1. Introduction

Over the past decade Uzbekistan has closed most of its regional digital divide. Between 2015 and 2024 internet subscriptions per 100 inhabitants rose 3.58 times in Khorezm and almost sevenfold in Tashkent region, and by 2024 no region stood below 64 [1], an intended result of the Digital Uzbekistan 2030 strategy [2]. Real retail turnover per capita grew 1.84 times nationally, yet the gap between Tashkent city (12.97 million soum in 2015 prices) and Syrdarya region (2.66 million soum) widened slightly, from 4.83 to 4.88 times [3; 4; 5].

We argue that this pairing of equalised opportunity and unequal outcomes is the regional face of a methodological problem: retailers outside the capital lack the strategic tools that turn digital access into sales. We measure regional retail imbalances, test whether retail and digital infrastructure converge, quantify each region's marketing strategic potential and its realisation, and estimate the determinants of retail development. It contributes a potential index validated against the outcome it excludes and a convergence comparison that separates access constraints from conversion constraints.

1.1 Literature Review

Barro and Sala-i-Martin [6] formalised sigma-convergence (shrinking dispersion) and beta-convergence (faster growth of initially poorer units) and found that income gaps across US states close at roughly 2% a year. We run it on an access and an outcome variable for the same regions, turning the contrast of slopes into a diagnostic. Theil's index [7]

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complements them as a decomposable inequality measure that is sensitive to the top of the distribution.

Retail research treats digital technology as a firm capability: Verhoef, Kannan and Inman [8] describe omnichannel retailing as managing all channels as one system, Shankar et al. [9] show how technology reshapes retail value creation, and Verhoef et al. [10] separate digitisation, digitalisation and digital transformation. These authors, however, study markets with high online penetration, not settings like Uzbekistan, where the first stage (access) is nearly complete but online conversion stays near 4%. For Russia, Munshi, Aleksandrova and Munshi [11] stress the rising weight of digital transformation and of offline-online blending in retail development; our evidence confirms this only in part. Uzbek research on regional retail is mostly supply-side: Ibrayimova [12] examined food retail mechanisms in Khorezm and our earlier study [13] described regional features of the retail network, but neither measured how much of a region's potential is used. An index of potential that contains retail turnover cannot be validated against it, so, following the OECD-JRC handbook [14], we build ours from conditions only.

2. Materials and Methods

The data form a balanced panel of 14 regions (Karakalpakstan, 12 provinces and Tashkent city) over 2015-2024, i.e. 140 observations, from the Statistics Agency under the President of the Republic of Uzbekistan: retail turnover and its growth in comparable prices [3; 4], resident population [5], gross regional product (GRP), retail outlets, and internet and mobile subscribers per 100 inhabitants [1]. The panel passed three consistency checks: regional sums against national totals, per capita values times population against volumes, and subscribers per 100 inhabitants against absolute counts. The only inconsistency concerns 2021, when regional retail figures sum to 216,694.8 billion soum, 14.03% below the national 252,056.6 billion, because the 2022 revision of the national series was not carried into the regional breakdown; we therefore avoid nominal regional levels and chain growth rates in comparable prices to the 2015 base.

Inequality is measured by the population-weighted coefficient of variation, the Gini coefficient and the Theil index [7]:

$$T_t = \sum_{i=1}^{N} s_{it} \ln \frac{s_{it}}{p_{it}} \qquad (1)$$

where s_{it} and p_{it} are region i's shares of national retail turnover and population in year t, and N = 14. Beta-convergence is tested as in [6]:

$$\frac{1}{T}\ln\frac{x_{iT}}{x_{i0}} = \alpha + \beta \ln x_{i0} + u_i, \qquad \lambda = -\beta, \qquad t_{1/2} = \frac{\ln 2}{\lambda} \qquad (2)$$

where x_{i0} and x_{iT} are the 2015 and 2024 values, T = 9, λ is the convergence speed and $t_{1/2}$ the half-life of the gap; sigma-convergence is tested by regressing the standard deviation of logs on a trend.

Index weights are set by the analytic hierarchy process [15] and accepted if CR < 0.10; reliability is checked by Cronbach's alpha and by recomputing the index with equal, entropy and CRITIC weights, compared through Kendall's W. Panel models (pooled OLS, fixed effects (FE), random effects (RE) and two-way FE) follow Baltagi [16], with the Hausman [17], Breusch-Pagan, Wooldridge, modified Wald and Pesaran CD [18] tests and with region-clustered and Driscoll-Kraay [19] standard errors. Computations were done in Python (pandas, numpy, statsmodels, linearmodels, scipy) and MS Excel.

2.1 Main Part

Regional inequality. Every inequality measure rose over the decade: the population-weighted coefficient of variation of real retail turnover per capita from 0.568 to 0.642 (+13.0%), the Gini coefficient from 0.2281 to 0.2373 and the Theil index from 0.1186 to 0.1450 (+22.3%). The Theil index rose most because the change happened at the top: Tashkent city's share of nominal turnover grew from 21.89% to 26.38% and the Herfindahl-Hirschman index from 1,030 to 1,185. Inequality dipped only in 2020 and 2022, the

pandemic year and the year of the statistical revision, and the regional hierarchy is rigid (rank correlation between 2015 and 2024: Spearman 0.868, Kendall's tau 0.736).

Convergence. Figure 1 contrasts the two tests. For internet subscriptions $\beta = -0.05226$ ($t = -7.777$; $p < 0.001$; $R^2 = 0.835$), a convergence speed of 5.23% a year and a half-life of 13.3 years; the standard deviation of log coverage fell by 43% (from 0.5122 to 0.2918). For real retail turnover per capita $\beta = +0.00012$ ($t = 0.017$; $p = 0.987$; $R^2 = 0.000$), the sigma trend is insignificant ($b = +0.00048$; $p = 0.522$), and conditioning on internet growth and relative GRP leaves the initial level insignificant (-0.0005; $p = 0.975$).

Khorezm illustrates the paradox. Its internet coverage rose from 22.6 to 80.8 per 100 inhabitants, and its real retail turnover per capita grew by 7.87% a year, faster than anywhere except Karakalpakstan; yet at 3.14 million soum it remained 9th. Syrdarya ranks 4th by internet coverage and last by retail. Opportunity has equalised, outcomes have not.

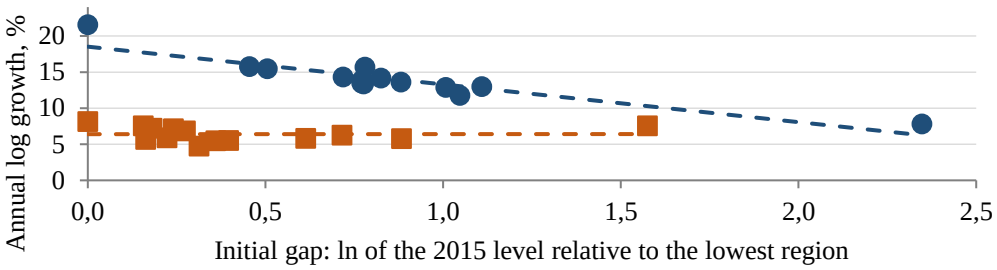


Figure 1. Beta-convergence of internet coverage and retail turnover, 2015-2024

Source: author's calculations based on [1; 3; 4; 5]. Circles: internet coverage; squares: real retail turnover per capita; dashed lines: OLS trends.

Marketing strategic potential index. We define a region's marketing strategic potential as the set of objective conditions for developing and implementing a retail marketing strategy and measure it by four blocks that exclude retail turnover: digital infrastructure B1 (internet and mobile subscribers per 100 inhabitants), demand base B2 (relative GRP per capita; real income growth in 2021-2024), retail infrastructure B3 (outlets per 100,000 inhabitants) and demographic base B4 (population and its growth in 2015-2024). Skewed level indicators are logged before min-max normalisation [14]. With n_{ik} the normalised indicator k,

$$\mathrm{IMSS}_i = 100 \sum_{j=1}^{4} \theta_j B_{ij}, \qquad B_{ij} = \frac{1}{m_j} \sum_{k \in j} n_{ik}, \qquad \sum_{j=1}^{4} \theta_j = 1 \qquad (3)$$

where θ_j is the weight of block j and m_j the number of its indicators. Digital infrastructure is weighted twice as heavily as demand, four times as heavily as outlets and three times as heavily as population: personalisation, retargeting and online-to-offline measurement require digital channels, while market size sets the scale of a strategy, not its quality. The weights are 0.46, 0.27, 0.09 and 0.18 (CR = 0.0115), Cronbach's alpha is 0.8148, and the rankings under equal, entropy and CRITIC weights stay concordant ($W = 0.8335$; $p < 0.001$). Because turnover is not a component, criterion validity can be tested directly:

$$\ln R_i = a + b\mathrm{IMSS}_i + u_i, \qquad K_i^r = \frac{R_i}{\exp(\hat{a} + \hat{b}\mathrm{IMSS}_i)} \qquad (4)$$

where R_i is real retail turnover per capita and K^r_i the realisation coefficient, the ratio of actual turnover to the level predicted by potential. With $\hat{a} = 0.7456$ and $\hat{b} = 0.0190$ ($t = 7.87$), $R^2 = 0.8375$: one index point corresponds to about 1.9% higher turnover per capita (Table 1).

Table 1. Marketing strategic potential index (IMSS), tiers and realisation coefficient by region, 2024

Region	B1	B2	B3	B4	IMSS	Tier	K^r
Tashkent city	1.000	0.946	1.000	0.894	96.62	I	0.984
Navoiy	0.329	0.565	0.537	0.263	39.97	II	1.231

Region	B1	B2	B3	B4	IMSS	Tier	K^r
Fergana	0.229	0.326	0.161	0.703	33.42	III	**0.836**
Andijan	0.116	0.397	0.073	0.670	28.78	III	**0.878**
Khorezm	0.169	0.348	0.296	0.424	27.49	III	**0.884**
Samarkand	0.101	0.222	0.286	0.767	27.00	III	0.934
Bukhara	0.171	0.318	0.388	0.379	26.76	III	1.207
Tashkent region	0.029	0.386	0.478	0.395	23.18	IV	1.495
Namangan	0.148	0.156	0.000	0.672	23.09	IV	0.955
Syrdarya	0.243	0.128	0.337	0.206	21.36	IV	**0.841**
Karakalpakstan	0.171	0.133	0.272	0.345	20.13	IV	**0.916**
Kashkadarya	0.030	0.150	0.040	0.729	18.91	IV	0.958
Jizzakh	0.134	0.116	0.091	0.454	18.29	IV	0.954
Surkhandarya	0.007	0.154	0.077	0.706	17.89	IV	1.123

Source: author's calculations based on [1; 3; 4; 5]. Tiers (at the largest breaks of IMSS): I ≥ 50; II 36-50; III 25-36; IV < 25. K^r: > 1.10 above, 0.92-1.10 balanced, < 0.92 below potential (bold).

Four regions achieve more than their conditions predict and five fall short by 8-16%. Khorezm ranks 5th by potential, but its turnover of 3.139 million soum per capita is below the predicted 3.551 million; by our calculation, about 13% more turnover per resident is attainable without new infrastructure. Tashkent region's K^r is inflated because many residents subscribe at capital addresses, which understates its B1 (0.029).

Panel model. The determinants are estimated on the full panel:

$$\ln R_{it} = \alpha_i + \beta_1 \ln \mathrm{INT}_{it} + \beta_2 \ln \mathrm{MOB}_{it} + \beta_3 \ln \mathrm{GRP}_{it} + \beta_4 \ln \mathrm{ORG}_{it} + \varepsilon_{it} \qquad (5)$$

where INT and MOB are internet and mobile subscribers per 100 inhabitants, GRP is relative GRP per capita (which sidesteps the missing regional deflator), ORG is outlets per 100,000 inhabitants and α_i the regional effect (Table 2).

Table 2. Panel estimates of the determinants of real retail turnover per capita, 2015-2024

Variable	Pooled OLS	FE	RE	Two-way FE
ln INT	0.3640*** (0.1246)	0.2894*** (0.0714)	0.2929*** (0.0800)	−0.1226** (0.0489)
ln MOB	−0.0018 (0.2899)	0.0813 (0.2237)	0.0830 (0.2806)	0.0720 (0.0601)
ln GRP	0.5421*** (0.1913)	−0.0707 (0.0793)	0.1066 (0.1077)	−0.0550 (0.0521)
ln ORG	0.0221 (0.1374)	0.0510 (0.0733)	0.0643 (0.0725)	0.0032 (0.0383)
Effects	none	region	random	region, year
R^2 (within)	0.6531	0.7554	0.7458	negative

*Source: author's calculations; N = 140. Dependent variable: ln of real retail turnover per capita. Region-clustered standard errors in parentheses; *** p < 0.01, ** p < 0.05, * p < 0.10.*

The poolability ($F(13; 122) = 39.157$) and Breusch-Pagan ($\chi^2(1) = 304.550$) tests reject pooled OLS, and the Hausman test ($\chi^2(4) = 20.363$; $p < 0.001$) favours FE, since unobserved regional traits such as location correlate with the regressors. The Wooldridge ($F(1; 13) = 35.010$), modified Wald ($\chi^2(14) = 82.186$) and Pesaran (CD = 19.106) tests reveal autocorrelation, heteroskedasticity and cross-sectional dependence; the maximum VIF is 2.25. In the FE model internet coverage is the only significant factor: a 1% rise in subscriptions goes with 0.29% higher real turnover per capita (0.2894; t = 4.05). Relative GRP, dominant in pooled OLS (0.5421), loses significance once regional effects absorb permanent income differences.

3. Results and Discussion

The internet elasticity survives five specifications: FE with clustered (t = 4.05) and Driscoll-Kraay (t = 4.96) errors, FE without mobile subscriptions (0.3149; t = 7.43), RE (0.2929) and pooled OLS (0.3640). With year effects, however, it turns negative (−0.1226) and the within R^2 falls below zero, because a common trend accounts for 62.9% of the variance of ln INT and the year dummies absorb it; in a dynamic model the lagged dependent variable (0.782) takes up most short-run movement and the internet coefficient drops to 0.0043 (t = 0.16). We therefore read 0.2894 as a stable association, not a causal effect: identification would require instruments or a natural experiment that regional statistics do not yet allow.

The variable most closely associated with retail converged fastest, at 5.23% a year, more than twice the speed Barro and Sala-i-Martin [6] report for US state incomes, yet retail did not converge. Had access gaps caused retail gaps, both would have narrowed. Digital infrastructure is necessary but not sufficient; the missing link is the mechanism that converts it into market results. Access matters, as Munshi et al. [11] stress, but it does not act by itself, which supports the capability-based reading of Verhoef et al. [10] and Shankar et al. [9]. The IMSS and K^r pair also separates two problems that outcome-based rankings merge: Jizzakh or Kashkadarya lack conditions, while Fergana, Andijan and Khorezm lack conversion. Limitations remain: a short panel, a bypassed 2021 break, subscription counts that measure connections rather than users, and judgement-based AHP weights.

4. Conclusion

Over 2015-2024 regional retail inequality in Uzbekistan grew (Theil +22.3%) while digital access converged, so the gap is structural and, in our view, methodological rather than technological. The IMSS is reliable and valid (R^2 = 0.8375) and places Fergana, Syrdarya, Andijan, Khorezm and Karakalpakstan 8-16% below potential; the FE internet elasticity of 0.2894 is robust but associative.

Regional retail programmes should therefore distinguish the type of gap. In the five under-performing regions, support for retailers' marketing capabilities (shared analytics, omnichannel tools, measurement of online-to-offline effects) promises more than new outlets or connectivity, while in regions above potential infrastructure investment remains the main lever. For Khorezm, the 13% gap to its predicted level is a realistic medium-term target, monitored annually through K^r. Retailers should set their strategy and KPIs by IMSS tier rather than copy a national template, and regional e-commerce statistics and a regional GRP deflator would allow causal identification of the digital channel's effect.

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