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Regional Differentiation of Small and Medium Business Development in Kazakhstan

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Abstract
The development of small and medium-sized businesses is considered one of the key factors for ensuring economic growth, employment, and sustainable regional development. The purpose of the study is to identify the structure of regional development among small and medium-sized businesses in Kazakhstan and to identify groups of regions with different levels of entrepreneurial activity. The methodological basis of the study includes data standardization using the Z-score method, principal component analysis (hereinafter – PCA) and cluster analysis using the Ward method. The study uses data from the Bureau of National Statistics for the period 2018-2024. The results of the study revealed significant interregional differences in the development of small and medium-sized businesses. The highest values of the indicators were recorded in the cities of Almaty and Astana. Thus, in Almaty, the standardized values for gross value added, output, employment, and the number of enterprises were 3.22, 3.11, 3.59, and 2.92, respectively. In Astana, the corresponding figures were 1.76, 1.92, 1.53, and 1.70. Cluster analysis identified two stable clusters of regions, with an intercluster sum of squares of 62.94 and a total sum of squares of 80.71, indicating high interregional differentiation. The results of the study showed that growth in the number of enterprises is not accompanied by proportional increases in output, employment, and value added, indicating structural heterogeneity in the development of small and medium-sized businesses across regions of Kazakhstan.

KEYWORDS
Enterprise, Entrepreneurial Activity, Business Environment, Employment, Economic Activity, Regional Policy

1 | INTRODUCTION

Modern economic development is accompanied by the strengthening of the role of small and medium-sized businesses as key factors in economic growth, employment, and regional sustainability. Small and medium-sized businesses help create a competitive environment, contribute to economic diversification and the development of local markets, and increase the flexibility of the economic system. In the context of increasing spatial differences, the study of regional features in the development of small and medium-sized businesses is of particular importance, since the level of entrepreneurial activity, the scale of production, employment, and the contribution of businesses to the regional economy vary significantly across territories.

The development of small and medium-sized businesses is considered a key factor in sustainable economic growth. SME development is particularly important in generating employment and increasing the flexibility of national economies. SME development facilitates the redistribution of resources, the development of local markets, and the emergence of new economic trends. However, evidence from Kazakhstan shows that the expansion of SMEs does not always correspond to a proportional increase in their contribution to economic output, indicating structural imbalances within the sector (Zamanbekov et al., 2020).

International organisations, including the World Bank and the OECD, view the development of SMEs as a key element of sustainable economic growth. First, it ensures the diversification of production markets. Second, a significant portion of employment is generated by the SME sector, especially at the regional level. Third, the economy's adaptability to external shocks increases due to enterprise flexibility. Fourth, it promotes the development of territories outside major economic centres. In Kazakhstan, this process is characterised by significant regional disparities, with pronounced differences in economic activity and development levels across regions (Sermagambet et al., 2022).

The experience of various countries shows that a combination of institutional, spatial, and industry factors determines SME development. In Germany, the SME development model is distinguished by its role as the foundation of industrial and export activity, driven by a high proportion of Mittelstand-type enterprises focused on narrow, specialised markets and long-term development. Approximately 99% of companies are classified as SMEs and account for 68% of exports (Parella & Hernández, 2018). Moreover, regions with a higher proportion of SMEs exhibit higher innovation activity (Berlemann & Jahn, 2016). In Brazil, the SME sector makes a strong contribution to local employment, accounting for 98.5% of all companies, approximately 27% of GDP, and 54% of employment (Machado et al., 2018). In South Korea, SME development is strongly supported by the government through financing, concessional lending, and development programs (Kang, 2023).

Despite the growing body of research on SME development, limited attention has been paid to the structural differentiation of SME indicators at the regional level using a unified system of comparable metrics. Existing studies mainly focus on individual indicators without analysing their joint variation across regions. Therefore, it is important to analyse the structure of SME development at the regional level and identify groups of regions with different levels of entrepreneurial activity. The purpose of the study is to identify the structure of regional development among small and medium-sized businesses in Kazakhstan and to identify groups of regions with different levels of entrepreneurial activity.

2 | LITERATURE

Small and medium-sized enterprises are significant in the economies of most countries, forming the foundation of the entrepreneurial environment and accounting for a significant

share of economic activity (Savlovschi & Robu, 2011). In developing economies, SME development is also associated with economic growth dynamics, as the expansion of the entrepreneurial sector is accompanied by an increase in the number of production units and the development of the market structure (Karadag, 2016; Morina & Gashi, 2016). At the regional level, SMEs form production and trade linkages and support economic interactions among market participants (Zafar & Mustafa, 2017). The traditional view of SMEs as the main driver of growth and employment is based on aggregate data that conceals significant heterogeneity among enterprises (Nightingale & Coad, 2014). Most SMEs exhibit low growth rates, limited productivity, and a high risk of market exit. Economic contributions in the form of employment and output growth are generated predominantly by a small group of fast-growing firms. At the same time, the rest of the sector does not produce a comparable effect.

Added value is identified as a key indicator of SME development. Economic output generated during the production process allows assessing the business sector's contribution to overall production volume. Integrating enterprises into production networks increases added value through specialisation and the distribution of production functions (Brazinskas & Beinoravičius, 2014). In Asian countries, SME participation in global value chains is associated with the expansion of production capabilities and increased economic performance (Abe & Proksch, 2017). For example, a small enterprise can produce components for a large international company, provide services (such as logistics or IT), or supply raw materials. Thus, the created value chain assumes that each company adds its share of value to the final product. In the context of technological change, the participation of small businesses in production networks is also associated with the adoption of new technologies and production modernisation, which contributes to increased added value creation (Chen, 2019). Empirical studies show that integrating businesses into international production networks can be associated with improved economic performance through access to new markets and technologies (Deyshappriya & Maduwanthi, 2021). Thus, the value-added indicator allows us to assess the SME sector's contribution to economic output.

SME production activity is measured by output volume as an indicator of added-value creation and changes in the sector's economic dynamics. However, the economic content of this indicator varies. The meaning of the SME output indicator changes depending on how the analysis is conducted and the data used. When individual enterprises are considered, output reflects their efficiency and competitiveness. When analysed at the industry or regional level, output reflects the overall scale of production activity. The choice of model determines which is considered the source of growth: the firm's internal productivity, inter-enterprise interactions, or the macroeconomic environment. In the production environment model, output volume depends on the concentration of SMEs within the cluster (Capello, 1999). Output volume increases when SMEs are located close to one another, facilitating the exchange of knowledge, technologies, and practices, reducing costs, and speeding up solution implementation. As a result, productivity increases. In microeconomic models, output dynamics are determined by the reallocation of resources among enterprises with different levels of productivity. The growth is regarded as aggregate output, achieved by crowding out less efficient and concentrating resources in more productive organisations (Aw, 2002). In this case, production activity reflects a change in the qualitative composition of enterprises, with output becoming an indicator of selective efficiency. Analysis of SME output in developing economies reveals a quantitative expansion of economic activity, accompanied by employment growth. However, limited capital and technology reduce their contribution to aggregate productivity (Li & Rama, 2015). In other words, a combination

of SME numbers and productivity does not ensure rapid efficiency. However, when SMEs produce more, this increases GDP over time, demonstrating the sector's contribution to the country's economy (Syzdykova & Azretbergenova, 2025).

The number of SMEs is considered an indicator of entrepreneurial activity and the spatial distribution of businesses. However, its economic content is also determined by the conditions under which the firms develop, form, sustain, and survive. The distribution of enterprises is linked to territorial and institutional conditions that determine the density and structure of the entrepreneurial environment (Yeung, 2009). There are also regional differences in firm concentration and access to resources, which influence the formation of entrepreneurial systems and the dynamics of their development (Plummer & Pe'er, 2010). The spatial development of entrepreneurial activity is also linked to processes of economic growth and regional transformation, in which an increase in the number of enterprises reflects a changing economic structure (Ferreira et al., 2018). However, quantitative growth of enterprises does not necessarily lead to an increase in economic performance. During crisis shocks, the dynamics of enterprise numbers reflect the entry and exit of firms from the market, with some enterprises ceasing operations and new firms emerging in response to changing economic conditions (Kuckertz et al., 2020). The number of SMEs reflects the instability of entrepreneurial activity, while firm density reflects the overall density of firms. Thus, a significant share of enterprise closures and short life cycles reflects firm density. In the European context, the number of enterprises is considered an element of a broader system of business demography, in which the relationships among firm creation, survival, and liquidation are important, determining the stability of the entrepreneurial environment (Andrei et al., 2021).

Employment in the SME sector is considered a key indicator of labour market performance. However, there is no unified interpretation of the mechanisms of job creation. SMEs have high labour intensity and flexible organisational structures, which enable faster adaptation to changes in demand and job creation during periods of economic growth (Kongolo, 2010; Nasr & Rostom, 2013). In developing economies, the SME sector generates a significant share of employment and drives private-sector expansion. Smaller firms exhibit higher net job creation rates, while this indicator decreases with increasing enterprise size (De Wit & De Kok, 2014). At the same time, there is no universal relationship between enterprise size and employment. The number of jobs depends on the enterprise's financial capacity. Thus, if an enterprise has access to credit and stable income, it can hire employees. Thus, access to finance, liquidity, enterprise size, and age significantly impact job creation (Yazdanfar & Öhman, 2015). Limited financial resources reduce the ability to expand employment. Reduced demand, lower revenues, and limited financial reserves, especially during periods of crisis, lead to job losses, especially among small firms (Engidaw, 2022). At the same time, some enterprises adapt to changing conditions. Outside of a crisis, an increase in the number of active enterprises and their expansion of activities leads to increased employment (Bekzhanova et al., 2023). However, job creation depends on the availability of financial resources as well as on support measures and institutional conditions that affect business sustainability (Kazbekova et al., 2024). In a favourable environment, enterprises expand their operations and increase employment, whereas restrictions hinder this process.

The share of SMEs in the economy reflects the distribution of value added, employment, and entrepreneurial activity among different types of enterprises (Woźniak et al., 2019). It is determined by a set of interrelated indicators, including SME participation in employment, their value-added share, and enterprise density per capita. This specification allows for assessing the degree of the sector's inclusion in the economic system and differences in its

functioning across territories. In developed economies, the share of SMEs in employment exceeds half of total employment, and their contribution to value added remains consistently high (Woźniak et al., 2019). At the same time, differences between countries and regions are associated with the distribution of value created and the sectoral structure, as the concentration of SMEs in certain activities limits their contribution to economic growth. A significant portion of value added is generated in trade and manufacturing, indicating the sector's dependence on industries with varying levels of productivity (Woźniak et al., 2019). As a result, the share of SMEs allows recording not only the quantitative presence of enterprises but also their real contribution to the economy, which requires comparison with indicators of output, employment, and the number of enterprises to assess the consistency of the business sector's development.

The choice of time frame for analysing entrepreneurial activity and the development of small and medium-sized businesses is examined through the lens of the stability of institutional and economic processes. Analysis of spatial differences in entrepreneurial activity requires a medium-term perspective, as institutional conditions, infrastructure, and the entrepreneurial environment change gradually. An analysis of the SMEs development in European cities is based on Eurostat and Urban Audit statistics for the period 2004–2010, which allows for the identification of persistent differences in entrepreneurial activity between regions and the assessment of the influence of institutional and infrastructural factors on the formation of regional entrepreneurial systems (Audretsch & Belitski, 2017).

At the same time, entrepreneurship development is increasingly analysed through integrated indicators that combine several characteristics of entrepreneurial activity into a single aggregated indicator. The index approach implemented in the Global Entrepreneurship Index aggregates institutional and economic characteristics across territories to rank countries and regions by the level of entrepreneurial system development (Acs et al., 2017). The OECD SME activity analysis is based on SMEs. dynamics of small and medium-sized businesses and are examined through comparison and analysis of key stages of the economic cycle, including periods of economic stability, crisis shocks, and subsequent economic recovery (OECD, 2018). At the same time, modern research on entrepreneurship development shows that analysing small business dynamics should account for the impact of external economic shocks, which can significantly alter the trajectory of enterprises. The COVID-19 pandemic has become one of the most significant factors impacting small firms. Thus, when analysing the entrepreneurial sector, it is necessary to consider periods of structural economic shocks that can alter the dynamics of employment, income, and firm resilience (Belitski et al., 2021). Analysing the development of small and medium-sized businesses requires a set of indicators reflecting various aspects of entrepreneurial activity, which justifies the use of integrated indicators and multivariate analytical methods when studying regional differences in the development of the entrepreneurial sector.

3 | METHODOLOGY

The methodological approach is based on the analysis of regional differences in small and medium-sized business development using a system of quantitative indicators and multivariate statistical methods. The study focuses on identifying structural differences between regions through comparable indicators reflecting production activity, employment, and the economic contribution of small and medium-sized businesses. To ensure comparability and eliminate scale effects, the analysis includes data standardisation followed by cluster analysis to identify groups of regions with similar characteristics of small and medium-sized business development.

The analysis of regional differences in small and medium-sized business development was conducted at the regional level using the following indicators:

(1) Gross value added of small and medium-sized businesses (Z_GVA);

(2) Output volume of small and medium-sized businesses (Z_OUT);

(3) Number of active small and medium-sized enterprises (Z_ENT);

(4) Number of people employed in small and medium-sized businesses (Z_EMP);

(5) Share of small and medium-sized businesses in gross regional product (Z_GDP_SH).

The selected variables reflect the scale of activity, labor force involvement, and SMEs' contribution to the regional economy. The data were collected from official sources, the Bureau of Statistics of the Republic of Kazakhstan, across regions for the period 2018–2024. The period represents a complete administrative-territorial structure comprising 17 regions, including the cities of national significance (Almaty, Astana, and Shymkent). The regional structure remains unchanged throughout the entire observation period, eliminating gaps and data incomparability. There are no gaps in the data, as the complete official indicator series for each year of the observation period was used. The panel data is balanced without the need to reconstruct or interpolate values.

The selection of the five indicators (Z_GVA, Z_OUT, Z_ENT, Z_EMP, and Z_GDP_SH) is based on empirical studies that identify value added, output, number of enterprises, employment, and the share of the sector in the economy as key characteristics of entrepreneurial activity and the contribution of small and medium-sized businesses to economic development. The value added indicator is used to assess the economic contribution of small and medium-sized businesses and their participation in production chains (Brazinskas & Beinoravičius, 2014; Abe & Proksch, 2017; Chen, 2019). Output reflects the scale of production activity and the reallocation of resources among enterprises with different levels of efficiency (Capello, 1999; Aw, 2002; Li & Rama, 2015). The number of enterprises is considered an indicator of entrepreneurial activity and spatial business density associated with institutional and territorial conditions (Yeung, 2009; Plummer & Pe'er, 2010; Ferreira et al., 2018). Employment in the small and medium-sized business sector reflects labour market dynamics through job creation patterns and is influenced by access to finance, firm-level resources, and institutional conditions (De Wit & De Kok, 2014; Yazdanfar & Öhman, 2015; Kazbekova et al., 2024). The integration of small and medium-sized businesses into the regional economy and their contribution to economic activity are assessed through the share of small and medium-sized businesses in gross regional product (Woźniak et al., 2019).

Since the original indicators are measured in different units (tenge, number of people, and percentages) and differ substantially in scale, data standardisation was performed prior to the cluster analysis. For each indicator and each year, the following statistical measures were calculated: the mean value across regions, sample variance (divided by N–1), standard deviation, and Z-score based on formula (1):

$$Z_{\text{it}} = \frac{X_{\text{it}} - \mu_t}{\sigma_t} \tag{1}$$

where:

X_{it} – the indicator value in region i in year t;

μ_t – the average value across regions in year t;

σ_t – standard deviation across regions in year t.

After standardisation, the data are converted to a comparable scale for each year. Moreover, this eliminated differences in units of measurement and shows the relative positions of regions at a specific point in time. At this stage, Z-scores reflect interregional differentiation within each year. Further averaging of Z-scores for the period 2018–2024 is used

to obtain an integrated regional profile that accounts for its position over time. These averaged values help smooth short-term fluctuations in indicators and highlight persistent differences between regions. This results in a generalised score used for clustering. The use of a medium-term horizon to identify stable regional differences aligns with approaches used in the analysis of entrepreneurial ecosystems (Audretsch & Belitski, 2017).

The aggregation of indicators into an integrated measure is also consistent with index-based approaches, including the Global Entrepreneurship Index (Acs et al., 2017), as well as OECD approaches to the analysis of small and medium-sized businesses based on the aggregation of indicators across different economic periods (OECD, 2018). The Z-score values were averaged over the period 2018–2024 using formula (2):

$$Z_i^{\text{avg}} = \frac{1}{7} \sum_{t=2018}^{2024} Z_{\text{it}} \tag{2}$$

where:

Z_i^{avg} – the average standardised value of the indicator for region i over the analysed period;

Z_{it} – the standardised value of the indicator for region i in year t.

Thus, for each region, one integrated value was obtained for each indicator, reflecting the region's average position relative to other regions over the analysed period.

To identify regional typologies, hierarchical cluster analysis using Ward's method and Euclidean distance was applied. Based on the dendrogram and the ratio of intra- to inter-cluster variances obtained in Jamovi, two clusters were identified. The partition into two clusters corresponds to maximum inter-cluster differentiation with low intra-cluster variance. The inter-cluster sum of squares exceeds the intra-cluster sum of squares, reflecting a stable separation of regions. A two-cluster structure is used in the analysis. Ward's method minimises intracluster variance and ensures the formation of compact and statistically stable clusters. Principal component analysis (hereinafter – PCA) shows that the first component accounts for most of the variance among the selected indicators. The results show that the first principal component explains the majority of the total variance, indicating a high degree of consistency among the indicators included in the clustering procedure.

4 | RESULTS

The use of standardized values makes it possible to compare regions with each other, regardless of differences in the scale of the initial indicators, and to determine the relative position of each region according to key characteristics of the development of small and medium-sized businesses over the analyzed period. To assess inter-regional differences in the development of small and medium-sized businesses, an analysis of standardized indicators reflecting production activity, employment and the sector's contribution to the regional economy was carried out. Table 1 shows the average standardized values of the indicators (Z-score) for the regions of Kazakhstan for 2018-2024 for five variables.

Table 1 Average standardised indicators of small and medium-sized business development for 2018-2024

Region	Z_GVA	Z_OUT	Z_ENT	Z_EMP	Z_GDP_SH
Akmola	-0.45	-0.46	-0.45	-0.53	-0.13
Aktobe	-0.39	-0.38	-0.12	-0.37	-0.43
Almaty	-0.07	-0.06	0.94	0.29	0.75
Atyrau	0.29	0.32	-0.36	-0.48	-0.76
West Kazakhstan	-0.21	-0.23	-0.50	-0.66	0.40
Zhambyl	-0.55	-0.57	0.08	-0.53	-0.45
Karaganda	-0.21	-0.17	0.33	0.20	-0.98
Kostanay	-0.33	-0.33	-0.33	-0.36	0.05
Kyzylorda	-0.62	-0.66	-0.38	-0.74	-0.99
Mangistau	-0.31	-0.34	-0.24	-0.54	-0.28
Pavlodar	-0.48	-0.46	-0.47	-0.53	-0.97
North Kazakhstan	-0.55	-0.55	-0.78	-0.74	0.00
Turkestan	-0.45	-0.46	1.53	0.15	-0.28
East Kazakhstan	-0.37	-0.35	0.15	-0.05	-0.82
Astana c.	1.76	1.92	1.70	1,53	2.43
Almaty c.	3.22	3.11	2.92	3.59	1.78
Shymkent c.	-0.30	-0.33	0.20	-0.21	0.66

Note: compiled by the authors.

The results presented demonstrate significant regional differences in SME development. The highest values for most indicators were observed in Almaty c. and Astana c. In particular, Almaty c. revealed the highest values for all key indicators (Z_GVA = 3.22, Z_OUT = 3.11, Z_ENT = 2.92, Z_EMP = 3.59). Thus, the results indicated a high concentration of SME economic activity, significant production volumes, and high employment in this sector. Astana c. is also characterised by high values for all variables, showing the significant role of SMEs in the capital's economy.

Several regions occupy an intermediate position. Almaty region demonstrated positive values for entrepreneurial activity indicators (Z_ENT = 0.94, Z_EMP = 0.29, Z_GDP_SH = 0.75), indicating a relatively high level of SME development compared to the average. Similarly, Turkestan stands out for a high number of SMEs (Z_ENT = 1.53), reflecting active entrepreneurship development, although production indicators remain below average. Negative Z-score values characterise most regions for production indicators. For example, Kyzylorda, Pavlodar, and North Kazakhstan demonstrated low values for several variables simultaneously, including output and employment, indicating relatively weaker SME economic activity. At the same time, differences between structural and production characteristics were observed in certain regions. For example, West Kazakhstan showed negative values for both output and employment indicators. Nevertheless, the share of SMEs in the regional product remained above average (Z_GDP_SH = 0.40), as the more significant role of entrepreneurship in the regional economic structure.

After assessing standardised indicator values for each region, the next stage of the study involved cluster analysis to identify groups of regions with similar patterns of SMEs devel-

opment. The analysis included average Z-score values for five indicators (Z_GVA, Z_OUT, Z_ENT, Z_EMP, Z_GDP_SH), ensuring data comparability and enabling the simultaneous consideration of multiple aspects of the SME sector. The results of the initial stage of cluster analysis are presented in Table 2.

Table 2 Summary of within-cluster and between-cluster sums of squares

Cluster component	Sum of squares	Interpretation
Cluster 1	4.85	Low intra-cluster variance
Cluster 2	12.93	Moderate intra-cluster variance
Between clusters	62.94	High inter-cluster differentiation
Total	80.71	Total variance

Note: compiled by the authors.

The total sum of squares is 80.71, of which 62.94 is accounted for by intercluster variation, while the intracluster variation is significantly lower, at 4.85 for the first cluster and 12.93 for the second. This distribution indicates that most of the total variation is explained by differences between the resulting clusters, demonstrating a fairly clear division of regions into groups with distinct characteristics of small- and medium-sized enterprise development. Thus, the selected variables enable us to effectively differentiate regions by the level of SME development.

The results of the cluster analysis determine characteristic indicator values for each formed group of regions. For this purpose, cluster centroids are calculated, which reflect the average values of standardised variables within each cluster. The clustering results indicate a strong differentiation in SME development across regions rather than a balanced multi-group typology. The first cluster unites regions with a high concentration of SME economic activity and a significant sectoral contribution to the economy. In contrast, the second cluster includes regions with lower production and structural characteristics of entrepreneurship development. The resulting values are presented in Table 3.

Table 3 The centroids of the clusters

Cluster component	Z_GVA	Z_OUT	Z_ENT	Z_EMP	Z_GDP_SH
Cluster 1	2.490	2.515	2.310	2.560	2.105
Cluster 2	-0.333	-0.335	-0.027	-0.340	-0.282

Note: compiled by the authors.

The first cluster is characterised by high positive centroid values across all analysed indicators: gross value added (2.490), output volume (2.515), number of enterprises (2.310), employment (2.560), and the share of SMEs in gross regional product (2.105). These values indicate that the regions included in this cluster significantly exceed the national average in terms of entrepreneurial activity, production performance, employment, and the economic contribution of the SME sector. The highest centroid value is observed for employment (2.560), while the lowest is recorded for the share of SMEs in gross regional product (2.105). Nevertheless, all indicators remain substantially above average, reflecting a high concentration of SME economic activity within this group of regions. The results indicate that

these territories are characterised by stronger business activity, higher production capacity, and a more significant role of SMEs in the regional economy. Overall, the cluster reflects the concentration of SME development in the largest urban and economically developed regions of Kazakhstan.

The second cluster exhibits centroid values close to zero, but predominantly negative: Z_GVA (−0.333), Z_OUT (−0.335), Z_EMP (−0.340), Z_GDP_SH (−0.282), and Z_ENT (−0.027). Regions in the second cluster generally perform below average in terms of production activity and SME employment. In terms of the number of small and medium-sized businesses, the regions of the second cluster are approximately average compared to other regions included in the analysis. Still, their economic performance and contribution to the regional economy remain lower. These regions exhibit moderate entrepreneurial activity, but with a weaker production base and a smaller contribution to the country's gross regional product. This indicates that the number of enterprises alone does not translate into higher output, employment, or value added across regions.

Figure 1 shows a dendrogram generated by Ward's hierarchical clustering.

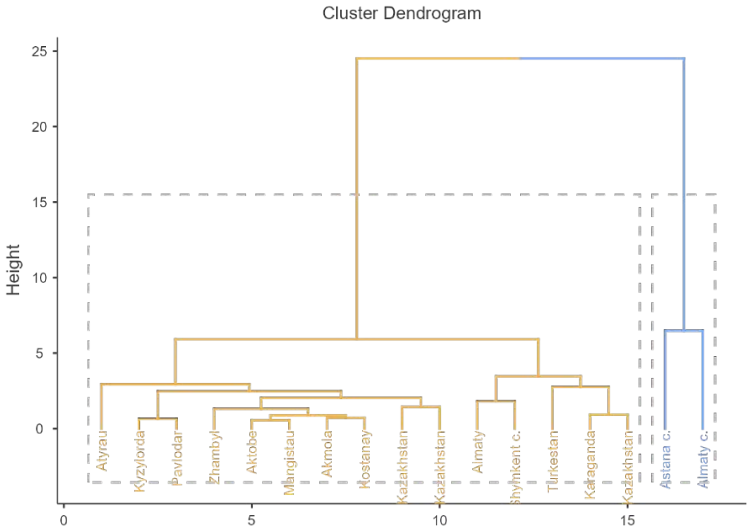

Figure 1 Ward's hierarchical cluster dendrogram of regional small and medium-sized business development in Kazakhstan

The dendrogram was constructed using Ward's hierarchical clustering method, which minimises intra-cluster variance and ensures the formation of relatively homogeneous regional groups. Euclidean distance based on standardised indicator values was used as the distance measure. The dendrogram illustrates the sequence of regional grouping during the clustering process. The vertical axis (Height) represents the linkage distance and reflects the degree of dissimilarity between the grouped regions. Higher linkage levels indicate greater differences between regional groups.

Analysis of the dendrogram structure reveals two main clusters, as confirmed by the results presented in the sums of squares and cluster centroid tables. The first cluster is formed at the top level and includes regions with significantly higher values of the indicators under

consideration. The second cluster includes the majority of regions and is characterized by lower values of the standardized indicators. The clustering structure is characterised by a high level of polarization: a small group of regions with exceptionally high values is separated from a large group of regions with relatively homogeneous and lower indicator levels.

The first cluster includes the cities of Almaty and Astana, which differ significantly from other regions across all the analysed indicators of small and medium enterprise development. The second cluster includes the remaining regions of the country, characterized by lower values of the standardized indicators. Thus, the dendrogram confirms a pronounced spatial concentration of SME economic activity in the country's largest cities. Thus, the results reflect a spatial pattern of SME development, with economic activity disproportionately concentrated in the largest cities rather than distributed across regions.

Figure 2 shows the distribution of variables and regions in the principal component space obtained using PCA.

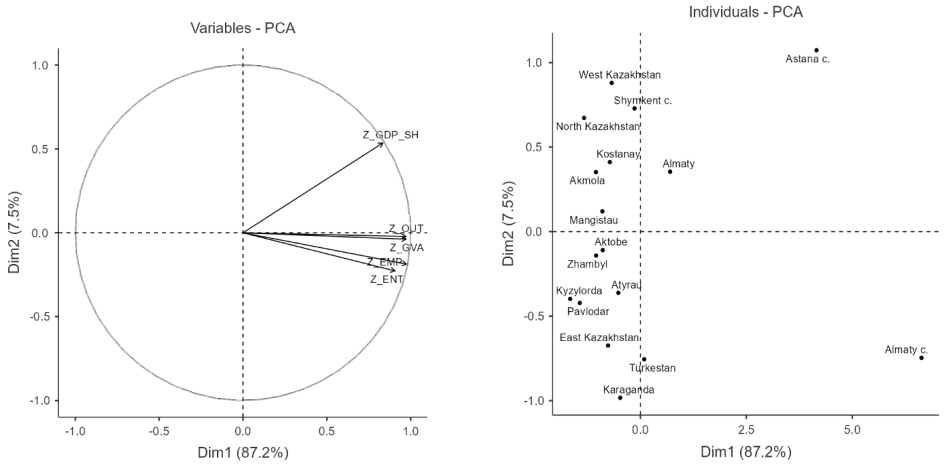

Figure 2 PCA distribution of regions and variable contributions

This method represents the structure of differences between regions in a two-dimensional coordinate system. The first principal component (Dim1) explains 87.2% of the total variance, while the second component (Dim2) explains 7.5%. The majority of differences between regions are formed along the first component. The distribution of variables on the graph shows that Z_GVA, Z_OUT, Z_ENT, Z_EMP, and Z_GDP_SH move in similar directions in the component space. These indicators change consistently and reflect the overall economic characteristics of small and medium-sized business development in the regions. As a result, the first principal component effectively aggregates the influence of these indicators and summarises their joint variation.

The distribution of regions in the component space demonstrates differences in the level of entrepreneurial activity development. Regions with higher values for these indicators shift toward the positive side of the first component. Regions with more moderate values are located closer to the negative side of the axis. The first principal component primarily captures differences between regions.

In Kazakhstan, regions differ in their overall level of entrepreneurship development. The highest indicators are observed in Almaty and Astana cities. These cities simultaneously exhibit higher SME added value, output volume, number of enterprises, and employment in the entrepreneurial sector. Moreover, higher values of one indicator correspond to higher values of other indicators.

The concentration of SME activity in Almaty and Astana is consistent with the economic role of major cities. Higher values of added value, output, employment, and the number of enterprises are observed in these cities. In most regions, including Akmola, Kostanay, Pavlodar, Zhambyl, Mangistau, Kyzylorda, North Kazakhstan, and West Kazakhstan, SME development indicators remain more moderate. The number of enterprises, output volume, and employment in the entrepreneurial sector remain at lower levels than in the largest cities.

The Almaty region, Karaganda, Atyrau, Turkestan, and East Kazakhstan regions occupy an intermediate position, with several SME indicators higher than in many other regions of the country. These regions show higher values for selected SME indicators compared to other regions, but remain below the levels observed in the largest cities. However, overall economic activity and SME indicator values in these regions are lower than in the largest cities, Almaty and Astana.

The integral analysis identified the overall distribution of regions according to the level of small and medium-sized business development. To further examine the dynamics of SME indicators, the analysis of individual indicators is presented below, taking into account the main stages of economic dynamics: the period of relatively stable business development before the pandemic (2018–2019), the period of the COVID-19 crisis shock in 2020, and the subsequent stage of recovery and adaptation of the business sector during 2021–2024 (Figure 3).

The period 2018–2019, before COVID-19, is characterised by a relatively stable structure of regional development of small and medium-sized businesses. The analysis of individual indicators confirmed the previously identified regional distribution. The share of gross value added of SMEs (Z_GVA), output volumes (Z_OUT), and employment (Z_EMP) form a similar spatial structure, where the first principal component explains the majority of the variation in the indicators (54.5% for value added, 57.9% for employment, and 51.5% for output). The concentration of economic activity in the business sector is found in economically developed regions, where the share of SMEs in regional economic output is higher (Z_GDP_SH). The indicator for the number of enterprises (Z_ENT) demonstrates a more even distribution of regions; however, differences in the scale of entrepreneurial activity persist. Overall, the analysis of individual factors reproduces the same regional structure identified in the integrated assessment of SME development, confirming the stability of the existing structure of regional differentiation.

The 2020 period, marked by the COVID-19 pandemic, is characterised by a change in the regional distribution of entrepreneurial activity. Changes in SME output (Z_OUT) and employment (Z_EMP) are reflected in shifts in the positions of regions in the principal component space. The most noticeable changes are observed in employment and production indicators, where differences between regions become more pronounced. At the same time, the number of enterprises (Z_ENT) indicator shows a more moderate response to the crisis, indicating a more stable distribution compared to other indicators. Despite temporary shifts in individual regions, the overall distribution in factor space retains the same basic structure identified in the integrated analysis.

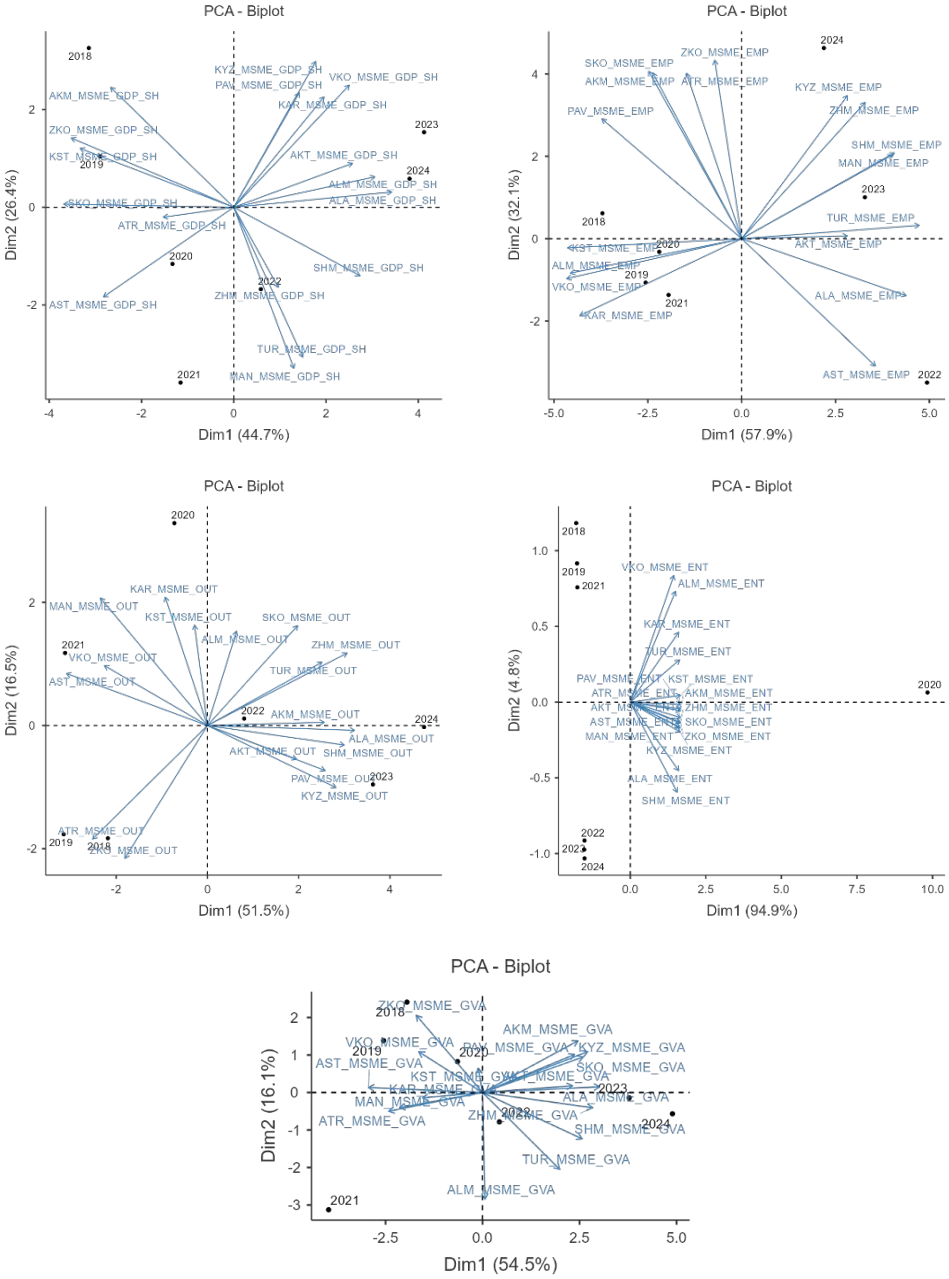

Figure 3 PCA biplot of regional small and medium-sized business development in Kazakhstan

In the period 2021–2024, characterised by a gradual recovery in economic activity, changes in SME indicators are observed. Partial changes in SME indicators, including employment (Z_EMP), output (Z_OUT), and value added (Z_GVA), are reflected in the component space. In the principal component space, regions are still divided into two groups: territories with a higher concentration of entrepreneurial activity and regions where SMEs' contribution to the economy remains more limited (Z_GDP_SH). The number of enterprises (Z_ENT) indicator also shows differences in dynamics across regions.

The results generally confirm several consistent findings presented in the academic literature, both at the regional level and across individual indicators. Factor analysis reveals that the first principal component explains over 50% of the variance in key indicators (54.5% for Z_GVA, 51.5% for Z_OUT, and 57.9% for Z_EMP), indicating that SME indicators are concentrated in a limited group of regions. Consistency with previous studies is evident in the structural heterogeneity of SMEs. The identified division of regions into groups with high and low entrepreneurial activity is consistent with the findings of Nightingale and Coad (2014), that a limited number of enterprises account for higher values of output and value added, while the rest of the sector demonstrates weaker performance, as evidenced by the formation of two stable groups of regions with different concentrations of value added and output. The employment results support findings of De Wit and De Kok (2014) and Ayyagari et al. (2014) that employment levels vary with enterprise structure and economic conditions. In 2020, Z_EMP declined, and regions' relative positions in employment levels changed. Between 2021 and 2024, regions show different dynamics in indicator values, and employment does not fully follow the patterns observed for the number of enterprises and output. The Z_ENT indicator shows a more stable structure, with the first component explaining 94.9% of the variation.

In terms of production activity and value added, the results align with findings of Abe and Proksch (2017) and Chen (2019), that sector indicators (Z_OUT, Z_GVA) differ depending on their position in the economic structure. Thus, the Z_OUT and Z_GVA indicators form a more concentrated structure than Z_ENT. At the same time, they reveal discrepancies with some studies that suggest a more direct relationship between enterprise growth and economic development (Savlovschi & Robu, 2011; Karadag, 2016). In the conducted analysis, the increase in the number of enterprises (Z_ENT) is not accompanied by proportional changes in Z_OUT and Z_GVA, as differences between regions in Z_OUT and Z_GVA remain. Thus, the results confirm the existing provisions on the heterogeneity and structural differentiation of the SME sector, indicating that the number of enterprises (Z_ENT) does not correspond in a proportional manner to Z_OUT, Z_EMP, and Z_GVA. At the same time, the identified structure is maintained both in the pre-crisis and post-crisis periods, indicating the stability of the regional distribution of SME activity.

The results of the cluster analysis categorized Kazakhstan's regions by the level of SME development. To visualise the identified structure of regional SME distribution and the differences in key economic indicators, a diagram was constructed that groups regions by level of entrepreneurial activity. The diagram shows a division of regions into two clusters with different levels of SME indicators (Figure 4).

The diagram clearly distinguishes Kazakhstan's regions by the level of development of small- and medium-sized enterprises. The results of the cluster analysis revealed a distinct division of regions into two clusters with different levels of SME indicators. The most prominent group is one with lower values for most of the analysed indicators, including SME added value, output volume, employment in the entrepreneurial sector, and the share of SMEs in the regional product. These regions are characterised by lower values of SME

indicators across the analysed variables.

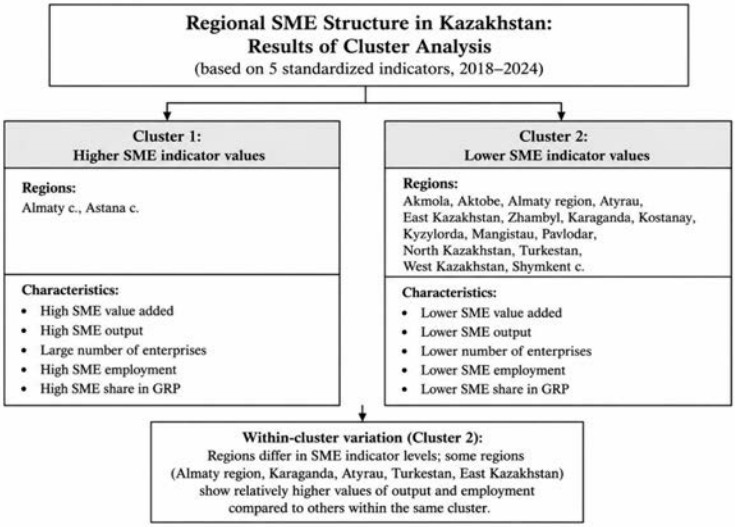

Figure 4 Regional SME Structure in Kazakhstan

Within the second cluster, regions differ in SME indicator levels. Regions such as Almaty, Karaganda, Atyrau, Turkestan, and East Kazakhstan show higher values for individual entrepreneurial activity indicators than most other regions. These regions show relatively higher values of SME indicators, including the number of enterprises, employment, and output, compared to other regions within the same cluster.

5 | CONCLUSION

The analysis revealed significant regional differences in the development of small- and medium-sized businesses in Kazakhstan. The results of the cluster analysis revealed two clusters.

The first cluster comprises territories with the highest values of entrepreneurial activity indicators (Almaty and Astana), where the highest values are observed for SME added value, output volume, number of enterprises, employment in the entrepreneurial sector, and the share of SMEs in the regional product. These cities show the highest values across the analysed SME indicators. The second cluster comprises regions with lower values of SME indicators across the analysed variables, including Akmola, Kostanay, Pavlodar, Zhambyl, Mangistau, Kyzylorda, North Kazakhstan, and West Kazakhstan. In addition, several regions (Almaty, Karaganda, Atyrau, Turkestan, and East Kazakhstan) occupy intermediate positions between the two clusters, with SME indicator values that fall between them.

Given the identified differences across regional groups, public policy measures for SME development should be tailored accordingly. For the largest cities, characterised by high SME indicators, the priority is to support improvements in the efficiency and quality of entrepreneurial activity, including the development of innovation and increased productivity. For regions with comparatively low SME indicators, it is advisable to focus on expanding the scale of entrepreneurial activity, including employment support, infrastructure devel-

opment, and improved access to finance. For regions in between, the priority is to level the SME indicator structure, specifically increasing output and added value for the existing number of enterprises. This approach allows for consideration of differences in the level of SME development and the development of more targeted regional policy measures.

As a recommendation, a more detailed analysis of the structure of entrepreneurship by economic sector is recommended for future studies. In particular, it seems appropriate to examine the differences in the development of small and medium-sized businesses in agriculture, industry, and services. Attention could be given to the analysis of entrepreneurship in the agro-industrial complex, as it is an important source of economic activity and employment in many regions of Kazakhstan.

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