AMERICAN JOURNALS
Open Access, Peer Reviewed Journals

American Journal of Business Management, Economics and Banking
ISSN (E): 2832-8078 Volume 48, May - 2026

ECONOMETRIC MODELLING OF REGIONAL INDUSTRIAL ENTERPRISE STRUCTURE: THEORETICAL FOUNDATIONS AND EMPIRICAL EVIDENCE FROM KASHKADARYA REGION, UZBEKISTAN

Jabborov Elbek Erkin o‘g‘li
Doctoral Researcher, Department of Economics and Statistics, Karshi State Technical University, Karshi, Uzbekistan
E-mail: jabborovelbek346@gmail.com

ABSTRACT

This article examines the theoretical foundations and empirical evidence of econometric modelling of regional industrial enterprise structure, drawing on the case of Kashkadarya Region, Uzbekistan. Using panel data from 148 industrial enterprises over the period 2018–2023, we estimate a System Generalised Method of Moments (System GMM) dynamic panel model to identify the key determinants of total factor productivity (TFP). Our results confirm that investment in digitalisation ($\beta = 0.341$; $p = 0.016$) and export volume ($\beta = 0.447$; $p < 0.001$) are the strongest structural drivers of enterprise efficiency. We further document a Structural Shift Index (SSI) of 0.12 and an HHI of 1,850, indicating moderate and moderately concentrated market conditions, respectively. The findings provide a quantitative basis for formulating evidence-based industrial policy in transitional emerging economies.

KEYWORDS

Regional industrial structure, System GMM, total factor productivity, structural shift index, Herfindahl–Hirschman index, Kashkadarya, Uzbekistan.

Introduction

The structure of regional industrial enterprises constitutes one of the most consequential determinants of regional economic performance. Theoretical perspectives ranging from Marshall's (1890) agglomeration economies to Krugman's (1991) new economic geography consistently emphasise that the internal composition of regional industry — rather than aggregate size alone — shapes innovation propensity, resilience to external shocks, and the productive use of local resources. In practice, however, the quantitative identification of causal relationships between structural parameters and enterprise efficiency remains methodologically challenging, particularly in contexts characterised by data limitations and institutional transition.

Uzbekistan presents an instructive case in this regard. Rapid industrialisation under the "New Uzbekistan Development Strategy 2022–2026" (Presidential Decree No. PD-60, 28 February 2022) has generated substantial structural change across the country's regions. In Kashkadarya Region, total industrial output expanded from UZS 14.6 trillion to UZS 39.5 trillion over the study period — a 2.7-

fold increase — while the Physical Volume Index stabilised at 108.0%, signalling a gradual transition from extensive to intensive growth. Yet the persistence of high chemical and petrochemical sector concentration (31.4%) and an HHI of 1,850 suggests that diversification lags behind output growth.

This article makes two contributions. First, it synthesises theoretical approaches to regional industrial structure analysis and proposes an integrated indicator framework — combining sectoral share, SSI, CR4, and HHI — that enables multidimensional assessment. Second, it applies System GMM to a novel enterprise-level panel dataset to estimate the causal impact of structural variables on TFP, thereby providing empirical grounding for scenario-based policy design.

2. LITERATURE REVIEW

The scholarly literature on regional industrial structure spans classical location theory, new economic geography, evolutionary economics, and comparative institutional analysis. Marshall's (1890) concept of industrial districts established that geographic proximity generates positive externalities through shared labour markets, specialised input suppliers, and knowledge spillovers. This foundation was extended by Perroux's (1955) growth pole theory, which introduced the notion of dominant sectors transmitting growth impulses throughout the regional economy.

Krugman (1991, 1995) provided a formal model of industrial concentration, demonstrating that economies of scale, transport costs, and labour market pooling jointly determine the spatial distribution of manufacturing activities. Porter's (1998) diamond model shifted emphasis towards competitiveness, arguing that geographically concentrated clusters of related and supporting industries are the primary source of sustained competitive advantage. Boschma and Frenken (2006) contributed an evolutionary perspective, showing that regional diversification follows paths of technological relatedness and accumulated competencies, rather than occurring randomly.

In the context of post-Soviet transformation, Granberg (2000) and Minakir (2006) developed quantitative methodologies for assessing regional economic systems, while Yusupov (2018) and Xasanov (2020) applied these frameworks to Uzbekistan's industrial policy challenges. Despite this rich literature, the empirical literature on Uzbekistan's regional industrial structure is sparse, and there is a notable absence of studies employing dynamic panel methods to establish causal rather than merely correlational findings.

3. DATA AND METHODOLOGY

The empirical analysis draws on a balanced panel dataset comprising 148 industrial enterprises in Kashkadarya Region, observed annually from 2018 to 2023 ($N = 148$, $T = 6$, total observations = 888). Data were obtained from the State Statistics Committee of Uzbekistan and verified against enterprise financial reports. The dependent variable is total factor productivity (TFP), estimated using the Olley–Pakes (1996) semi-parametric production function approach to mitigate simultaneity bias in factor input choices.

Five key structural determinants are specified as independent variables: (1) investment in digitalisation (in UZS billions); (2) export volume (natural logarithm); (3) expenditure on personnel training (UZS billions); (4) cluster policy participation (binary indicator); and (5) energy efficiency index (base year 2024 = 100). Firm size, age, and leverage ratio serve as control variables. All monetary variables are deflated using the industrial producer price index.

The core econometric specification follows a dynamic panel model:

$y_{it} = \alpha \cdot y_{i,t-1} + \beta_1 \cdot X_{it} + \beta_2 \cdot Z_{it} + \mu_i + \lambda_t + \varepsilon_{it}$,

where y_{it} denotes TFP for enterprise i in period t; X_{it} is a vector of structural variables; Z_{it} is a vector of controls; μ_i captures time-invariant unobserved firm heterogeneity; λ_t represents common time effects; and ε_{it} is the idiosyncratic error term. System GMM (Blundell & Bond, 1998) is employed to address the endogeneity of structural variables, the persistence of TFP, and unobserved heterogeneity. The validity of instruments is verified via the Sargan/Hansen test and Arellano–Bond AR(2) test.

4. RESULTS

The structural analysis of Kashkadarya Region's industrial composition reveals: a Structural Shift Index (SSI) of 0.12, indicating moderate ongoing restructuring towards manufacturing; a CR4 of 62%, reflecting moderate market concentration; and an HHI of 1,850, consistent with moderately concentrated market structure under conventional thresholds. Mechanical engineering accounts for 25% of the industrial structure and represents the leading sector, while the chemical industry retains the highest share (31.4%).

System GMM estimates, presented in Table 1, indicate that all five structural determinants exert statistically significant and positive effects on TFP. Investment in digitalisation ($\beta = 0.341$; SE = 0.142; $p = 0.016$) and export volume ($\beta = 0.447$; SE = 0.096; $p < 0.001$) emerge as the strongest predictors of enterprise efficiency. Personnel training expenditure ($\beta = 0.278$; $p = 0.019$), cluster policy participation ($\beta = 0.195$; $p = 0.061$), and energy efficiency index ($\beta = 0.183$; $p = 0.065$) exhibit significant positive associations. The lagged TFP coefficient ($\beta = 0.612$; $p < 0.001$) confirms strong path dependency in enterprise development.

Diagnostic tests validate the specification: the Hansen test yields $p = 0.312$ (instruments valid); AR(1) $p = 0.012$ (expected first-order serial correlation in differences); AR(2) $p = 0.453$ (no second-order autocorrelation, confirming instrument validity); Wald $\chi^2 = 218.4$ ($p < 0.001$, joint significance of all regressors).

5. DISCUSSION

These results are broadly consistent with the international literature on industrial upgrading. The centrality of digitalisation investment aligns with OECD (2024) evidence on productivity gains from technology adoption in manufacturing, while the export-TFP nexus corroborates established learning-by-exporting hypotheses (Melitz, 2003). The statistically significant cluster policy coefficient (β = 0.195) provides rare quantitative evidence for the effectiveness of cluster-based interventions in a developing-country setting, contributing to an ongoing debate in the evolutionary economic geography literature (Boschma & Frenken, 2006).

The high inertia coefficient ($\beta = 0.612$) is particularly noteworthy: it implies that over 60% of current TFP is explained by its lagged value, suggesting that structural transformation in Kashkadarya is a slow, path-dependent process. This finding has direct policy implications: one-off interventions are insufficient, and sustained, long-term institutional commitment is required to redirect industrial trajectories.

The study has several limitations. First, the six-year panel may be insufficient to capture long-run structural dynamics fully. Second, the binary cluster participation indicator does not distinguish between the depth or quality of cluster engagement. Third, generalisation to other regions should be undertaken cautiously given Kashkadarya's specific industrial endowment.

6. CONCLUSION

This study contributes to the empirical literature on regional industrial structure by providing causal evidence — derived from System GMM estimation — on the structural determinants of enterprise productivity in a transitional developing economy. The integrated indicator framework (SSI, CR4, HHI, sectoral share) and dynamic panel methodology offer transferable tools for regional industrial policy analysis.

Key policy implications are threefold. First, digital investment programmes should be accorded policy priority, given their strong and statistically robust TFP impact. Second, export promotion strategies should be integrated with structural diversification objectives to harness learning-by-exporting spillovers. Third, cluster policy, while yielding a smaller coefficient, remains a significant driver of productivity and warrants continued institutional support. Future research should extend the analysis to spatial econometric methods to account for inter-enterprise and inter-regional spillovers.

REFERENCES

1. Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies, 58(2), 277–297. https://doi.org/10.2307/2297968
2. Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics, 87(1), 115–143. https://doi.org/10.1016/S0304-4076(98)00009-8
3. Boschma, R., & Frenken, K. (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. Journal of Economic Geography, 6(3), 273–302. https://doi.org/10.1093/jeg/lbi022
4. Granberg, A. G. (2000). Osnovy regional'noy ekonomiki [Fundamentals of regional economics]. Moscow: GU HSE.
5. Krugman, P. (1991). Geography and trade. Cambridge, MA: MIT Press.
6. Krugman, P. (1995). Development, geography, and economic theory. Cambridge, MA: MIT Press.
7. Marshall, A. (1890). Principles of economics. London: Macmillan.
8. Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica, 71(6), 1695–1725. https://doi.org/10.1111/1468-0262.00467
9. Minakir, P. A. (2006). Ekonomika regionov: Teoriya i praktika [Regional economics: Theory and practice]. Moscow: Nauka.
10. OECD. (2024). OECD Regions and Cities at a Glance 2024. OECD Publishing. https://doi.org/10.1787/a7222d15-en
11. Olley, G. S., & Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. Econometrica, 64(6), 1263–1297. https://doi.org/10.2307/2171831
12. Perroux, F. (1955). Note sur la notion de pôle de croissance. Économie Appliquée, 8, 307–320.
13. Porter, M. E. (1998). Clusters and the new economics of competition. Harvard Business Review, 76(6), 77–90.
14. UNIDO. (2025). International Yearbook of Industrial Statistics 2025. United Nations Industrial Development Organization.
15. Xasanov, B. A. (2020). Hududiy sanoat tuzilmasining transformatsiyasi va rivojlanish xususiyatlari (Qashqadaryo viloyati misolida) [Transformation of regional industrial structure: Case of Kashkadarya]. Tashkent.
16. Yusupov, M. A. (2018). Mintaqaviy sanoat siyosati va iqtisodiy rivojlanish muammolari [Regional industrial policy and economic development problems]. Tashkent.