

Article

# Analyze Time Series Changes in the Korea Security Index

Seol A Kwon , Hyun Soo Park

National Crisisonomy Institute, Chungbuk National University, 1 Chungdae-ro, Seowon-Gu, Cheongju, Chungbuk, Korea

**Abstract:** The study focuses on qualitative indices that encompass economic activity, personal safety, health, and residential environment. The volatility of the qualitative indices was examined, and the score variations for each sub-domain were analyzed. In the domain of economic activity, a strong correlation was observed between the qualitative indices of 2022 and 2023, indicating relatively low volatility compared to other domains. In the domains of personal safety, health, and residential environment, the relative positions of the qualitative indices did not show significant changes, and the score variations within each sub-domain were also relatively small. Particularly in the health domain, the sub-domains of medical environment and healthcare satisfaction exhibited a higher correlation compared to other domains. Correlation analysis was conducted to investigate the volatility of qualitative indices, and the rank changes in each domain and sub-domain were analyzed. The results showed that there was not significant volatility in the qualitative indices between 2022 and 2023. This can be attributed to the stability of residents' perceptions in the region. Moreover, there were no significant score variations observed among the sub-domains, and specifically, the medical environment and healthcare satisfaction within the health domain displayed lower volatility compared to other domains. These findings provide valuable insights into understanding the volatility of the social safety index between 2022 and 2023 and assessing the reliability of the qualitative indices. Therefore, the analysis of volatility and reliability can support decision-making processes for social safety policies and improvement strategies.

**Keywords:** Social safety index, volatility, reliability, qualitative indices, social safety policies,

## 1. Introduction

In the contemporary era, safety has emerged as a prominent societal concern, necessitating the evaluation of safety as a crucial factor in social dynamics and policy formulation. The assessment of safety encompasses a diverse range of indicators and methodologies, with quantitative and qualitative indicators being recognized as pivotal constituents in the comprehensive evaluation of safety. (Hezer, et. Al., 2021; Prozialeck, et. Al, 2019).

In a broader context, the evaluation of safety typically involves the utilization of quantitative indicators, which encompass objective data analysis of various parameters such as the number of safety-related facilities and accident rates. Conversely, qualitative indicators aim to capture the subjective perception of safety from the perspective of the local population. Ideally, qualitative indicators should be derived from comprehensive census surveys to ensure an accurate assessment. However, practical limitations often necessitate the utilization of sample surveys instead, leading to concerns regarding the reliability of qualitative indices. Consequently, it becomes imperative to scrutinize whether qualitative indicators genuinely reflect the local population's perception of safety and establish the degree of trustworthiness associated with the obtained results.

Hence, the present study aims to assess the longitudinal reliability of the qualitative index by analyzing the data from the Korea Security Index for the years 2022 and 2023, with a specific focus on the qualitative index data. The Korea Security Index comprises four major domains and corresponding sub-domains, carefully designed to encompass a wide spectrum of security concerns. These sub-domains incorporate both quantitative indicators, derived from official statistical sources, and qualitative indicators, sourced from the perceptions of local residents. The integration of quantitative and qualitative indicators, weighted accordingly, facilitates the computation of scores for each domain, subsequently culminating in the computation of the overall security index.

The primary objective of this study is to assess the dependability of the qualitative index through an examination of the Korea Security Index data for the years 2022 and 2023. Through this analysis, the study endeavors to ascertain the patterns of variation within the qualitative index and evaluate its trustworthiness as an indicator of safety.

This research endeavor is anticipated to make a valuable contribution to the foundational comprehension of reliability concerns surrounding qualitative indexes, as well as to enhance the dependability of qualitative indexes in safety assessment. By doing so, it aims to establish a more precise and trustworthy safety assessment system, thereby promoting an improved understanding of safety levels and facilitating informed policy decisions.

## 2. Data and Method

### 2.1. Data

This study aims to examine the reliability of the qualitative index during safety evaluation. That is, the quantitative index for safety can be looked at through objective indicators such as the number of safety-related facilities and the number of accidents, and if an evaluation item is selected, a constant value can always be calculated no matter who evaluates it. On the other hand, the qualitative index evaluates the level of safety experienced by local residents who are service targets for safety. It is ideal to conduct a complete enumeration survey due to practical limitations. In this process, the reliability problem of the qualitative index may be raised. In other words, it is a question whether the result of the qualitative index reflects the safety perception of the local residents and whether the result can be trusted.

Therefore, this study aims to find out whether the reliability problem of qualitative indices is a fundamental problem in safety-related evaluation. To this end, we look through the safety-related evaluation data that reflect the qualitative index.

To this end, we use the Korea security index data, which has been released since 2021. The Korea security index expanded the scope of safety and consisted of four sectors that affect the overall safety or anxiety of citizens. Then, each sector was divided into subsectors and examined. The indicators constituting each subsector were measured using quantitative indicators using official statistical data and qualitative indicators measuring the level of feeling of the residents. The index is calculated by calculating scores for each sector by assigning weights to the quantitative and qualitative indicators measured in this way.

In this study, 2022 and 2023 data from the Korea security index were analyzed. Through this data, we would like to examine the reliability of the qualitative index over time, focusing on the data of the qualitative index.

&lt;Table 1&gt; The sector and subsector of the Korea security index

| Sector                  | Subsector               |
|-------------------------|-------------------------|
| Economic activity       | Income                  |
|                         | Employment              |
|                         | Welfare                 |
| Life safety             | Old age                 |
|                         | Policing                |
|                         | Fire fighting           |
| Health                  | Traffic safety          |
|                         | Health                  |
|                         | Medical environment     |
| Residential environment | Medical satisfaction    |
|                         | Atmospheric environment |
|                         | Housing/Education       |
|                         | Culture/Leisure         |
|                         | Population change       |

## 2.2. Method

In order to examine the reliability of the qualitative index, we will compare the scores of the 2022 qualitative index and the 2023 qualitative index for each region. If the qualitative index scores of each year do not show the sameness, the reliability of the qualitative index may be considered low. On the other hand, if the qualitative index score of each year shows the sameness, it can be judged that the reliability of the qualitative index is high. Several methods are used to examine the change of qualitative indices over time. First of all, we examine the differences in each region through absolute scores. We look at the difference between the qualitative index score in 2022 and the score in 2023, and examine the reliability of the qualitative index with this difference.

The second method is to look at the correlation between the 2022 qualitative index and the 2023 qualitative index. It is difficult to determine whether the difference in the absolute score of the qualitative index was caused by the low reliability of the qualitative index or whether the perceived safety of the region changed. Therefore, the qualitative index level of each region is to be identified through a correlation analysis that can examine the relative position compared to the overall average. Through this, it is possible to examine whether the qualitative index scores of each region show sudden fluctuations or randomness, and through this, the reliability of the qualitative index can be examined.

## 3. Result

<Table 2> shows the difference in qualitative indices between 2022 and 2023 among the Korea security index for each sector. In this result, 70 regions(45.2%) had a difference of less than 1 point in 2023 compared to 2022 in the 'economic activity' sector, and 47 regions (30.3%) had a decrease of more than 1point, and There were 38 regions(24.5%) that increased by more than 1point.

In the sector of 'life safety', there were 102 re-gions(65.8%) with a difference of less than 1 point, 28 regions(18.1%) with a decrease of more than 1 point, and 25 regions(16.1%) with an increase of more than 1 point. In the 'health' sector, 94 re-gions(60.6%) had a difference of less than 1 point, 23 regions(14.8%) had a decrease of more than 1 point, and 38 regions(24.5%) had increased by more than 1 point. In the 'residential environment' sector, 97 regions(62.6%) had a difference of less than 1 point, 21 regions(13.5%) had a decrease of more than 1 point, and 37 regions(23.9%) had increased by more than 1point.

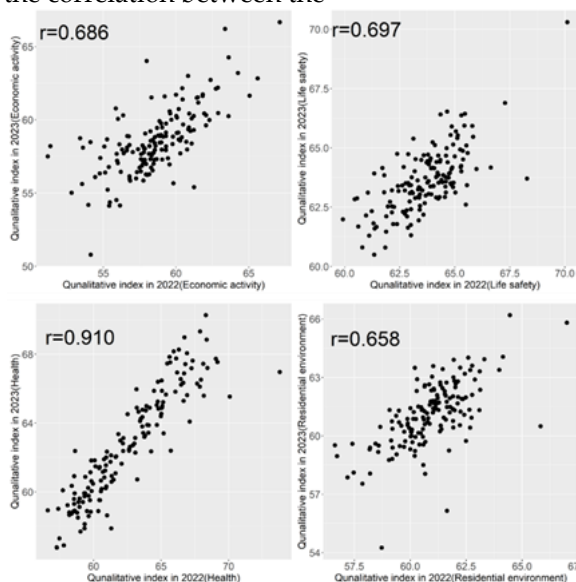
Among the differences in the qualitative index of the Korea security index in 2023 compared to 2022, there was a difference of less than 1 point in more than half of the regions except for the ‘eco-nomic activity’ sector, in the ‘economic activity’ sector, the regions with a difference of less than 1 point was the lowest at 45.2%.

Looking at this result, compared to 2022, the qualitative index in 2023 showed some volatility. However, the fact that there is no change in the absolute score does not mean that the quantitative index is reliable. Rather, it is because this difference may be a change in the degree of feeling of the actual local residents. However, if the change in scores is random and shows rapid fluctuations, the reliability of the qualitative index may be questioned. In order to examine these aspects, correlation analysis is performed. Through this, the relative position compared to the overall average in 2022 and 2023 is compared to determine the reliability of the qualitative index.

<Table 2> Difference in qualitative index in 2022 and 2023

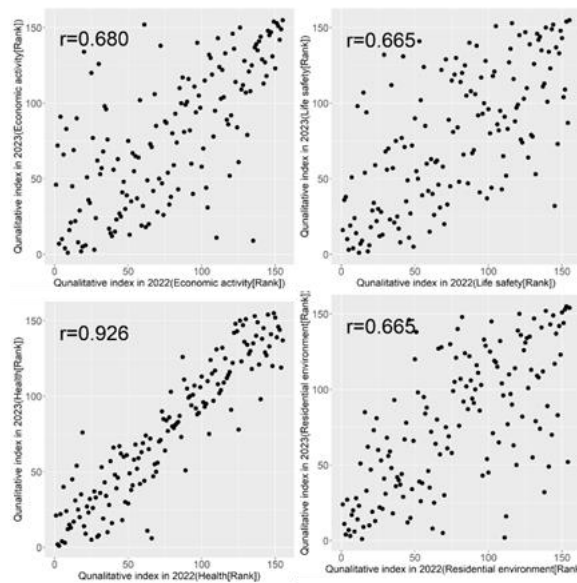
| Difference          | Economic activity | Life safety    | Health         | Residential Environment |
|---------------------|-------------------|----------------|----------------|-------------------------|
| Less -1             | 47<br>(30.3)      | 28<br>(18.1)   | 23<br>(14.8)   | 21<br>(13.5)            |
| -1 ≤ Difference ≤ 1 | 70<br>(45.2)      | 102<br>(65.8)  | 94<br>(60.6)   | 97<br>(62.6)            |
| Greater 1           | 38<br>(24.5)      | 25<br>(16.1)   | 38<br>(24.5)   | 37<br>(23.9)            |
| Total               | 155<br>(100.0)    | 155<br>(100.0) | 155<br>(100.0) | 155<br>(100.0)          |

Figure 1 shows the results of the correlation analysis of the qualitative indices in 2022 and 2023 for each sector. First, looking at the ‘economic activity’ sector, it was found that the correlation between the



**Figure 1. Comparison by sector score(2022/2023)**

qualitative indices in 2022 and 2023 was high( $r=0.680$ ). In other words, it was found that the relative position of the qualitative index compared to the overall average in 2022 and the position in 2023 did not show a significant difference. And in the field of ‘life safety’, the correlation between the qualitative index between 2022 and 2023 was high( $r=0.697$ ). The correlation between the qualitative index between 2022 and 2023 was high( $r=0.910, 0.658$ ) in the ‘health’ and ‘residential environment’ sectors. In particular, the ‘health’ sector showed a higher correlation than other sectors



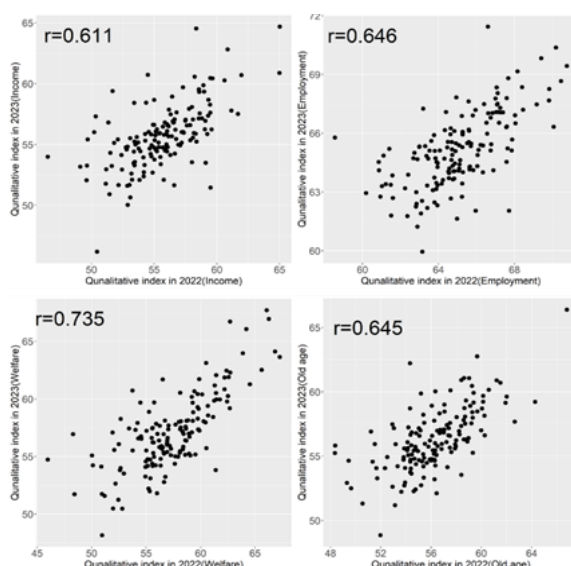
**Figure 1. Comparison by sector order(2022/2023)**

In order to examine whether the rankings have changed due to changes in scores over time, a cor-relation analysis was conducted in 2022 and 2023 by converting the data into rankings according to the scores for each sector. The result in shown in Figure 2.

The correlation in the 'economic activity' sector was high, indicating that there was no significant change in the ranking( $r=0.680$ ). In the 'life safety' sector, the correlation coefficient value was also high, showing no significant change in ranking. There was no significant change in the ranking over time as the correlation coefficient value was high in the 'health' and 'residential environment' sectors. In particular, the correlation coefficient value in the 'health' sector was very high at 0.926, indicating a small change in ranking compared to other sectors.

Next, we look at the variation over time of the subsector for each region. First of all, the correlation between the quantitative index scores in 2022 and 2023 in the 'economic activity' sector is shown in Figure 3. This sector are 4 subsectors of income, employment, welfare, and old age in the area of 'economic activiey'. In income, the correlation coefficient was high at 0.611. in other words, even if there is a change in the score over time, it was found that the position compared to the average in 2022 and the position in 2023 did not differ significantly.

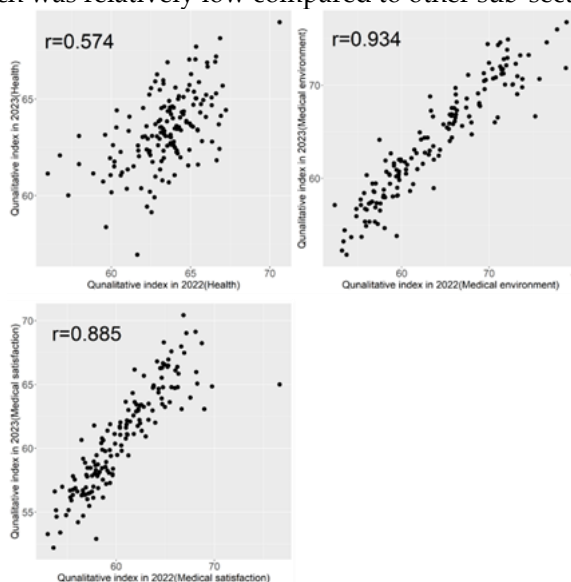
In addition, all of the correlation coefficients in



**Figure 1. Comparison by subsector in economic activity sector(2022/2023)**

other subsectors were above 0.6, indicating that the change in scores for each subsector between 2022 and 2023 was not very large.

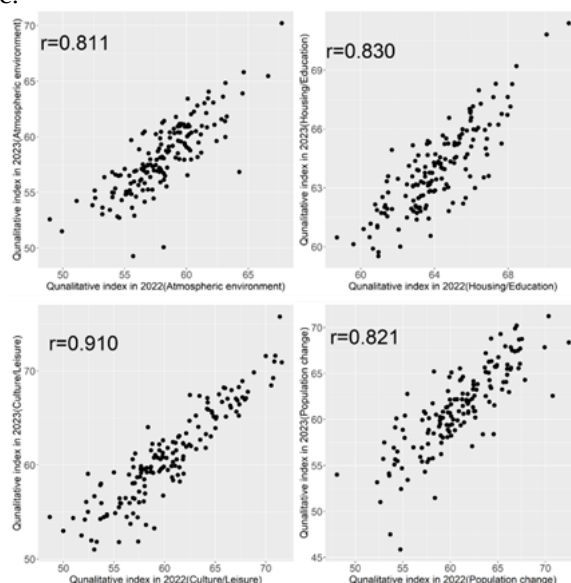
Figure 4 shows the correlation between the quantitative index scores in 2022 and 2023 in the ‘life safety’ sector. The subsectors of this sector are policing, fire fighting, and traffic safety. Among the three subsectors, policing and fire fighting both had correlation coefficients of 0.7 or higher, indicating that the change in scores between 2022 and 2023 was not very large. In contrast, the correlation coefficient for traffic safety was 0.549, which was relatively low compared to other sub-sectors, but the correlation was high.



**Figure 1. Comparison by part in health sector(2022/2023)**

The ‘health’ sector consists of health, medical environment, and medical satisfaction. Figure 5 shows the correlation between the 2022 quantitative index score and the 2023 score in this sector. The correlation coefficient of the health sector was 0.574, which was relatively low compared to other sub sectors. The correlation coefficient of the medical environment was 0.934, which was a very high level, and the correlation coefficient of medical satisfaction was 0.885, which was a high level.

The correlation between 2022 and 2023 in the subsector of the 'health' sector shows very high coefficient values in the medical environment and medical satisfaction, indicating that the amount of change over time is not very large. In addition, the change in the quantitative index score for health is only low in correlation coefficient value compared to other subsectors, but it can be seen as high level. Therefore, the change in quantitative index scores between 2022 and 2023 in the subsectors of the health sector was not very large.



**Figure 1. Comparison by subsector in residential environment sector(2022/2023)**

Finally, the correlation between the quantitative index scores between 2022 and 2023 for the sub-sector of 'residential environment' is shown in Figure 6. The subsectors of this sector consisted of atmospheric environment, housing/education, culture/leisure, and population change. The correlation coefficient of atmospheric environment was 0.811, housing/education was 0.830, culture/leisure was 0.910, and population change was 0.821. The correlation coefficients in the subsectors of this sector were generally at a very high level of 0.8 or higher.

#### 4. Conclusions

This study conducts a comparative analysis of the Korea Security Index in 2022 and 2023, aiming to examine its variability and reliability. The obtained results reveal that there exists a persistent overall stability in the index. Specifically, when comparing the qualitative indexes between the two years, the indexes in 2023 demonstrate a higher degree of stability. Nonetheless, it is important to note that such stability may primarily arise from variations in the perception of the local residents rather than indicating substantial alterations in the actual scores.

Second, the analysis reveals a significant correlation between the qualitative indexes of economic activity, life safety, health, and housing in both 2022 and 2023. Particularly, the correlation is notably strong for the health domain.

Third, upon investigating the ranking variations among the sub-scales within each domain, it was observed that there were no significant changes in rankings, with the health sub-sector displaying minimal fluctuations.

Fourth, sub-scores did not change significantly between 2022 and 2023. In particular, the Housing sub-scale did not change significantly.

Therefore, the results of this study indicate that the change in the qualitative index of the Korea Security Index between 2022 and 2023 remained constant and relatively stable.

However, this does not guarantee absolute confidence in the changes in the qualitative index, and further research and analysis may be required for a more reliable assessment.

The policy implications of our findings are as follows. First, continuous monitoring and analysis is needed to assess changes in the qualitative index. Although the volatility of the qualitative index was found to be constant, this may simply be interpreted as a change in perception. Further research and analysis should be conducted for a more reliable assessment, which can then be used to inform policy decisions (Kaskie, et. Al., 2022).

Second, a higher correlation was observed in the health sector than in other sectors. Based on this, it is necessary for the government and related organizations to prioritize and strengthen the health sector. Prevention policies and healthcare infrastructure improvements can improve the health status of local residents (Giles-Corti, et. Al., 2019).

Third, the need to manage the living environment. The scores for the sub-scales of the housing environment domain did not change significantly. This suggests that there is a need for continued management and maintenance policies to maintain current housing conditions (Pezzica, et. Al., 2021).

Fourth, the need for policy consistency and sustainability. Overall, the volatility of the qualitative indexes was stable. This stability emphasizes the need for consistency and sustainability in government policies. Governments should pursue comprehensive policy formulation in various areas affecting social safety, which can lead to continuous improvement in social safety (Bull, et. Al., 2019).

Finally, the results of this study provide an initial analysis of changes in the qualitative dimensions of the Korea Security Index. However, further research and multidisciplinary collaboration are needed for more reliable assessment and policy development. Interdisciplinary and integrated research is needed to improve social security by strengthening cooperation among stakeholders such as the government, academia, and civil society (Peek, et. Al., 2020; Mostafavi & Ganapati, 2021; Adams, et. Al., 2022).

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## Profile

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Hyun Soo Park (chaos51@hanmail.net)

He received his Ph.D. from Korea University, Korea in 2008. He is a Leader of Center for Citizen Safety Research of National Crisisology Institute(NCI), Chungbuk National University.

Seol A Kwon (@chungbuk.ac.kr)

She received her Ph.D. from Chungbuk National University, Korea in 2017. She is a Leader of Center for Disaster Safety Innovation of National Crisisology Institute(NCI), Chungbuk National University.