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# Selection of Strategies for Increasing Labor Market Efficiency Using Multi-Criteria Evaluation: The Case of the Republic of Croatia

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## Abstract

Labor market efficiency represents a multidimensional public policy problem that requires the simultaneous consideration of institutional, structural, as well as technological and dynamic factors. The aim of this paper is to identify and rank the strategies that, according to expert evaluation, contribute most to the long-term efficiency of the labor market of the Republic of Croatia. For this purpose, a multi-criteria evaluation model was developed, encompassing eight criteria and eight strategies identified on the basis of the relevant theoretical and empirical literature. The evaluation was conducted based on the assessments of nine experts from the academic community who deal with labor market issues. The fuzzy Modified Simple Weight Calculation (fuzzy M-SiWeC) method was applied to determine the relative importance of the criteria, while the ranking of the strategies was carried out using the fuzzy COmpromise Ranking from Alternative Solutions (fuzzy CORASO) method. The results show that technological adaptability and innovation incentives represent the most important evaluation criterion, whereas the reform of education and lifelong learning is the highest-ranked strategy for increasing the efficiency of the Croatian labor market. This is followed by active employment policies based on data analytics. The obtained results point to the need to direct Croatian labor market policies towards the systematic alignment of education and lifelong learning with labor market needs, as well as the development of active employment policies based on data analytics.

**Keywords***:* Labor market efficiency, strategy evaluation, multi-criteria decision making (MCDM), M-SiWeC method, CORASO method, Croatia.

## 1. Introduction

Labor market efficiency is one of the significant issues of European economic policy, especially under the conditions of demographic change, digital transformation, and structural adjustments to the global economy [1]. Although the European Union (EU) has implemented numerous reforms in recent decades aimed at increasing employment, mobility, and productivity, differences among member states remain pronounced, and labor markets continue to be burdened by segmentation, skills mismatch, and institutional rigidities.

The existing literature provides rich theoretical and empirical insights into individual aspects of labor market functioning – from matching models and frictions [2], through the influence of institutional rigidities [3], to the importance of human capital and technological transformation [4]. However, strategies for increasing efficiency are most often analyzed in isolation, without an integrated framework that would enable their systematic and comparative evaluation.

The motivation for conducting this research arises from the need to carry out, in a systematic manner, an

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evaluation of strategies for increasing labor market efficiency. The research for the purposes of this paper stems from the need for a comprehensive approach that simultaneously takes into account the institutional, structural, and technological dimensions of labor market efficiency. Since different strategies produce multidimensional and often conflicting effects, their evaluation represents a multi-criteria public policy problem.

The aim of this paper is to identify and rank the strategies that, according to expert evaluation, contribute most to the long-term efficiency of the labor market of the Republic of Croatia, taking into account their economic effectiveness, institutional sustainability, and development potential. In order to achieve this, the following research questions are posed:

- Which criterion is the most significant, according to the experts' opinions, for evaluating strategies for increasing the efficiency of the labor market of the Republic of Croatia?
- Which strategy yields the best results for increasing labor market efficiency in the Republic of Croatia, according to the experts' opinion?

This paper fills a gap in the existing literature by developing a unique multi-criteria framework for the systematic evaluation of labor market efficiency strategies. Unlike previous studies that analyzed individual strategies, this research assesses the relative importance of economic, social and institutional criteria, as well as transparently compares alternative approaches to labor market policy. The contribution of this research lies not only in the application of Multi-Criteria Decision Making (MCDM) methods, but also in demonstrating how the relative prioritization of labor market strategies depends on policy objectives. By using a methodological framework that integrates institutional, structural and technological dimensions, this research provides a workable model for evaluating labor market policies. It thus provides practical guidance to policymakers by showing which strategies would yield the best results in different scenarios and which criteria are decisive in determining the efficiency of certain labor market interventions. This is particularly important because there is not enough research that has addressed the labor market in the Republic of Croatia in this way.

## 2. Literature Review

In economic theory, labor market efficiency is traditionally viewed through the system's ability to match labor supply and demand with minimal frictions and to ensure high employment and optimal resource allocation. Within the framework of search and matching models, Mortensen and Pissarides [2] show that unemployment arises from frictions in the process of matching workers and jobs, while the dynamics of job creation and job destruction determine the equilibrium level of employment. Blanchard and Diamond [5] further emphasize the role of unemployment duration and candidate ranking mechanisms, while Layard et al. [6] highlight that institutional factors – such as the tax wedge, benefit systems, and labor market regulation – have a decisive influence on the natural rate of unemployment. Thus, labor market efficiency becomes the result not only of market forces but also of institutional design.

In the European context, the issue of labor market segmentation and duality is particularly emphasized. Saint-Paul [7] analyses the political-economic dynamics of institutional rigidities, pointing out that workers with permanent contracts (insiders) often have a stronger influence on regulatory outcomes than workers with precarious forms of employment (outsiders). Bentolila et al. [8] show that dual systems can generate inefficiencies through reduced mobility and high turnover among vulnerable groups. T. Boeri [9] emphasizes that reforms aimed at reducing segmentation can increase overall efficiency but require political coordination and institutional stability.

In response to the tension between flexibility and security, the concept of flexicurity was developed. Wilthagen and Tros [10] define it as an institutional strategy that combines flexible contractual arrangements with active employment policies and strong social protection. This model can increase labor market resilience and serve as a basis for labor market modernization. Structural frictions, particularly the mismatch between workers' skills and employers' needs, represent an additional challenge. Şahin et al. [11] develops empirical measures of mismatch and show that it can significantly contribute to overall unemployment. Dustmann et al. [12] emphasize the role of labor mobility in reducing regional imbalances. In this context,

investment in education and retraining becomes crucial for the long-term efficiency of the labor market.

Human capital theory [13] posits education and skills development as fundamental determinants of productivity and growth. Goldin and Katz [4] show that, historically, the "race between education and technology" has shaped distributional outcomes and the level of inequality. Hanushek and Woessmann [14] further emphasize the importance of the quality of education for long-term economic growth. In the context of European policies, investment in human capital represents one of the key strategies for increasing labor market efficiency and adapting to technological change.

Industrial policy and structural transformation are also linked to labor market efficiency. Aghion and Howitt [15] develop a model of endogenous growth based on creative destruction, according to which innovations generate long-term growth but also transitional costs in the labor market. Mazzucato [16] emphasizes the importance of the state in encouraging innovation and undertaking risky investments. In this way, labor market efficiency cannot be analyzed in isolation from the broader development strategy.

Digital transformation and artificial intelligence are further changing labor market dynamics. Brynjolfsson and Hitt [17] point out those information technologies require organizational adaptations in order to generate productive effects, while Graetz and Michaels [18] empirically confirm the positive effect of robotization on productivity, with redistributive implications.

Active labor market policies (ALMPs) represent an important instrument of institutional adaptation. Card et al. [19], in a meta-analysis, show that such policies can have positive long-term effects, especially when focused on training and skills development. However, Crépon et al. [20] warn of possible displacement effects, which imply the need for careful policy design in order to avoid inefficiencies. Despite the rich literature on individual aspects of the labor market, an integrated and comparative approach that would systematically rank different strategies for increasing labor market efficiency is lacking. Previous studies have predominantly focused on individual interventions such as flexicurity reforms [10], active labor market policies [19] or investment in education [14], without considering the effectiveness of these strategies in a unified framework. Although some studies have used quantitative methods to evaluate labor market policies, they have usually been limited to econometric analyses of the effects of individual policies rather than comparing policies. This study aims to fill the gaps in existing studies by: (1) integrating institutional, structural and technological dimensions into a unified evaluation framework, (2) applying MCDM methods to enable transparent comparisons between policies and (3) systematically testing the robustness of rankings to changes in policy priorities through sensitivity analysis. This approach goes beyond the isolated analysis of individual interventions and provides a reproducible, evidence-based methodology for policy prioritization.

## 3. Research Methodology

This research will be conducted through three phases (Figure 1). These research phases are interconnected and form a unified sequence of activities in order to obtain the results of this research. The first phase of the research encompasses the definition of strategies for increasing labor market efficiency and the criteria for their evaluation. Based on a review of the relevant theoretical and empirical literature, eight strategies aimed at increasing labor market efficiency were identified. The strategy identification itself proceeded through three steps. In the first step, an initial identification of strategies existing in the literature was carried out. First, a review of papers published in the period 2000-2025 was carried out, where 47 potential strategies were identified using keywords related to labor market strategies. The second step was an analysis of the application of these strategies in the Republic of Croatia, where it was examined whether these strategies were relevant to the labor market in Croatia, then whether they were applicable within national policies and whether there was sufficient theoretical and empirical support for these strategies in existing scientific sources. This step reduced the number of strategies to 18. In the third step, the final selection and validation was carried out by three independent labor market experts who were not subsequently involved in the evaluation process of these strategies in order to maintain independence in the selection. By applying panel research, the total number of strategies was reduced to eight, which were used in this research.

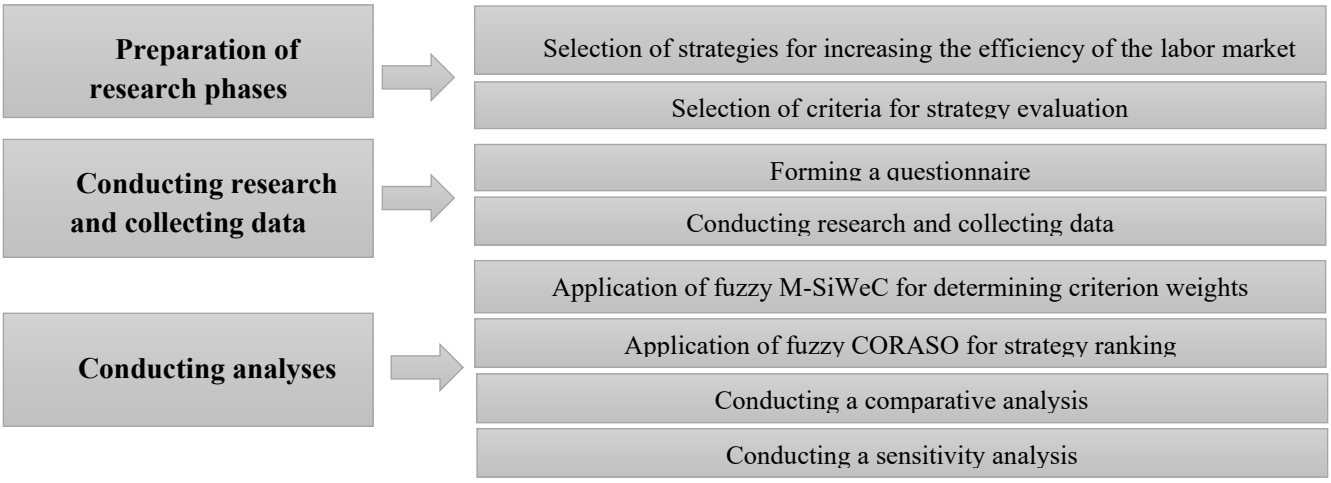


**Figure 1.** Phases in conducting the research.

The identified strategies belong to three fundamental dimensions: the institutional, the structural, and the technological and dynamic dimension. The institutional dimension includes STR.1, STR.2, and STR.3; the structural dimension includes STR.4, STR.5, and STR.6; while the technological and dynamic dimension includes STR.7 and STR.8. Although, according to their fundamental orientation, the strategies belong to a particular dimension, their effects may manifest across multiple dimensions of labor market efficiency. The identified strategies are as follows:

- STR.1 – Reform of labor legislation according to the flexicurity model. This strategy enables the modernization of contractual forms accompanied by strong active policies and security mechanisms.
- STR.2 – Tax reform through the reduction of the tax wedge. This strategy works towards reducing the tax burden on labor in order to encourage formal employment.
- STR.3 – Digital transformation of labor market institutions. In this strategy, the digitalization of public employment services and the reduction of regulatory frictions are carried out.
- STR.4 – Reform of education and lifelong learning. The task of this strategy is the alignment of education with labor market needs.
- STR.5 – Economic migration management strategy. This strategy is reflected in the selective attraction of labor and the integration of qualifications.
- STR.6 – High value-added industrial policy. The task of this strategy is the development of technology-intensive sectors.
- STR.7 – Encouraging technological diffusion and the digitalization of enterprises. In this strategy, investment in the digital modernization of small and medium-sized enterprises is carried out through the application of artificial intelligence (AI).
- STR.8 – Active employment policies based on data analytics. In this strategy, the use of big data for the precise targeting of employment and retraining is carried out.

After defining the strategies for increasing labor market efficiency, the next step encompasses the definition of criteria for their evaluation. In the same way as the strategy was determined, the criteria for this research were also determined. In the first step, a total of 37 criteria were determined, in the second step they were reduced to 15 criteria, while in the third step they were reduced to a total of 8 criteria that were used in this research. In accordance with the previously defined dimensions, the institutional dimension includes CRI.1, CRI.2, and CRI.3; the structural dimension includes CRI.4, CRI.5, and CRI.6; while the technological and dynamic dimension includes CRI.7 and CRI.8. The defined criteria, their characteristics, and their theoretical foundation are presented in Table 1.

**Table 1.** Criteria for evaluating strategies for increasing labor market efficiency.

| Id | Criterion | Description | References |
|---|---|---|---|
| CRI.1 | Institutional flexibility and security | Adaptation of the labor market while preserving social security | [21], [22] |
| CRI.2 | Reduction of labor market segmentation | Reduction of divisions between stable and unstable forms of employment | [23], [24] |
| CRI.3 | Institutional feasibility and administrative efficiency | Real possibility of implementation with low transaction costs | [25], [26] |
| CRI.4 | Increase in overall employment | Long-term employment growth | [27], [28] |
| CRI.5 | Reduction of structural mismatch | Alignment of skills, sectors, and regions | [29], [30] |
| CRI.6 | Long-term demographic resilience | Mitigation of the effects of ageing and migration imbalances | [31], [32] |
| CRI.7 | Labor productivity growth | Increase in output per employee/hour worked | [33], [34] |
| CRI.8 | Technological adaptability and innovation incentives | Incentive for digitalization, automation, and innovations | [35], [36] |

The next phase of this research involves conducting the research and collecting data. Before the research is carried out, it is first necessary to form a questionnaire based on the selected strategies and criteria. The evaluation of the questionnaire will be performed using ratings in the form of linguistic values (Table 2). These ratings range from the value "very bad" to the value "very good" with seven levels. In order to use these ratings in the research, a fuzzy approach was chosen, specifically the use of triangular fuzzy numbers. Therefore, when determining the ratings, it is necessary to also determine the membership function on the basis of which the linguistic values will be converted into fuzzy numbers (Table 2).

**Table 2.** Linguistic ratings and membership function.

| Linguistic value | Id | Fuzzy number |
|---|---|---|
| Very bad | VeB | (1, 1, 2) |
| Bad | Bad | (2, 3, 4) |
| Medium bad | MeB | (3, 4, 5) |
| Medium | Med | (4, 5, 6) |
| Medium good | MeG | (5, 6, 7) |
| Good | Goo | (6, 7, 8) |
| Very good | VeG | (8, 9, 9) |

After the questionnaire has been formed and the linguistic values have been determined with which the importance of the criteria weights and the extent to which a particular strategy meets the set objectives will be assessed, the distribution of these questionnaires to the respondents is carried out.

The respondents included in the research were members of the academic community from higher education institutions in the Republic of Croatia who, in their scientific and research work, are narrowly focused on the field of the labor market. In order to be selected as a respondent for this study, it was necessary to work at a higher education institution, to be actively engaged in scientific research in the field of labor market and to have published at least five papers in Web of Science (WoS) in this field in the last five years. The decision to include only academic respondents in this study was made to ensure a consistent theoretical and methodological background in the evaluation of the strategy. By including only the academic community, the potential conflict that practitioners from the public or private sector might have was avoided. Although this is a limitation of this study because the focus is only on academic staff, the use of these respondents avoided institutional advocacy or consideration of certain strategies that are most suitable for practitioners and that would not yield the best results. The questionnaires were forwarded to these respondents, and a total of nine respondents completed the survey. The sample of nine respondents corresponds to the recommended size in studies where MCDM methods are included because these respondents have a high level of knowledge in a specific area of the labor market. These collected data serve to carry out the next phase of the research, namely conducting analyses.

In the third phase of the research, the importance of the criteria weights is first determined, then the ranking of the

strategies is performed, and at the end of this phase, a sensitivity analysis is conducted. In determining the importance of the criteria weights in this research, the fuzzy M-SiWeC (Modified Simple Weight Calculation) method was adopted. This method represents a modification of the classical fuzzy SiWeC method carried out by the authors Juhász-Hallai et al. [37]. The modification of the SiWeC method refers to giving equal importance to the experts' assessments so that all experts equally influence the determination of the final criteria weight. This method has advantages over other methods, namely:

- M-SiWeC is a modified SiWeC method and is a simpler form because it has fewer steps for calculating the weights.
- It ensures that all expert ratings participate equally in determining the weights of the criteria
- It facilitates evaluation because experts do not have to take into account the mutual relationship of the criteria but only determine their individual importance.
- Specific characteristics of the method, for which it has been widely used in practice, have been retained.

It should be noted that the M-SiWeC method is a simple method that does not model the mutual relationships between the criteria. Therefore, this method is suitable in research where the criteria are viewed as independent dimensions, as is the case in this research. The steps of this method are:

Step 1. Assessment of the importance of criteria using linguistic values.

Step 2. Transformation of linguistic values into fuzzy numbers.

Step 3. Normalization of fuzzy numbers.

$$\tilde{n}_{ij} = \frac{x_{ij}^{l}}{max\ x_{ij}^{u}}, \frac{x_{ij}^{m}}{max\ x_{ij}^{u}}, \frac{x_{ij}^{u}}{max\ x_{ij}^{u}} \quad (1)$$

Where $max\ x_{ij}^{u}$ is the maximum value of the fuzzy number.

Step 4. Calculation of the sum of weights from the normalized values.

$$\tilde{s}_j = \sum_{j=1}^{n} \tilde{n}_j \quad (2)$$

Step 5. Determination of criteria weights.

$$\widetilde{w}_j = \frac{s_j^{l}}{\sum_{j=1}^{n} s_j^{u}}, \frac{s_j^{m}}{\sum_{j=1}^{n} s_j^{m}}, \frac{s_j^{u}}{\sum_{j=1}^{n} s_j^{l}} \quad (3)$$

On the basis of these steps, the importance of the criteria is determined by means of the weights of these criteria.

In order to determine which of the selected strategies, in the opinion of the respondents, best meets the set research criteria, the fuzzy CORASO (COmpromise Ranking from Alternative SOlutions) method will be used. The specificity of this method is that it enables a compromise ranking of alternatives in relation to the minimum and maximum values of the alternatives. This method was chosen for several reasons: it takes into account the maximum and minimum values of alternative solutions when evaluating alternatives and a compromise ranking is made in relation to these solutions. The result of this method is between minus one (-1) and one (1), which shows how much an individual alternative deviates from the average. If the value is positive, it indicates that the values of the alternative for all criteria as a whole are greater than the average and vice versa. In order for an alternative to be better, it must have a value as close to one as possible. Using these results facilitates the interpretation of the results and allows for direct comparison between alternatives. Through its application in practice, it has demonstrated high accuracy in ranking alternatives and, for this reason, has wide practical application, which was shown in various conducted studies [38], [39]. The steps of this method are as follows:

Step 1. Assessment of the importance of strategies using linguistic values.

Step 2. Transformation of linguistic values into fuzzy numbers.

Step 3. Normalization of fuzzy numbers.

$$n_{ij} = \frac{x_{ij}^{l}}{\max x_j^{u}}, \frac{x_{ij}^{m}}{\max x_j^{u}}, \frac{x_{ij}^{u}}{\max x_j^{u}} \quad (4)$$

Where: $x_{j\,max}$ – the maximum value of the fuzzy number for a particular criterion.

Step 4. Determination of alternative solutions.

Step 5. Weighting of normalized data.

$$\tilde{v}_{ij} = \widetilde{w}_j \cdot \tilde{n}_{ij} \quad (5)$$

Step 6. Calculation of the sum values of the alternatives.

$$\tilde{S}_i = \sum_{j=1}^{n} \tilde{v}_{ij} \quad (6)$$

Step 7. Calculation of the deviation from the alternative solutions.

$$\tilde{R}_i = \frac{\tilde{S}_i}{\tilde{S}_{i\,max\,AS}} \quad (7)$$

$$\widetilde{R'}_i = \frac{\tilde{S}_{imin\,AS}}{\tilde{S}_i} \quad (8)$$

Step 8. Defuzzification.

$$R_{i\,def} = \frac{R_i^l + 4R_i^m + R_i^u}{6} \quad (9)$$

$$R'_{i\,def} = \frac{R'_i{}^l + 4R'_i{}^m + R'_i{}^u}{6} \quad (10)$$

Step 9. Calculation of the CORASO method value.

$$Q_i = \frac{R_i - R'_i}{R_i + R'_i} \quad (11)$$

The specificity of this method is that the values can range from minus one (-1) to one (1). If the values are negative, this means that the majority of ratings for the criteria are below average, and vice versa. The closer the value of this method is to one, the better the ranking of the alternatives [39].

After the ranking of strategies is completed, a comparative analysis is also conducted. This analysis is performed in order to confirm or refute the ranking obtained by one multi-criteria decision-making method. The specificity of these methods is that each of them has its own steps that influence the ranking of alternatives [40]. Therefore, it is necessary to perform ranking using several MCDM methods and establish that the ranking of alternatives is stable. In the comparative analysis, the same decision matrix and the same criteria weights are used; only the ranking is performed using other MCDM methods. In this research, four additional MCDM methods will be used, namely SAW (Simple Additive Weighting) [41], ARAS (Additive Ratio Assessment) [42], MABAC (Multi-Attributive Border Approximation area Comparison) [43], and MARCOS (Measurement of Alternatives and Ranking according to COmpromise Solution) [44]. Some of these methods use a different normalization compared to the CORASO method, namely the ARAS and MABAC methods, while the SAW and MARCOS methods use the same normalization.

Finally, a sensitivity analysis will be performed. The purpose of the sensitivity analysis is to determine the extent to which an individual criterion influences the final ranking of alternatives [45]. Sensitivity analysis can be conducted in several ways, and what all these ways have in common is that the original criteria weight is changed and the impact that this change in weights has is observed. In this research, the sensitivity analysis will be conducted in such a way that the importance of an individual criterion is increased by 2, 3, and 4 times relative to the weights obtained by the fuzzy M-SiWeC method, while the remaining criteria weights are proportionally reduced in relation to that weight. In this way, an individual criterion gains greater importance in the final ranking of strategies. If a particular strategy achieves a better ranking, this is a sign that it had better indicators for that criterion compared to other strategies, and vice versa.

## 4. Research Results

The research results are presented in the third phase of the research after the data are collected from the respondents. Due to the need to use the criteria weights when ranking the strategies, the determination of the criteria weights is first performed using the fuzzy M-SiWeC method and the steps of this method are carried out. The first step of this method is the formation of a linguistic decision matrix based on the respondents' assessments (Table 3).

After that, each linguistic rating is transformed into the corresponding fuzzy number using the defined membership function (Table 2), and then normalization is performed where all values of the fuzzy numbers are divided by the highest value, which is the number nine (9) (Expression 1); then the summation of the normalized criteria values is performed and the aggregate criteria weights are formed (Expression 2). Finally, the final weight value is formed by dividing the individual values of the aggregate criteria weights by the total values of the aggregate weights (Expression 3).

**Table 3.** Assessment of criteria for the selection of strategies for increasing labor market efficiency.

| | CRI.1 | CRI.2 | CRI.3 | CRI.4 | CRI.5 | CRI.6 | CRI.7 | CRI.8 |
|---|---|---|---|---|---|---|---|---|
| Expert 1 | Goo | MeG | Goo | VeG | Goo | MeG | VeG | Goo |
| Expert 2 | VeG | Goo | Goo | Goo | Goo | VeG | VeG | VeG |
| Expert 3 | Goo | MeG | Med | Goo | VeG | MeB | MeG | VeG |
| Expert 4 | Med | MeG | MeG | Goo | Med | MeG | Med | Med |
| Expert 5 | Goo | Med | VeG | Goo | Goo | VeG | MeG | Goo |
| Expert 6 | Med | MeB | MeB | Med | MeG | MeB | Bad | MeG |
| Expert 7 | MeG | Med | Goo | VeG | MeG | Goo | Med | VeG |
| Expert 8 | MeG | MeG | Goo | VeG | VeG | VeG | VeG | VeG |
| Expert 9 | Goo | Goo | Goo | VeG | VeG | VeG | VeG | VeG |

**Table 4.** Importance of criteria for the selection of strategies for increasing labor market efficiency

| Criteria | $\tilde{s}_j$ | $\widetilde{w}_j$ | Criteria | $\tilde{s}_j$ | $\widetilde{w}_j$ |
|---|---|---|---|---|---|
| CRI.1 | (5.56, 6.56, 7.44) | (0.09, 0.12, 0.16) | CRI.5 | (6.22, 7.22, 7.89) | (0.10, 0.13, 0.17) |
| CRI.2 | (4.78, 5.78, 6.78) | (0.08, 0.10, 0.14) | CRI.6 | (6.00, 7.00, 7.56) | (0.10, 0.13, 0.16) |
| CRI.3 | (5.56, 6.56, 7.44) | (0.09, 0.12, 0.16) | CRI.7 | (5.78, 6.78, 7.33) | (0.09, 0.12, 0.15) |
| CRI.4 | (6.67, 7.67, 8.22) | (0.11, 0.14, 0.17) | CRI.8 | (6.78, 7.78, 8.22) | (0.11, 0.14, 0.17) |

**Table 5.** Aggregate fuzzy decision matrix

| | CRI.1 | CRI.2 | CRI.3 | … | CRI.8 |
|---|---|---|---|---|---|
| STR.1 | (6.22, 7.22, 7.78) | (5.00, 6.00, 6.78) | (4.89, 5.89, 6.78) | … | (6.11, 7.11, 7.78) |
| STR.2 | (4.44, 5.33, 6.11) | (4.00, 5.00, 6.00) | (4.89, 5.89, 6.78) | … | (4.00, 4.89, 5.89) |
| STR.3 | (4.44, 5.44, 6.33) | (4.33, 5.33, 6.22) | (5.11, 6.11, 6.89) | … | (5.44, 6.44, 7.11) |
| STR.4 | (5.44, 6.44, 7.33) | (5.56, 6.56, 7.44) | (4.78, 5.78, 6.78) | … | (6.22, 7.22, 7.89) |
| STR.5 | (5.56, 6.56, 7.22) | (5.22, 6.22, 6.89) | (4.44, 5.44, 6.33) | … | (4.11, 5.11, 6.00) |
| STR.6 | (4.44, 5.44, 6.44) | (4.44, 5.44, 6.44) | (3.78, 4.67, 5.67) | … | (6.33, 7.33, 7.89) |
| STR.7 | (3.78, 4.78, 5.78) | (4.00, 5.00, 6.00) | (5.00, 6.00, 6.78) | … | (6.00, 7.00, 7.67) |
| STR.8 | (5.33, 6.33, 7.11) | (5.67, 6.67, 7.33) | (5.11, 6.11, 7.00) | … | (6.44, 7.44, 8.00) |

On the basis of these steps, the results were obtained (Table 4), which show that the most important criterion according to the respondents' assessments is CRI.8 – Technological adaptability and innovation incentives, followed by criterion CRI.4 – Increase in overall employment. When these criteria weights are viewed as a whole, it can be concluded that there is no significant deviation in these weights and that each criterion contributes to the selection of a strategy for increasing labor market efficiency.

After the criteria weights are obtained, the ranking of strategies is performed using the fuzzy CORASO method. In this method, it is first necessary to form an aggregate decision matrix. The formation of this matrix is carried out by the respondents evaluating these strategies using linguistic ratings, and then the transformation of these ratings into fuzzy numbers is performed. Finally, the mean values of these fuzzy numbers are found and an aggregate decision matrix is formed, which serves as the basis for carrying out the specific steps of the fuzzy CORASO method (Table 5).

**Table 6.** Results of the fuzzy CORASO method.

| | $\tilde{S}_i$ | $\tilde{R}_i$ | $\tilde{R'}_i$ | $R_{i\,def}$ | $R'_{i\,def}$ | $Q_i$ | Rank |
|---|---|---|---|---|---|---|---|
| maxAS | 0.61, 0.92, 1.29 | | | | | | |
| STR.1 | 0.55, 0.84, 1.21 | 0.43, 0.92, 1.98 | 0.33, 0.76, 1.77 | 1.02 | 0.85 | 0.086 | 3 |
| STR.2 | 0.44, 0.70, 1.04 | 0.34, 0.76, 1.71 | 0.38, 0.91, 2.21 | 0.85 | 1.04 | -0.101 | 8 |
| STR.3 | 0.46, 0.72, 1.07 | 0.36, 0.79, 1.75 | 0.37, 0.88, 2.13 | 0.88 | 1.01 | -0.069 | 7 |
| STR.4 | 0.58, 0.88, 1.26 | 0.45, 0.96, 2.06 | 0.32, 0.73, 1.69 | 1.06 | 0.82 | 0.129 | 1 |
| STR.5 | 0.50, 0.78, 1.13 | 0.39, 0.85, 1.86 | 0.35, 0.82, 1.95 | 0.94 | 0.93 | 0.007 | 4 |
| STR.6 | 0.49, 0.76, 1.12 | 0.38, 0.83, 1.84 | 0.36, 0.84, 2.00 | 0.92 | 0.95 | -0.017 | 5 |
| STR.7 | 0.46, 0.72, 1.08 | 0.36, 0.79, 1.76 | 0.37, 0.88, 2.12 | 0.88 | 1.00 | -0.065 | 6 |
| STR.8 | 0.58, 0.87, 1.24 | 0.45, 0.95, 2.03 | 0.32, 0.73, 1.70 | 1.05 | 0.82 | 0.120 | 2 |
| minAS | 0.40, 0.64, 0.98 | | | | | | |

First, the normalization of the elements of the fuzzy decision matrix is performed (Expression 4), where each element is divided by the highest value of these elements for individual criteria. This is followed by the determination of alternative solutions, where the highest values of the criteria for the maximum alternative solution and the minimum values of the criteria for the minimum alternative solution are determined. After that, weighting is performed (Expression 5), where the normalized values are multiplied by the corresponding criteria weights, and then the sum values of the alternatives are calculated (Expression 6). Subsequently, the deviations from the alternative solutions are calculated (Expressions 7 and 8). Finally, defuzzification is carried out (Expressions 9 and 10) and the values of the fuzzy CORASO method are calculated (Expression 11). The results of this approach (Table 6) show that, according to the respondents' assessments, the most important strategy for increasing the efficiency of the labor market in the Republic of Croatia is strategy STR.4 – Reform of education and lifelong learning, followed by strategy STR.8 – Active employment policies based on data analytics. Both of these strategies indicate that continuous work on training and the improvement of knowledge is necessary, because changes in the market are constant and demand constant adaptation in the labor market.

In order to establish whether this ranking is realistic, a comparative analysis will be conducted. In this analysis, the results will be compared with four additional MCDM methods. The results of the comparative analysis (Figure 2) show that the ranking is stable and identical for all MCDM methods used. In this way, it can be confirmed that the ranking obtained by the fuzzy CORASO method is corroborated by other MCDM methods.

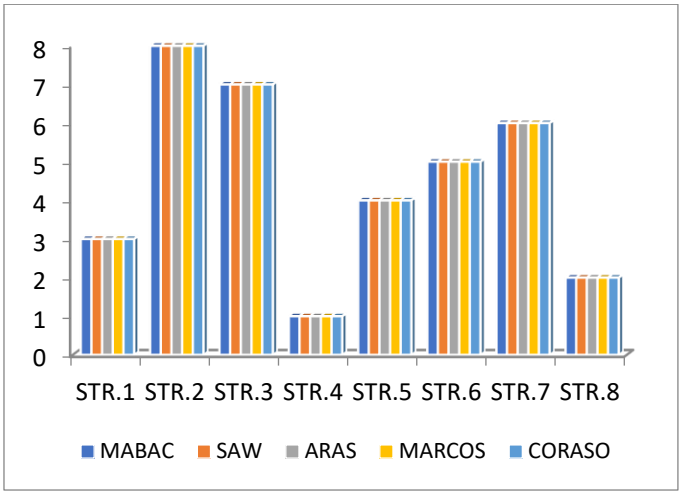


**Figure 2.** Results of the comparative analysis.

At the end of the analysis phase, a sensitivity analysis will also be performed, where it will be established which criteria have an influence and to what extent on the final ranking of the strategies. In each sensitivity scenario, the weight of one criterion was increased relative to its original value (2×, 3×, or 4×), while the remaining criteria weights were proportionally reduced. Scenario S0 represents the baseline with original weights.

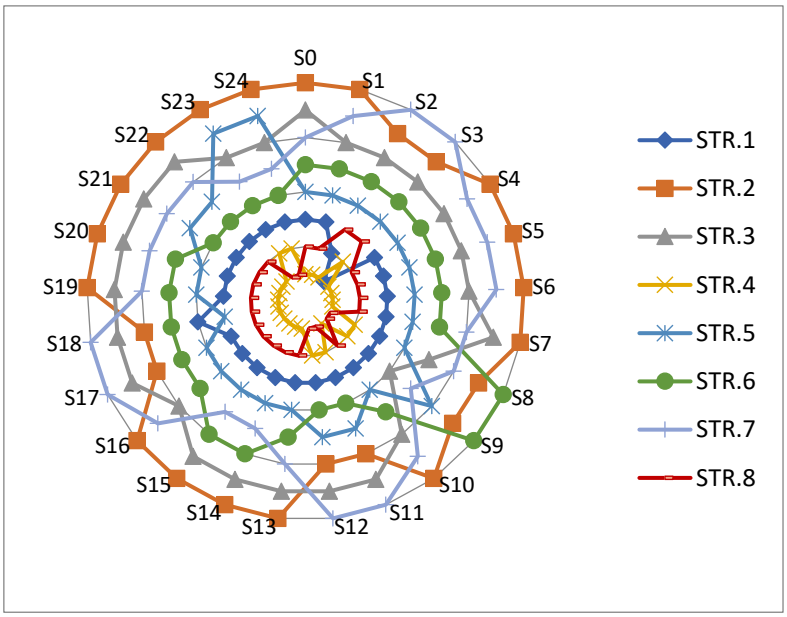


**Figure 3.** Results of the sensitivity analysis.

Scenarios S1-S3 correspond to CRI.1 at 2×, 3×, and 4×; S4-S6 to CRI.2; S7-S9 to CRI.3; S10-S12 to CRI.4; S13-S15 to CRI.5; S16-S18 to CRI.6; S19-S21 to CRI.7; and S22-S24 to CRI.8. By means of this, the advantages and disadvantages of these strategies will be examined. The results of this analysis (Figure 3) first show that there is a change in the ranking for all strategies. In this way, it is possible to examine the advantages and disadvantages of all strategies. If strategy STR.4, which took first place in the primary ranking, is considered, it retained this ranking in most scenarios, but when the weights of four criteria were changed, it fell to second place. Thus, for this strategy, the characteristics must be improved so that it is better evaluated for criteria CRI.1, CRI.3, CRI.4, and CRI.8. When the weight of these criteria was increased, STR.8 was better in three cases, while in one scenario, when CRI.1 was changed, STR.1 was better ranked. When the sensitivity analysis is examined, it becomes apparent that strategy STR.8 has an advantage over strategy STR.4 with respect to criteria CRI.3, CRI.4, and CRI.8. In this way, the advantage of one strategy can be assessed as the relative weakness of another strategy, providing insight into areas for improvement. In this manner, other strategies can also be observed, and guidelines can be provided on how to improve them so that they produce better effects in the labor market.

## 5. Discussion

In this research, a multi-criteria evaluation of eight strategies for increasing the efficiency of the labor market of the Republic of Croatia was conducted. By applying the fuzzy M-SiWeC method, the relative importance of the evaluation criteria was determined, while the fuzzy CORASO method was used to rank the observed strategies. The stability of the obtained ranking was additionally examined through a comparative analysis using other MCDM methods and a sensitivity analysis. The evaluation was based on the assessments of nine experts from the academic community who, in their scientific and research work, are narrowly focused on labor market issues.

The results of the fuzzy M-SiWeC method show that the experts attached the greatest importance to technological adaptability and innovation incentives (CRI.8) and to the increase in overall employment (CRI.4). At the same time, relatively high weights were achieved by the criteria of reduction of structural mismatch (CRI.5), institutional flexibility and security (CRI.1), and long-term demographic resilience (CRI.6). Such a distribution of criteria importance points to the multidimensional nature of the efficiency problem of the Croatian labor market. According to the experts' assessments, its more efficient functioning depends not only on increasing employment but also on the ability to adapt to technological changes, better matching of labor

supply and demand, and long-term resilience to demographic changes.

The obtained results should be viewed in the context of the specific characteristics of the Croatian labor market. The Croatian labor market is faced with the simultaneous effects of structural, demographic, and technological challenges. The reduction of the available labor force and population ageing increase the need for more efficient use of the existing human capital, while the mismatch between the knowledge and skills of the labor force and the needs of employers further hampers the efficient matching of labor supply and demand [46]. At the same time, digitalization, automation, and the application of new technologies are changing job requirements and increasing the need for the continuous adaptation of workforce competencies [47]. Under such conditions, labor market efficiency cannot be viewed exclusively through the number of employed and unemployed persons but also through the ability of the labor market to efficiently connect the available labor force with the needs of employers and to enable the continuous acquisition and adaptation of knowledge and skills.

In the aforementioned context, the highest ranking of strategy STR.4 – reform of education and lifelong learning – can be interpreted. Its first place indicates that the experts recognize one of the key challenges to the efficiency of the Croatian labor market in the need for the continuous alignment of the knowledge and skills of the labor force with changes in the structure of labor demand. Such a result is in line with human capital theory, according to which education and skills development represent important determinants of the productivity of individuals and the economy [13]. STR.4 was best evaluated according to the criteria of reduction of structural mismatch (CRI.5), long-term demographic resilience (CRI.6), and labor productivity growth (CRI.7). The aforementioned results show that the experts do not view the reform of education and lifelong learning solely as an education policy but as a structural strategy for labor market adaptation. Under conditions of limited labor force availability, increasing labor market efficiency increasingly depends on the quality, adaptability, and productivity of the existing human capital. Such an interpretation is also in line with the findings of Card et al. [19], who emphasise the long-term importance of policies focused on training and skills development for labor market outcomes.

The second-ranked strategy, STR.8 – active employment policies based on data analytics – further confirms the importance of more efficiently connecting the available labor force with labor market needs. The strategy was particularly well evaluated according to the criteria of increase in overall employment (CRI.4) and technological adaptability and innovation incentives (CRI.8). Its high ranking can be interpreted by the need for more precise identification of skills gaps, profiling of unemployed persons, and targeted direction of employment and retraining programmes. Unlike the traditional approach to active employment policies, the application of data analytics enables a more differentiated design of interventions according to the characteristics of individual labor force groups and the needs of employers. However, as Crépon et al. [20] warn, the effects of active employment policies depend on their design and can include displacement effects, which is why their effectiveness requires precise targeting and continuous evaluation.

On the other hand, the lowest ranked are STR.2 – tax reform through the reduction of the tax wedge, STR.3 – digital transformation of labor market institutions, and STR.7 – encouraging technological diffusion and the digitalization of enterprises. The lower ranking of these strategies does not mean that they are not relevant for the Croatian labor market, but rather that the experts, in relation to the other observed strategies and the defined criteria, assessed them as less comprehensive in addressing the key structural challenges. Reducing the tax wedge can have a positive effect on employment incentives and labor supply, but by itself it does not solve the problem of skills mismatch, demographic constraints, and the adaptation of human capital to technological changes. Similarly, the digitalization of labor market institutions and the technological modernization of enterprises can increase administrative and business efficiency, but their effects on labor market efficiency depend on the availability of a labor force with appropriate knowledge and competencies. The results therefore point to the need to observe individual interventions within the broader structural and institutional context of the labor market, which is in line

with arguments about the importance of institutional design and the interconnectedness of reforms [6], [9].

The results of the comparative analysis showed that the ranking of strategies is stable, as the application of all MCDM methods used yielded an identical ranking of alternatives. This confirms the robustness of the results obtained by the fuzzy CORASO method. Comparative analysis was conducted in this study using the SAW, ARAS, MABAC and MARCOS methods. This consistency is significant because the ARAS and MABAC methods used different normalization procedures, while the SAW and MARCOS methods used the same normalization. In this way, it was proven that normalization or different weighting, and the steps of the MCDM method do not affect the ranking of strategies. In this way, complete agreement between such methodologically different approaches confirms the results that STR.4 and STR.8 are the most desirable strategies to be applied in the labor market in Croatia.

The sensitivity analysis through the nuanced weights of the criteria showed that changes in the weights of individual criteria can influence the ranking of strategies. STR.4 retained first place in most of the analyzed scenarios, while in certain scenarios STR.8, i.e., STR.1, gained an advantage. When the weight of CRI.1 was increased four times, STR.1 overtook STR.4 and STR.8 and achieved the highest rank. This indicates what happens if policymakers prioritize institutional flexibility and security above all other goals. Similarly, when the weights of CRI.3, CRI.4, and CRI.8 were increased, STR.8 outperformed STR.4, suggesting that STR.8 has relative advantages in these specific dimensions.

Such results show that the optimal choice of strategy depends on the relative importance of the objectives to be achieved in the labor market. If greater importance is attached to institutional flexibility, technological adaptability, or an immediate increase in employment, other strategies can achieve a relative advantage. However, the stability of STR.4 and STR.8 in most scenarios confirms their high relevance in the context of the structural, demographic, and technological challenges of the Croatian labor market. These results provide very important information for designing labor market policies in Croatia. The stability of STR.4 and STR.8 in most scenarios suggests that they represent a good tool for policymakers to enable the functioning of the labor market across a wide range of policy objectives. However, the fact that other strategies may perform better in certain scenarios highlights the importance of explicitly setting policy priorities. Policymakers need to clearly define primary objectives in order to determine which strategies are most appropriate. The sensitivity analysis also reveals specific areas for improvement: STR.4 needs to be strengthened in terms of institutional flexibility and technological adaptability, while STR.8 needs to be improved in terms of institutional feasibility and long-term demographic resilience.

The obtained results therefore indicate that increasing the efficiency of the Croatian labor market requires a combination of structural and technologically supported policies. The reform of education and lifelong learning represents a long-term basis for the adaptation of human capital to changes in labor demand, while active employment policies based on data analytics can enable a more precise and faster connection of the available labor force with labor market needs. Their high ranking shows that the experts primarily associate the efficiency of the Croatian labor market with the ability to develop, adapt, and more efficiently direct human capital.

## 6. Conclusion

This research has provided a systematic and transparent methodological framework for the evaluation of strategies for the purpose of increasing labor market efficiency through the application of MCDM methods and a fuzzy approach. The results of the research, using the example of the Republic of Croatia, showed that the most important criteria are technological adaptability and innovation incentives, while the best results in practice, in the opinion of the respondents, would be delivered by the strategy of reform of education and lifelong learning (STR.4). These results show that human capital plays a key role in addressing labor market challenges caused by the digital transformation and demographic changes taking place in this market. The second-ranked strategy, STR.8, shows that it is necessary to increasingly apply modern technologies in shaping the labor market and in creating efficient employment policies. The results showed that the lowest ranked strategies are those focused on individual aspects of the labor market. These results

indicate that it is necessary to develop comprehensive labor market reforms in order to influence its efficiency.

The implications of this research show that it is necessary to implement labor market reforms in the Republic of Croatia. It is necessary to apply national strategies focused on lifelong learning and education and on the development of analytical tools for the precise targeting of employment policies. The application of fiscal measures also yields results, but these results are often short-term and do not influence the development of the labor market. They should not be viewed as a substitute for the structural changes that need to be made in the labor market. The proposed methodological framework can serve as a tool for monitoring labor market policies in order to be able to influence changes in the labor market in a timely manner so as to increase employment.

In addition, this research has certain limitations. The evaluation relies exclusively on academic experts, which may result in theoretical bias because the perspectives of practitioners, employers or job seekers are not included. Future research should include stakeholders as well as respondents who are directly or indirectly related to the labor market. The set of strategies and criteria, although systematically derived from the literature, may be subject to criticism because there are other strategies and criteria that are not included in this research. Future research should focus only on the selection of criteria and strategies. The results are related exclusively to the specific context of the Croatian labor market and cannot be directly generalized to other countries that have their own specificities. Therefore, future research should consider multiple countries and make comparisons between them. The research evaluates strategies based on the perceptions of experts, and not on the basis of observed labor market results. Future research should use available data as well as the evaluation of respondents. The MCDM methods used assume independence between the criteria, while in reality there may be interdependencies and feedback effects between the evaluated dimensions. Future research could use more complex methods, such as fuzzy cognitive maps or system dynamics, to model these interrelationships.

## Author Contribution Roles

Conceptualization, J.B. and A.P.; methodology, J.B.; software, A.P.; validation, J.B., S.P. and I.M.V.; formal analysis, A.P.; investigation, J.B.; resources, S.P.; data curation, A.P.; writing – original draft preparation, J.B.; writing – review and editing, I.M.V.; visualization, S.P.; supervision, I.M.V.; project administration, A.P.; funding acquisition, J.B. All authors have read and agreed to the published version of the manuscript.

## Competing Interest Statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

## Data Availability Statement

The aggregated decision matrices and final numerical results are included in this article. Additional data are available from the corresponding author upon reasonable request via jbosna@unizd.hr.

## Statement on the Ethical Use of AI Tools

AI tools were used for proofreading and improving the linguistic quality of the manuscript. All suggested corrections were manually reviewed and approved by the authors, who take full responsibility for the content of the manuscript.

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