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ECONOMETRIC ASSESSMENT OF FACTORS AFFECTING THE STRUCTURAL DEVELOPMENT OF SMALL BUSINESS IN THE REGIONS OF UZBEKISTAN

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Abstract. This article assesses the factors affecting the structural development of small business across the regions of Uzbekistan using panel data for 2015–2024. The dataset covers 14 territorial units over ten years, yielding 140 observations. Fifteen institutional, sectoral, financial, technological and demographic indicators were initially considered. Pearson correlations and variance inflation factors were used to reduce multicollinearity. The Hausman test supported a fixed-effects specification. The final model identifies the number of small business entities, export share, service-sector share, credit volume, fixed-capital investment and the digital technology index as statistically significant determinants. The within R-squared equals 0.847, indicating that a large share of within-region variation in the regional efficiency index is explained by the selected factors. The largest estimated effects are associated with the number of small business entities (β=0.214), fixed-capital investment (β=0.203) and export participation (β=0.187).
Keywords: small business, panel data, fixed effects, Hausman test, VIF, investment, exports, digitalization, regional efficiency

Introduction

The role of small business in the national economy is determined not only by the number of enterprises or their share in employment, but also by their sectoral allocation, investment activity, access to export markets, use of financial resources, and adoption of digital technologies. Economic, infrastructural and institutional differences across regions may cause small-business outcomes to vary even under the influence of similar factors. Therefore, a panel econometric approach that simultaneously accounts for spatial and temporal dimensions is methodologically appropriate for assessing the structural development of the entrepreneurship sector.

The purpose of this study is to identify the main factors affecting the regional economic efficiency of small business in Uzbekistan, quantify the magnitude of their effects, and substantiate policy priorities for structural development. To achieve this objective, a panel dataset for 2015–2024 was constructed; descriptive statistics, correlation analysis and VIF diagnostics were performed for the initial 15 factors; and the final regression equation was then estimated using a fixed-effects model.

The literature extensively documents the role of small and medium-sized enterprises in economic growth, employment and poverty reduction. Ayyagari, Beck and Demirgüç-Kunt show in a cross-country setting that SMEs are a key structural component of economic systems, while Beck, Demirgüç-Kunt and Levine empirically examine the relationship between SMEs, growth and welfare. From the perspective of regional panel-data analysis, Baltagi demonstrates the advantages of controlling for unobserved regional heterogeneity. The present study applies

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these methodological perspectives to the assessment of structural small-business development across the regions of Uzbekistan.

Figure 1. Panel Econometric Research Design

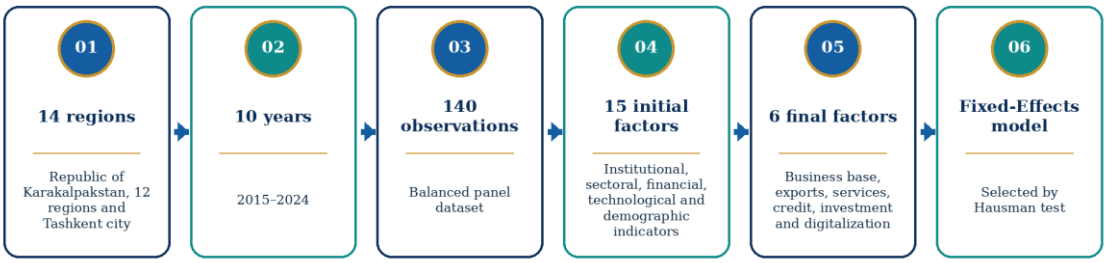

Figure 1. Panel econometric research design

Data and Research Methodology

The empirical database covers 14 territorial units of the Republic of Uzbekistan over the period 2015–2024. Ten annual observations are available for each region, producing a balanced panel with N=140 observations. The dependent variable is the regional economic efficiency index of the entrepreneurship sector (Y). In the dissertation methodology, this index is interpreted as an integral indicator summarizing small-business outcomes associated with investment, exports and the service sector.

The initial explanatory set consisted of variables X1–X15, covering the number of small business entities, shares of private enterprises and individual entrepreneurs, exports, innovation, service-sector, industrial and agricultural participation, credit and investment, digital technologies, business demography, business density, and women and youth entrepreneurship. The article focuses primarily on the indicators retained near the final model and on those that play a central role in the economic interpretation.

Table 1. Structure of the empirical database

Parameter	Value
Number of regions	14
Period	2015–2024
Periods per region	10
Total observations	140
Initial factors	15
Factors in the final model	6
Selected model	Fixed Effects (FE)

Descriptive statistics reveal substantial cross-regional dispersion. The mean number of small business entities is 52.4 thousand, while the maximum reaches 218.6 thousand. The export share ranges from 2.1% to 47.8%, and the share of small business in services varies from 18.2%

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to 68.4%. Fixed-capital investment ranges from UZS 464.2 billion to UZS 91,643 billion. Such differences reinforce the need to account for region-specific individual effects.

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Table 2. Descriptive statistics for the main variables (N=140)

Indicator	Mean	SD	Min–Max	Median
Regional efficiency index	0	1	−1.847 – 3.214	−0.112
Small business entities (000s)	52.4	48.7	8.3 – 218.6	38.2
Export share (%)	14.7	9.4	2.1 – 47.8	12.3
Innovative firms (%)	4.2	2.8	0.4 – 14.6	3.7
Services share (%)	41.3	11.6	18.2 – 68.4	40.7
Credit (UZS bn)	8742	14381	159.7 – 99609	2993
Fixed investment (UZS bn)	17845	21634	464.2 – 91643	9847
Digital technology index	0.312	0.184	0.041 – 0.847	0.278

Correlation and Multicollinearity Diagnostics

Before estimating the multivariate regression, relationships among the explanatory variables were examined using Pearson correlation coefficients. The strongest positive correlations with the regional efficiency index were observed for investment (r=0.698), credit (r=0.621) and the number of small business entities (r=0.614). The correlations were r=0.573 for export share, r=0.487 for the service-sector share and r=0.412 for the digital technology index. The correlation of r=0.714 between credit and investment indicated the need for a separate multicollinearity check.

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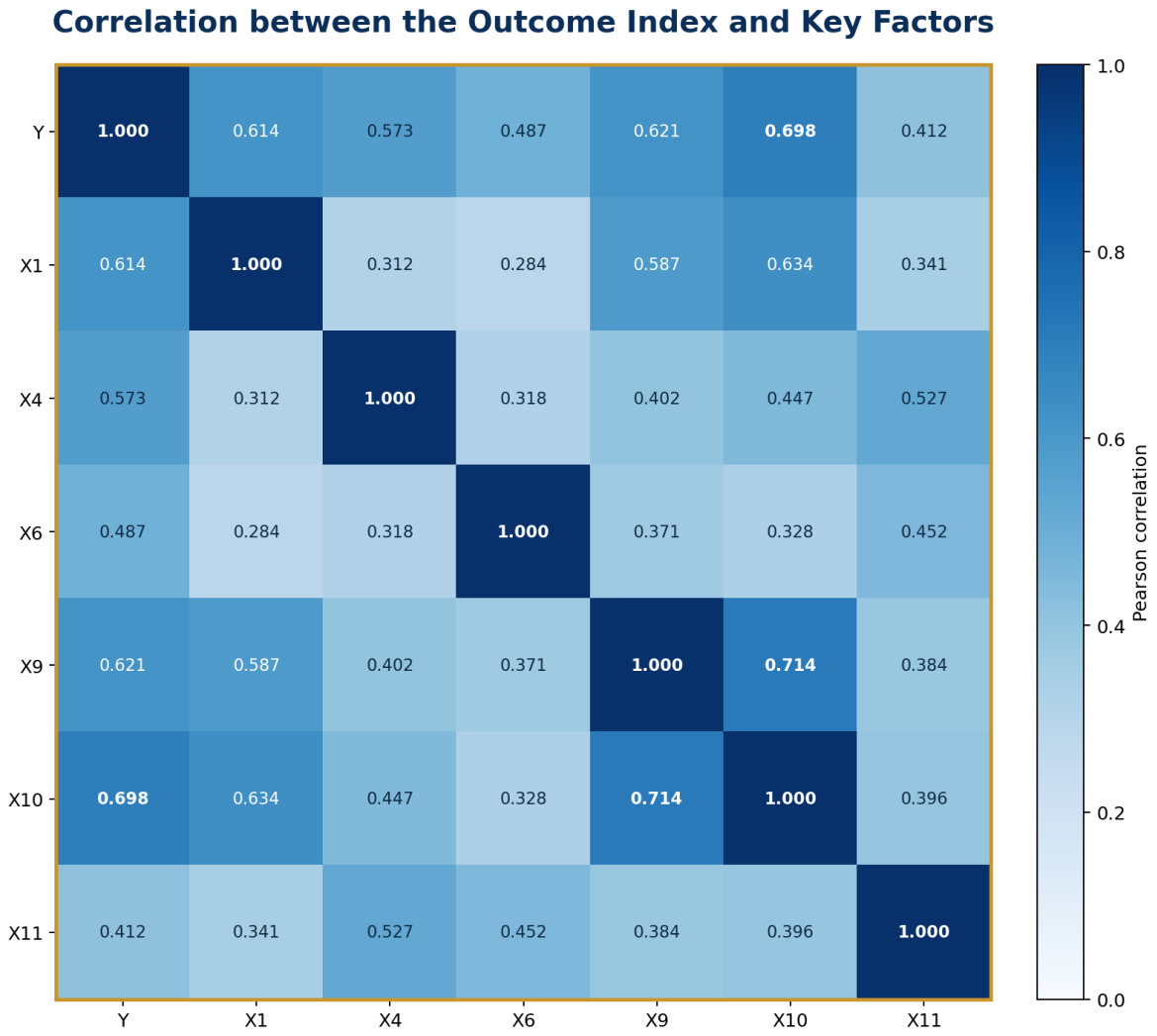

Figure 2. Correlation matrix between the outcome index and selected factors

A VIF value above 5 was adopted as a cautionary threshold. Variables X2, X3, X7, X8, X12, X13 and X14 were excluded because of elevated VIF values. Variables X5 and X15 were initially retained, but were later removed from the final regression because they produced p-values above 0.05. The final specification therefore consisted of six explanatory factors.

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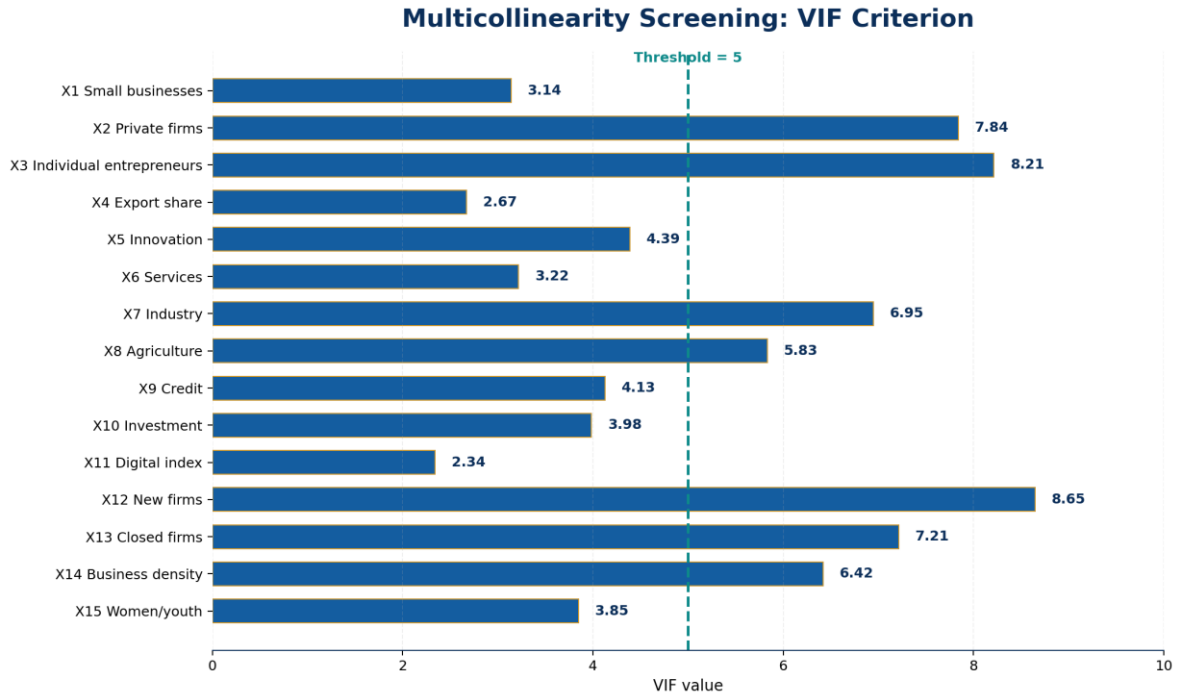

Figure 3. VIF diagnostics for the initial explanatory variables

Table 3. Factor screening based on the VIF criterion

Factor	VIF	Decision
X1 Small businesses	3.142	Retain
X2 Private firms	7.841	Exclude
X3 Individual entrepreneurs	8.214	Exclude
X4 Export share	2.674	Retain
X5 Innovation	4.387	Retain
X6 Services	3.218	Retain
X7 Industry	6.947	Exclude
X8 Agriculture	5.832	Exclude
X9 Credit	4.127	Retain
X10 Investment	3.984	Retain
X11 Digital index	2.341	Retain
X12 New firms	8.647	Exclude
X13 Closed firms	7.213	Exclude
X14 Business density	6.418	Exclude

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Factor	VIF	Decision
X15 Women/youth	3.847	Retain

Model Selection and Econometric Specification

The Hausman test was applied to select among pooled regression, random-effects and fixed-effects specifications. The test produced $\chi^2(6)=24.83$ with $p=0.0004$, so the null hypothesis was rejected. This result indicates that unobserved regional characteristics may be correlated with the explanatory variables and supports the fixed-effects model as the more reliable specification.

Because the dependent index contains negative values, two units were added to Y before logarithmic transformation. The final specification is expressed as follows:

$$\ln(Y_{it} + 2) = \alpha_i + 0.214\ \ln X1_{it} + 0.187\ \ln X4_{it} + 0.156\ X6_{it} + 0.132\ \ln X9_{it} + 0.203\ \ln X10_{it} + 0.098\ X11_{it} + \varepsilon_{it}$$

Here, α_i denotes the time-invariant region-specific effect, while ε_{it} is the stochastic error term. Coefficients on logarithmically transformed variables can be interpreted approximately as elasticities, whereas coefficients on shares and indices indicate conditional changes in the dependent index.

Results

Table 4. Regression results from the fixed-effects model

Factor	β	95% CI lower	95% CI upper	p-value
Number of small businesses	0.214	0.103	0.325	<0.001
Export share	0.187	0.098	0.276	<0.001
Service-sector share	0.156	0.051	0.261	0.004
Credit volume	0.132	0.028	0.236	0.013
Fixed-capital investment	0.203	0.117	0.289	<0.001
Digital technologies	0.098	0.009	0.187	0.031

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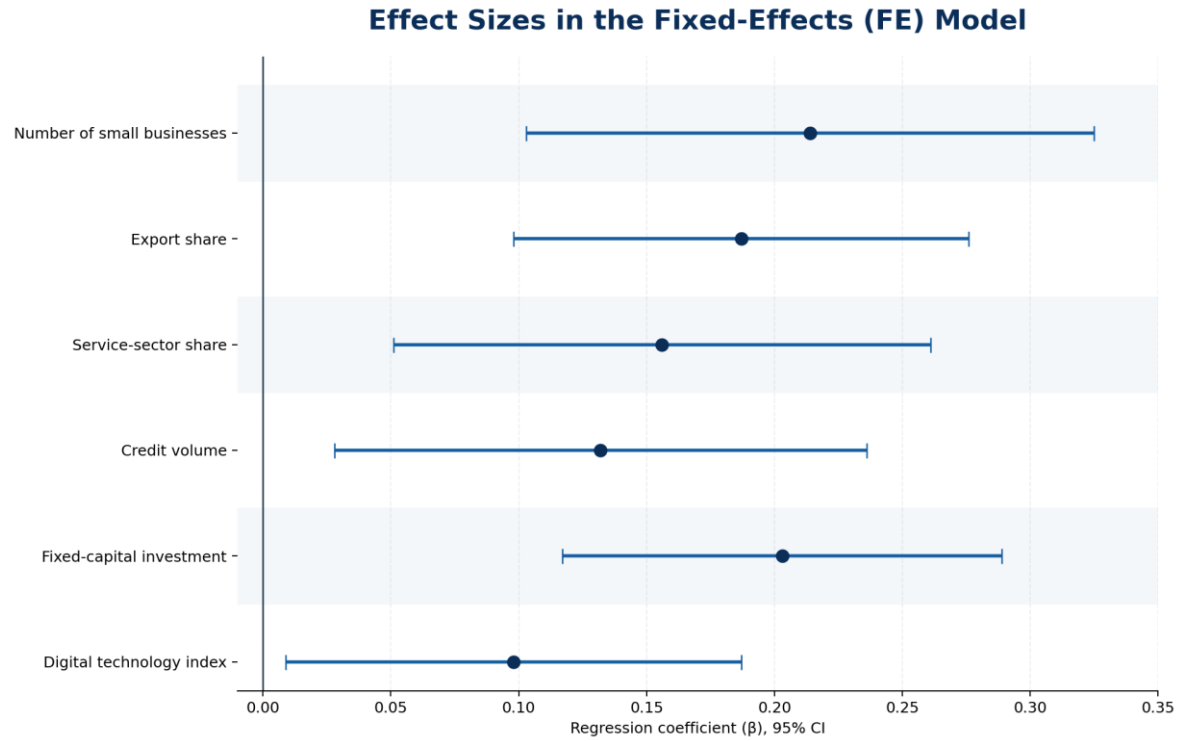

Figure 4. Regression coefficients and 95% confidence intervals

All six explanatory variables are statistically significant at the 5% level. The number of small business entities has the largest coefficient (β=0.214), indicating that expansion of the entrepreneurial base is closely associated with regional economic efficiency. The coefficient on fixed-capital investment (β=0.203) shows that investment activity is a central factor in the structural modernization and productive capacity of small business.

The export-share coefficient is β=0.187 with $p<0.001$, showing that greater participation of small business in external markets significantly improves regional efficiency. The service-sector share has β=0.156, reflecting the growing role of service-oriented and demand-responsive small-business segments. Credit volume has a positive effect (β=0.132), although its coefficient is lower than that of investment, implying that the transformation of financial resources into real capital is more important than credit availability alone.

The digital technology index is positive but comparatively small (β=0.098, p=0.031). This result indicates that stronger economic returns from digitalization require broader internet infrastructure, e-commerce, digital payments, business-process automation and digital skills.

Table 5. Model fit and diagnostic tests

Diagnostic	Result
R^2 (within)	0.847
R^2 (between)	0.763
R^2 (overall)	0.812
Adjusted R^2	0.831

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Diagnostic	Result
F-statistic	$F(6,120)=71.24$; $p<0.001$
Hausman test	$\chi^2(6)=24.83$; $p=0.0004$
Breusch–Pagan/Cook–Weisberg	$\chi^2(6)=9.47$; $p=0.148$
Durbin–Watson	1.874
Significance of regional FE	$F(13,120)=8.74$; $p<0.001$

The within R^2 of 0.847 indicates that 84.7% of the within-region variation over time is explained by the selected factors. The overall R^2 of 0.812 also shows a high explanatory capacity. The F-statistic confirms the overall significance of the model. A Breusch–Pagan/Cook–Weisberg p-value of 0.148 indicates no serious heteroskedasticity problem, while Durbin–Watson=1.874 suggests the absence of strong first-order residual autocorrelation.

Table 6. Results of hypothesis testing

Hypothesis	Content	Result	Key statistic
H1	Diversification and innovation activity	Partially supported	$\beta1=0.214$; X5 insignificant
H2	Small-business expansion and employment/efficiency	Supported	$\beta1=0.214$; $p<0.001$
H3	Export share increases efficiency	Supported	$\beta4=0.187$; $p<0.001$
H4	Innovation and digital technologies	Partially supported	$\beta11=0.098$; $p=0.031$
H5	Service-sector share strengthens regional growth	Supported	$\beta6=0.156$; $p=0.004$
H6	Credit and investment accelerate transformation	Supported	$\beta9=0.132$; $\beta10=0.203$

Discussion and Policy Recommendations

The empirical results show that increasing the number of firms alone is insufficient for an effective small-business policy. High performance is generated through the combined influence of firm numbers, capital investment, export integration, participation in service markets, financial resources and digitalization. Regional policy should therefore move beyond quantitative incentives toward improving the structural quality of entrepreneurship.

The first priority is to strengthen the joint investment-export mechanism. Investment projects should support local small businesses in ways that integrate them into export value chains and link them to standardization, certification, logistics and marketing infrastructure. The second priority is to connect credit allocation to efficiency and investment outcomes. Monitoring

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should focus on whether borrowed resources are converted into productive fixed capital, technological modernization and more efficient working capital.

The third priority is to develop service and digital-business ecosystems. The positive but relatively modest coefficient on the digital technology index indicates the need to improve the economic returns to existing technological infrastructure. Expanding e-commerce, fintech, remote services, digital accounting and the use of e-government services in the regions can reduce transaction costs for small firms.

A limitation of the study is that, although the panel model controls for time-invariant regional effects, it does not fully establish causality. More developed regions may themselves attract greater business formation and investment. Future work could apply instrumental variables, dynamic-panel GMM or spatial-panel models to examine endogeneity and interregional spillovers more rigorously.

Conclusion

The panel analysis of 140 observations covering 14 regions over 2015–2024 confirms that the structural development of small business in Uzbekistan is multifactorial. The Hausman test supports the fixed-effects specification, and the final six-factor model demonstrates strong explanatory power.

The most influential factors are the number of small business entities (β=0.214), fixed-capital investment (β=0.203) and export share (β=0.187). Service-sector participation, credit resources and digital technologies also exert statistically significant positive effects. The results indicate that regional entrepreneurship policy should not be limited to expanding the number of firms, but should combine investment, exports, services and digitalization within a unified mechanism of structural development.

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