USE OF THE INDEX METHODS OF INCOME INEQUALITY FOR ASSESSING THE SECURITY LEVEL

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Abstract: The article briefly describes the security environment. In this paper, I describe selected methods of income inequality, which can be used for assessing the safety level. The practical example is presented, how it is possible to use the Lorenz curve and Gini coefficient to assess the level of security of the territory. The value of the index of income inequality could become an indicator of a potential security breach.

Keywords: security, methods of income inequality, Lorenz curve, Gini coefficient

1. Introduction
Climate change, social change, technological developments and other phenomena affect the scope and volume of crisis phenomena. Crisis phenomenon then means the harmful effects of forces and phenomena caused by human activity, natural effects and also accidents that disrupt or prevent the functioning of the existence or development process or system. Complexly speaking, that these changes affect the established safety level. Influence of crisis phenomena can endanger the lives and health of people, their property or the environment. Crisis events can also lead to other consequences such as endangering the safety of the population, psychological distress, disruption to businesses, etc.. For these reasons, it is necessary to implement preventive measures and to deal with crisis situations before they occur, prior to the effect of the devastating effects on the system and the surroundings.

State and local governments have an irreplaceable role in preventing, preparing for and responding to crisis event. Effectiveness of their work results from a functional structure, legal security and adequate preparedness and competence of the various actors of crisis management.

2. Security environment
Defining the term security environment is not clear, because it has complicated both vertical and horizontal structure. Security environment is an area in which human activities are carried out in terms of the risks affecting security interests, activities and values of the international community, the state, social groupings, legal entities or individuals.

According to the document security terminology Czech University of Defence is "security environment external environment affecting national security policy. It can be seen as an area located outside the national borders, which are realized and state interests clash with the interests of other actors in international relations and in which place processes that have a significant impact on the level of national security. "[5]

Since the 90s of the last century the security environment of the world has changed. The main changes in the perception of safety was to minimize the possibility of armed conflict
ended bipolar division of the world, a decrease in aggression in relations between states, but also the extensive activities of international security organizations and the like. On the other hand, saw an increase in non-military threats, including international terrorism. Changes in society and lead to the result that a natural or technological disaster often do not have a company such as the impact of disasters in the economic sphere, in the territorial and social infrastructure, information technology, communications, energy and banking.

3. Security assessment using index methods of income inequality

Exist many methods and approaches to the assessment of the safety area. Among the most commonly used methods include index. Index methods can include the generic methods that are based on the examination of important determinant and other indicators that influence the development of the security situation. Index methods are used to identify sources of risk. In most cases, methods used to detect specific sources of risk. Other sources of risk using these methods cannot be identified, methods are not equipped to do. Methods of income inequality are used because income inequality determines how the real incomes of individuals, families on social groups distinct from the situation where everyone had the same income. In every society exists a greater or lesser degree of income inequality. In essence, it is the basic yardstick for poverty or prosperity. At the same time, however, it folds as evidence the state of the public finance system and social system. Today, differences in income and societal wealth very apparent. Individual groups such differences could be seen as unfair, what can cause the emergence of conflicts that can escalate into violence or changes in the political system.

Ways to measure income inequality and then analyze it, there are many. Among the best known and most used methods include:

- Lorenz curve,
- Gini coefficient,
- Hoover Index (Robin Hood Index)
- Atkison index of inequality. [3]

3.1. Lorenz curve

Author Lorenz curve is an American economist Max O. Lorenz, who model the Lorenz curve remembered the first time in his dissertation, "The Economic Theory of Railroad Rates" in 1905.

Lorenz curve is among the most widely used models and graphic presentation of income inequality. Waveform is defined by two axes, the x-axis represents the proportion of the population and the y-axis total revenue (Fig. 1). Values of both axes are moved in the interval <0; 1>. The graph is also a shaft angle of 45 degrees (diagonal unit square). The curve represents absolute equality of income in society. In practice, this situation does not occur. The Lorenz curve describes the actual state of income distribution in a society. Generally speaking, the more the Lorenz curve approaches the diagonal, the lower the income inequality. Conversely, the more the Lorenz curve moves away from the diagonal, the greater the income inequality increased.
Curve absolute income equality in society
(Diagonal of the unit square)

Figure 1: Lorenz curve
By: Fürst, 2012

3.2. Gini coefficient
In 1912, an Italian statistician and demographer Corrado Gini presented a statistical model which pointed to the differences in financial income residents. Model describing the variation in real income from absolutely equitable distribution of income among residents. Since then, the Gini coefficient \( G \) is used to express income inequality and inequality drew attention to the sum of the accumulated wealth.

The starting point for determining the Gini coefficient is Lorenz curve. Gini coefficient takes values from the interval \(<0; 1>\). If the coefficient value approaches 0, i.e. area A is zero. This situation indicates an absolutely equal distribution of income. Conversely, if the Gini coefficient takes a value of 1, i.e. area B is zero. The company then has an absolute inequality of income distribution.

The Gini coefficient can be calculated as the ratio between the size of the area A and the total area under the diagonal \( A + B \) (Fig. 2).

\[
G = \frac{A}{A + B}
\]  
(1)
3.3. **Hoover index (Robin Hood Index)**

Hoover index is used to determine total income that should be reallocated so that it attained absolute uniformity of income distribution. This means that part of the total income should be removed richer part of the population in favor of the poorer sections of the population (the idea of Robin Hood).

Graphically Hoover index can be interpreted as the longest distance between the point F, which lies on the curve of the absolute equality of income, and point E, which lies on the Lorenz curve (Fig. 3).
Hoover index can be mathematically defined as:

\[ HI = \left( \frac{\sum_{i=1}^{n} \frac{x_i}{\sum_{i=1}^{n} x_i}}{n} - \left( \frac{m \cdot 1}{n} \right) \right) \times 100 \text{ for } \frac{x_i}{\sum_{i=1}^{n} x_i} \neq \frac{1}{n} \text{,} \tag{2} \]

where:  
- \( x_i \) the individual receiving the i-th group,  
- \( n \) is the number of income groups,  
- \( m \) is the number of groups which are set off in total sum.

### 3.4. Atkison index of inequality

British economist Anthony Barnes Atkinson presented Atkinson's index of inequality. It is a tool that quantifies the degree of income inequality by calculating the so-called fair average income \( Y_e \). This income is defined as income evenly split in the group, which will create the same level of prosperity as the existing distribution of income.

The general formula for calculating the Atkinson index of inequality is defined as:

\[ A_e (y_1, y_2, ..., y_n) = \begin{cases} 
1 - \frac{1}{\mu} \left( \frac{1}{N} \sum_{i=1}^{N} y_i^{1-\varepsilon} \right)^{1/(1-\varepsilon)} & \text{for } \varepsilon \in (0,1) \cup (1,\infty), \\
1 - \frac{1}{\mu} \left( \prod_{i=1}^{N} y_i^{1/N} \right) & \text{for } \varepsilon = 1, \end{cases} \tag{3} \]

where:  
- \( y_i \) is the individual income (balanced intake of the ith group of people),  
- \( \mu \) is the average income in society (to the group),  
- \( \varepsilon \) is parameter aversion to inequality,  
- \( N \) is the number of income groups. [2]

As is apparent from the formula (4), inequality aversion parameter can take values from the interval \(<0, \infty)\). If the parameter of aversion to inequality is 0, it means that the company occupies an indifferent attitude towards the distribution of income. Conversely, the greater the value of the parameter aversion to inequality, the more the company emphasizes the transfer of income at the bottom of the income distribution and less emphasis on the transfer of income at the top of the income distribution. [3]

Atkinson index itself varies in the interval \(<0, 1>\) is true that the more the current average per capita income approaching fair average per capita income, the lower the value Atkinson index. [3]

### 4. Case study on use of index of methods of assessment levels of security

The case study shows how it is possible to use the selected index methods to assess the potential risks that could compromise the security of the monitored area.

When examining income inequality were used two indicators - the number of private households \( (x) \) and net cash income household \( (y) \). All figures relate to the year 2013. Net cash inflows are calculated from gross cash receipts deducting income tax and compulsory personal insurance.

#### 4.1. Use Lorenz curve

As is evident from the table (Tab. 1) between individual regions are major differences between the net cash income or the number of households. It suggests that the Lorenz curve will tend to approach the diagonal and income inequality will be of great significance.
Table 1: Table of frequency indicators x a y

<table>
<thead>
<tr>
<th>Regions of SR</th>
<th>x</th>
<th>y</th>
<th>rel(x)</th>
<th>rel(y)</th>
<th>kum(x)</th>
<th>kum(y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region of Košice</td>
<td>237</td>
<td>328</td>
<td>0,128</td>
<td>0,110</td>
<td>0,128</td>
<td>0,110</td>
</tr>
<tr>
<td>Region of Prešov</td>
<td>261</td>
<td>337</td>
<td>0,141</td>
<td>0,113</td>
<td>0,270</td>
<td>0,223</td>
</tr>
<tr>
<td>Region of Bánská Bystrica</td>
<td>247</td>
<td>354</td>
<td>0,134</td>
<td>0,118</td>
<td>0,403</td>
<td>0,341</td>
</tr>
<tr>
<td>Region of Nitra</td>
<td>240</td>
<td>356</td>
<td>0,130</td>
<td>0,119</td>
<td>0,533</td>
<td>0,460</td>
</tr>
<tr>
<td>Region of Žilina</td>
<td>218</td>
<td>362</td>
<td>0,118</td>
<td>0,121</td>
<td>0,651</td>
<td>0,581</td>
</tr>
<tr>
<td>Region of Trenčín</td>
<td>208</td>
<td>376</td>
<td>0,113</td>
<td>0,126</td>
<td>0,764</td>
<td>0,707</td>
</tr>
<tr>
<td>Region of Trnava</td>
<td>191</td>
<td>388</td>
<td>0,103</td>
<td>0,130</td>
<td>0,867</td>
<td>0,837</td>
</tr>
<tr>
<td>Region of Bratislava</td>
<td>245</td>
<td>487</td>
<td>0,133</td>
<td>0,163</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Σ</td>
<td>1852059</td>
<td>2988</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Statistical Office of the Slovak Republic, 2013

After calculating the relative and cumulative frequency graph was created, which can be seen as the Lorenz curve and the diagonal graph (Fig. 4). As predicted, the Lorenz curve does not deviate from the curve of the absolute equality of income. This means that between each region SR is pronounced income inequality, which could in any way compromise the security of the regions.

Figure 4: Lorenz curve of income inequality
Source: Author

4.2. Use Gini coefficient
Gini coefficient will be used in monitoring the income inequality between selected indicators. As already written above, the statistical values of individual regions are significant differences (Tab. 2). It indicates that the Gini coefficient is rather closer to the value 0.
The value of the Gini coefficient, as previously written, it always reaches values from the interval \(<0; 1\). The value of the Gini coefficient can be calculated from the formula (1).
Value of the area \((A + B)\) is always equal to the value of 0.5 (half the area of a square with edges 1 * 1).
To calculate the Gini coefficient is therefore necessary to determine the size of the area B (Tab. 3.). If we start from Lorenz curve, then we will see that the first decile in the chart resembles the shape of a right triangle, the area we are able to calculate. Second decile area can be divided into a rectangle, and again right triangle. The same applies for all other deciles in the chart. Area B thus calculated as the sum of the areas of individual deciles.

\[ G = \frac{A}{A + B} \]  

\( G = \frac{0,044}{0,044 + 0,456} \)  
\( G = 0,088 \)

Since the Gini coefficient close to zero, it indicates an absolutely equal distribution of income among households counties SR. It could be concluded that, based on these two indicators should not impair the safety levels set by the monitored area.

5. Conclusion
Within the scientific-technical work we are dealing with a project entitled "Identification of factors and indicators of changes in the security environment necessary for designing prevention strategies and their financing." Monitoring of indicators that can affect safety, it is important to maintain the level of safety set by individual regions.
In the article we were approximated index methods, which are used for assessing the safety level. Methods could become the basis for developing methods to assess the safety of the Regions of the Slovak Republic, but it must be specified threshold values of changes in the level of security for the specific conditions of the Slovak Republic.

Understanding of the security environment is one of the prerequisites for the proper application of the principles of security policy in practice. At all levels of the security environment may be held events that may have a primary, but also secondary effects on the safety of people, property and the environment, as well as ongoing events and processes. Therefore it is important to analyze comprehensively and permanently security environment and processes running therein, to allow timely and appropriate action in order to maintain the required level of safety.

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References


