
Article

A Study the Difference between Quantitative and Qualitative Indicators of the Korea Security Index

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Abstract: This study analyzes the differences between quantitative and qualitative indicators of the Korean Social Safety Index and suggests ways to consider different aspects of safety and security assessment. Various indicators for economic activity, life safety, health and well-being, and housing environment were collected, and the results were derived through quantitative analysis and qualitative evaluation. The analysis showed interactions and similar patterns between economic activity and life safety, health and well-being, and housing environment indicators. In addition, the regional clusters formed by the analysis show differences in the level of safety between regions in Korea. This study highlights the importance of conducting safety management assessments that take into account the differences between quantitative and qualitative indicators, and will contribute to improving the level of safety and disaster management in Korea by suggesting customized improvement strategies for each region

Keywords: disaster management, crisis management, qualitative indicators, quantitative indicators, Korea security index

1. Introduction

In the contemporary era, ensuring safety management has become a crucial and significant challenge for both nations and individuals. In Korea, specifically, diverse indicators are employed to evaluate and enhance disaster preparedness and safety management. Among these indicators, the "Social Safety Index" stands out as a quantitative measure of the societal safety level, encompassing economic activity, life safety, health and healthcare, and housing environment (Yi & Yeo, 2021).

Nonetheless, the utilization of indicators presents a limitation in that it predominantly incorporates quantitative data while neglecting qualitative aspects. Hence, the objective of this study is to analyze the disparity between quantitative and qualitative indicators within the Korean Social Safety Index, with the aim of investigating variations in the assessment of social safety. (Heo, et. Al., 2021; Choi & Song, 2022).

This paper undertakes an analysis of the disparities between quantitative and qualitative indicators pertaining to economic activity, life safety, health and well-being, and housing environment. Additionally, regional clusters are formed based on these indicators. The establishment of these clusters enables a distinct perspective in evaluating the level of safety and security by taking into account the unique characteristics of each region. (kim, et, al., 2015;. Chun, et. Al., 2017; Yu, et. Al, 2015).

The objectives of this study are twofold. Firstly, it aims to analyze the disparities between quantitative and qualitative indicators within the Korean Social Safety Index, with the purpose of identifying the key aspects crucial for safety and disaster assessment.

Secondly, the derived regional clusters are employed to comprehend the specific characteristics of safety and security within each region. These insights can subsequently be utilized to propose tailored improvement strategies for each region.

2. Data and Method

2.1. Data

This study conducts a comparative analysis between quantitative and qualitative indices in order to evaluate safety and seeks to provide guidance for enhancing future safety-related evaluations.

To accomplish this, the study will utilize data obtained from the publicly available Korea Security Index, which has been accessible since 2021. The data is categorized into four sections that influence individuals' sense of safety or insecurity. These sections include "Economic Activity," "Life Safety," "Health and Wellness," and "Housing Environment." Each section of the social security index comprises three to four sub-areas, and the indicators for each sub-area encompass both quantitative indicators derived from official statistics and qualitative indicators gauging residents' perceptions within the respective area.

This study aims to explore the disparities between the quantitative and qualitative aspects of the Social Security Index, thereby elucidating regional characteristics and highlighting the importance of the qualitative component.

2.2. Method

This study investigates the spatial distribution and characteristics of clusters by identifying regions that exhibit similarities based on both the quantitative and qualitative indices of the Social Security Index. (Marin, et. Al., 2021; dos Santos, et. Al., 2014; Zhou, et. Al., 2017).

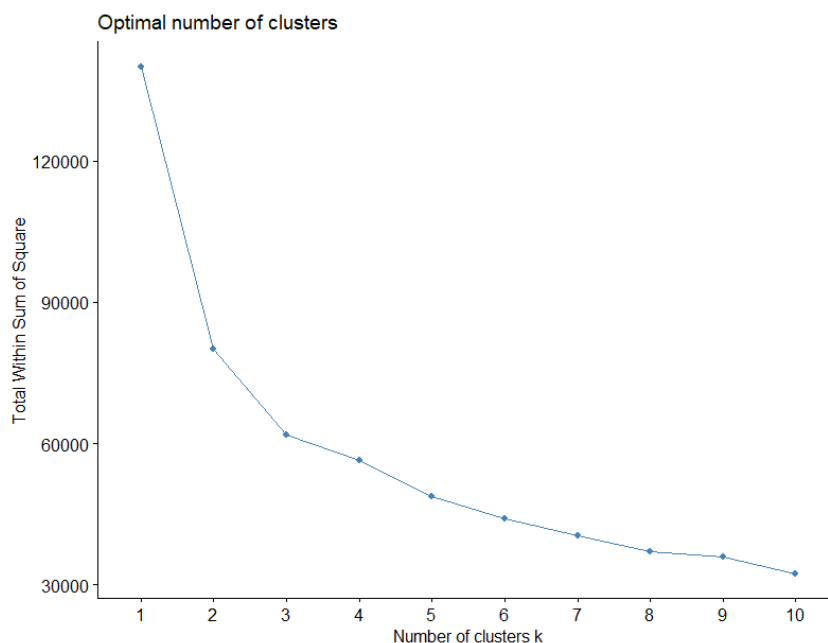
To categorize the clusters, we utilize the "quantitative index" as well as the "difference between the qualitative and quantitative indexes" within the four components of the Social Security Index, namely "economic activity," "life safety," "health and well-being," and "housing environment."

To discern clusters with comparable characteristics across regions, we employ K-means analysis. K-means analysis is a methodology that predefines the number of clusters (k) and assigns each data case to one of the k clusters based on their similarity.

Prior to conducting the K-means analysis, it is essential to determine the number of clusters. The elbow method is utilized for this purpose. The elbow method assesses the number of clusters in the K-means analysis and selects the appropriate number of clusters based on the total sum of squares within the clusters.

The outcome of the Elbow method is presented in Fig. 1. From these findings, the appropriate number of clusters is determined by comparing the values of WSS (Within Cluster Sum of Squares), which diminishes as the number of clusters increases. The number of clusters is selected at the point where the sharp decrease in WSS is mitigated.

According to the results depicted above, the WSS value exhibited a rapid decrease until cluster 3, followed by a slower decrease at cluster 4. However, beyond 5 clusters, the decrease accelerated once again, and after 6 clusters, the decrease slowed down once more. Considering these findings, it was deemed appropriate to partition the data into five clusters for the purpose of statistical parsimony.



Number of cluster	1	2	3	4	5
wss	139,925.03	79,959.72	61,703.88	56,332.15	48,692.75
difference		59,965.31	18,255.84	5,371.73	7,639.4
Number of cluster	6	7	8	9	10
wss	44,075.26	40,506.72	37,014.23	35,867.93	32,413.06
difference	4,617.49	3,568.54	3,492.49	1,146.3	3,454.87

Figure 1. Elbow method for optimal number of clusters

3. Result

The K-means method was employed to partition the five clusters based on the 'quantitative index' and the 'difference between qualitative and quantitative index' across the sectors of economic activity, life safety, health and healthcare, and housing environment within the Social Security Index. The average values of the quantitative index and the difference between the qualitative and quantitative indexes for each cluster are presented in Table 1.

In Cluster 1, the notable aspect is the 'Life Safety' sector, where the quantitative index is the lowest among all clusters. However, there is a substantial difference between the qualitative and quantitative scores, with the qualitative score being 17.44 points higher than the quantitative score. In contrast, the differences between the qualitative and quantitative scores in other sectors were not particularly significant.

In Cluster 2, the "economic activity" sector exhibits the lowest quantitative score, but the qualitative score surpasses it by 15.30 points. Similarly, in the "living environment" sector, Cluster 2 also demonstrates the lowest quantitative score, with the qualitative score exceeding it by 20.11 points. Nonetheless, the differences between the qualitative and quantitative scores in other dimensions were relatively minor.

In Cluster 3, the "Economic Activity" sector displays the highest quantitative index, with a negligible difference of only -0.22 between the qualitative and quantitative indexes, which is not a significant distinction.

In Cluster 2, the quantitative index for the "Living Environment" sector is nearly identical to that of Cluster 1. However, there is a substantial difference of 20.12 between the qualitative and quantitative indexes, indicating a significant disparity.

<Table 1> Quantitative and difference between qualitative indices by part according to clusters

Cluster	Part1 (quant. value)	Part1 (quant-qual)	Part2 (quant. value)	Part2 (quant-qual)	Part3 (quant. value)	Part3 (quant-qual)	Part4 (quant. value)	Part4 (quant-qual)
Cluster1	52.84	3.10	43.35	17.44	47.92	5.80	49.80	4.83
Cluster2	40.69	15.30	55.13	6.71	52.03	5.42	36.26	20.11
Cluster3	59.08	-.22	54.64	9.30	58.71	.28	38.55	20.12
Cluster4	49.76	7.33	54.17	6.48	49.79	2.11	63.49	-9.34
Cluster5	48.53	9.88	46.77	13.56	42.39	9.45	67.02	-12.76

Part1: Economic activity

Part2: Life safety

Part3: Health

Part4: Residential environment

Within Cluster 4, the distinctions between the quantitative and qualitative indexes were not substantial in the domains of "economic activity," "life safety," and "health and well-being." However, in the "housing environment" category, the quantitative index recorded a higher value of 63.49, while the difference between the quantitative and qualitative indexes was -9.34, indicating that the quantitative index surpassed the qualitative index.

<Table 2> Regional characteristics according to clusters

Cluster	Area	Population		
		Less than 200,000	200,000~500,000	Over 500,000
Cluster1	Gun in province	3	-	-
	City in Province	6	21	7
	Borough in metropolitan	2	3	-
Cluster2	Gun in province	-	-	-
	City in Province	2	1	1
	Borough in metropolitan	12	33	5
Cluster3	Gun in province	-	-	-
	City in Province	3	5	8
	Borough in metropolitan	2	9	2
Cluster4	Gun in province	11	2	-
	City in Province	11	2	-
	Borough in metropolitan	-	1	-
Cluster5	Gun in province	22	-	-
	City in Province	9	-	-
	Borough in metropolitan	-	-	-
Total	Gun in province	36	2	-
	City in Province	31	29	16
	Borough in metropolitan	16	46	7

In Cluster 5, when compared to Cluster 4, the quantitative index exhibited relatively lower values across all sectors except for the 'living environment' sector. However, the qualitative index displayed higher scores for the difference between the qualitative and

quantitative indexes. Specifically, in the 'living environment' sector, the quantitative index reached its highest value at 67.02. Nonetheless, the difference between the qualitative and quantitative indexes was -12.76, indicating that the qualitative index was notably lower compared to the quantitative index.

The regional characteristics of the five clusters are outlined in Table 2. Firstly, Cluster 1 primarily comprises cities located within metropolitan areas, with a notable presence of cities with a population size exceeding 200,000. In Cluster 2, there is a predominance of boroughs situated within metropolitan areas. Cluster 3 tends to consist of cities with a population of 200,000 or more within metropolitan areas, or boroughs within metropolitan areas. Clusters 4 and 5, on the other hand, generally encompass counties within metropolitan areas or cities with a population of 200,000 or less.

The spatial distribution of these clusters is depicted in Figure 2. Cluster 2 primarily exhibits a distribution within autonomous districts located within metropolitan cities, as indicated in Table 2. On the other hand, Cluster 3 is predominantly concentrated in Seoul or the surrounding metropolitan area, with only a few cities located outside of the provinces.

Furthermore, Cluster 1 predominantly exhibits a distribution pattern in cities with a population size of 200,000 or more situated outside of metropolitan areas and provincial metropolitan areas. Clusters 4 and 5 are primarily concentrated in counties within metropolitan areas and urban areas with a population of 200,000 or less.

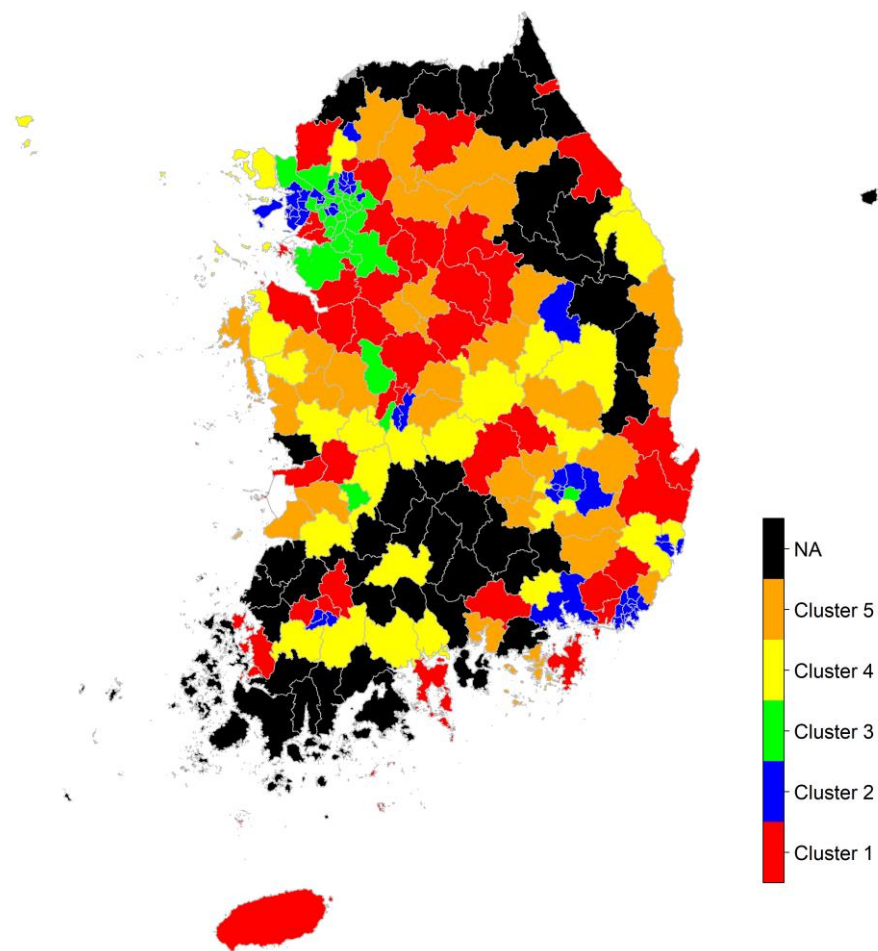


Figure 2. Spatial distribution of clusters

When we examine the findings in Table 1 in conjunction with the results, we observe that the metropolitan area, which predominantly encompasses Cluster 2, displays the lowest quantitative score in the "Economic Activity" sector. However, the qualitative score surpasses the quantitative score by approximately 15.30 points, signifying the most significant disparity between the quantitative and qualitative indexes.

To elaborate further, it can be inferred that the region characterized by Cluster 2 exhibits a higher level of instability in terms of income, employment, welfare, and retirement compared to other areas. However, there is a noteworthy level of satisfaction with income and job opportunities. It is worth noting that if a region is known to have a greater number of "good jobs" relative to other regions, these positions may not be indefinitely available. Consequently, while quantitative indicators such as unemployment rates may appear low, qualitative indicators such as job satisfaction and job security can still be high.

In Korean society, economic activity is predominantly concentrated in major urban centers, including metropolitan areas and metropolitan cities, where a concentration of desirable employment opportunities can be observed. However, solely examining these areas from a quantitative standpoint may yield results that differ from the public's perception. It is crucial to consider qualitative aspects and public perception in order to obtain a comprehensive understanding of the dynamics at play in these regions.

Regarding the 'Living Environment' section, both Cluster 2 and Cluster 3 exhibited quantitative indexes below 40 points, which is notably lower compared to other clusters. However, the qualitative indexes surpassed the quantitative indexes by more than 20 points.

In both Cluster 4 and Cluster 5, the quantitative indexes in the 'Living Environment' section surpassed 60 points, indicating a high level of performance. However, the qualitative indexes tended to be notably lower compared to the quantitative indexes. The 'Living Environment' section encompasses aspects such as air quality, residential childcare education, cultural leisure, and population change.

In the context of residential childcare education, the presence of a significant number of old houses does not necessarily indicate an unsafe environment. It is important to consider that older neighborhoods often foster close-knit communities, resulting in frequent interaction among neighbors. This social capital can contribute to enhancing the overall sense of safety in the area. Furthermore, it should be noted that a high number of cultural and sports facilities does not necessarily guarantee a favorable living environment.

It is crucial to consider whether the facilities in a given region are meeting the quality standards desired by the residents. This can be observed by noting that Cluster 2 and Cluster 3, which exhibit low quantitative indexes in the "Living Environment" category, are predominantly found in metropolitan areas or large cities. This finding highlights the limitations of relying solely on quantitative indexes to evaluate a region. Therefore, it becomes necessary to complement the quantitative index with qualitative indexes to conduct a more comprehensive assessment of the safety level in a particular region.

4. Conclusions

This study investigated the disparities between the quantitative and qualitative indicators of the Korea Social Safety Index to analyze multiple dimensions of safety and security. The findings indicate variations in quantitative and qualitative indicators among regions classified into five distinct clusters.

In Cluster 1, there was a notable discrepancy between the quantitative and qualitative indicators of life safety. While the quantitative measures indicated a low level of life safety, the qualitative indicators revealed higher perceptions and satisfaction among residents. This implies that although the area may exhibit quantitative deficiencies in terms

of life safety, residents' subjective experiences and contentment are comparatively positive. In Cluster 2, both the quantitative indicators for economic activity and living environment were low, yet the qualitative indicators were relatively high. This suggests that the economic activity in the area is characterized by instability, and the housing environment is relatively inadequate compared to other regions. However, residents in this cluster reported higher levels of job satisfaction and perceived job security.

Moreover, Cluster 3 exhibited high quantitative scores for economic activity, with relatively small discrepancies compared to the qualitative indicators. On the other hand, both Cluster 4 and Cluster 5 demonstrated high quantitative scores, but the differences with the qualitative indicators tended to be more pronounced. Specifically, in Cluster 4 and Cluster 5, the quantitative indicators pertaining to the residential environment category were notably high, but the disparities with the qualitative indicators were substantial.

Based on these analysis results and taking into account the regional characteristics, it can be inferred that Cluster 2, characterized by numerous autonomous districts within the metropolitan area, and Cluster 3, predominantly distributed in Seoul and the metropolitan area, exhibit relatively lower stability in terms of economic activity and living conditions compared to other regions. Additionally, Cluster 4 and Cluster 5, comprising a considerable number of counties or cities with a population of 200,000 or less within the metropolitan area, tend to display relatively lower quantitative indicators in categories other than living conditions.

These findings highlight the limitations of solely relying on quantitative indicators to evaluate safety and security, emphasizing the need for a more comprehensive analysis that incorporates qualitative indicators. Specifically, economic activities and living conditions have emerged as crucial factors influencing safety and security outcomes. To enhance these aspects, it is essential to analyze both quantitative and qualitative indicators, taking into account residents' perceptions and satisfaction. By adopting a more nuanced approach, policymakers and stakeholders can gain deeper insights and implement targeted measures to improve safety and security in the examined regions.

These findings have practical implications for governments and relevant organizations in shaping policies and guiding efforts towards enhancing safety and security. To achieve a comprehensive assessment of safety and security, it is crucial to systematically consider and analyze both quantitative and qualitative indicators. By adopting a holistic approach, policymakers can identify areas of improvement and propose targeted measures to enhance safety and security conditions. This integrated approach ensures a more robust evaluation and facilitates the formulation of effective strategies to address the identified challenges.

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