

USING VIKOR METHOD FOR ANALYZING OF QUALIFICATION LEVELS AND TRANSITION TO EMPLOYMENT OF EUROPEAN UNION AND CANDIDATE COUNTRIES

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Abstract: The aim of this study is to evaluate and rank European Union and Candidate countries with respect to some of the qualification levels and transition to employment indicators especially which are relevant with women. The data obtained from the “Key Data on Education in Europe 2012” report. Indicators have selected as follows: 1- proportion of tertiary education qualifications awarded to women by field of educational/professional training, 2- proportion of people in employment by age group (25-39; 40-64), 3- tertiary education graduates in employment of females by occupational category (age 25-64), 4- unemployment rates of females for the 25-64 age group by educational attainment. VIKOR Method which is one of the multi-criteria decision making techniques used in this study. By using this method, alternatives (EU and candidate countries) ranked by comparing the measure of closeness to the ideal alternative and then the best (compromise) alternative from a set of alternatives in the presence of conflicting criteria (indicators mentioned above) has selected.

Keywords: Multi Criteria Decision Making, VIKOR Method, Education, Employment, European Union.

Introduction

The gap of gender in education and employment has important effects on the countries’ development. There are many studies about gender inequality in education in the literature. Some of them investigated its economic effects. Barro and Lee (1994) and Barro and Sala-i-Martin (1995) considered the impact on gender inequality in education. They suggest differences in male and female schooling may indicate backwardness and can bring on economic growth (Klasen, 2002). Hill and King (1995) find that a low female-male enrollment ratio is associated with lower per capita, over and above the impact of female education levels on GDP per capita (Nganga, 2011). Knowles et al. (2002) find that gender inequality in education significantly reduces GDP per capita (Klasen, 2002). Klasen (1999, 2002) and Klasen and Lamanna (2009) investigated the implications of gender inequality in labor market participation on economic growth. Klasen (1999) found that female share of the total labor force participation had a large, positive and significant impact on growth.

It is important to analyze and monitor the differences on educational levels and situations of countries. The aim of this study is to evaluate and rank European Union (EU-27) and candidate countries (Turkey and Croatia in 2012) with respect to some of the qualification levels and transition to employment indicators especially which are relevant with women. The data obtained from the “Key Data on Education in Europe 2012” report. Eurydice Network is producing the Key Data on Education report for more than 15 years. Since 1980, Eurydice network has been one of the strategic mechanisms established by the European Commission and Member States to support European cooperation in the field of education. The educational information of 41 national units based in 37 countries participating in the Erasmus+ programme obtainable on Eurydice Network. Key Data on Education in Europe makes a valuable contribution to the debate on education policy at both European and national level and helps to monitor progress on the strategic framework. Based on data collected through the Eurydice network, Eurostat and the PISA international survey, the report provides standardised and readily comparable quantitative and qualitative indicators which offer a wide-ranging overview of the organisation and functioning of European education systems (Key Data on Education in Europe, 2012).

Instead of statistical methods, VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) Method which is one of the multi-criteria decision making (MCDM) techniques, used for ranking countries with respect to their performances in this study. Multi criteria decision making is a branch of Operations Research. The VIKOR Method was introduced as an applicable technique to implement within MCDM (Opricovic, 1998). It has been used in

many areas such as energy planning, marketing, supplier selection, financial performance evaluation, university selection, personnel training selection, performance evaluation, strategy evaluation, site selection, etc.

Vikor Method

The VIKOR method focuses on ranking and selecting from a set of alternatives, and determines compromise solutions for a problem with conflicting criteria, which can help the decision makers to reach a final decision (Opricovic, 1998; Opricovic and Tzeng, 2007). It introduces the multi criteria ranking index based on the particular measure of “closeness” to the “ideal” solution (Opricovic and Tzeng, 2004)

The steps of the VIKOR Method are explained in detail below (Opricoviz and Tzeng, 2004; Opricoviz and Tzeng, 2007):

Step 1. Determination the best f_i^* and the worst f_i^- values of all criterion functions, $i=1,2,\dots,n$. If the i th function represents a benefit then

$$f_i^* = \max_j f_{ij} \quad f_i^- = \min_j f_{ij} \quad \text{if the } i\text{-th function represents a benefit;} \quad (1)$$

$$f_i^* = \min_j f_{ij} \quad f_i^- = \max_j f_{ij} \quad \text{if the } i\text{-th function represents a cost.}$$

Step 2. Computation the values S_j and R_j , $j=1,2,\dots,J$

$$S_j = \sum_{i=1}^n w_i (f_i^* - f_{ij}) / (f_i^* - f_i^-), \quad (2)$$

$$R_j = \max_i [w_i (f_i^* - f_{ij}) / (f_i^* - f_i^-)], \quad (3)$$

Here w_i are the weights of criteria.

Step 3. Computation the values Q_j , $j=1, 2 \dots J$

$$Q_j = v(S_j - S^*) / (S^- - S^*) + (1 - v)(R_j - R^*) / (R^- - R^*) \quad (4)$$

Where $S^* = \min_j S_j$, $S^- = \max_j S_j$, $R^* = \min_j R_j$, $R^- = \max_j R_j$

v is introduced as weight of the strategy of “the majority of criteria” (or “the maximum group utility”), here $v = 0.5$.

Step 4. Ranking the alternatives, sorting by the values S , R and Q , The results are three ranking lists.

Step 5. Proposing as a compromise solution the alternative (a') which is ranked the best by the measure Q (minimum) if the following two conditions are satisfied:

C1: “Acceptable advantage”: $Q(a'') - Q(a') \geq DQ$ Where a'' is the alternative $DQ = 1/(J - 1)$; J is the number of alternatives.

C2: “Acceptable Stability in decision making”: The alternative a' must also be the best ranked by S or/and R . This compromise solution is stable within a decision making process, which could be the strategy of maximum group utility (when $v > 0.5$ is needed), or “by consensus” $v \approx 0.5$, or “with veto” ($v < 0.5$). Here, v is the weight of decision making strategy of maximum group utility.

The best alternative, ranked by Q , is the one with the minimum value of Q . The main ranking result is the compromise ranking list of alternatives, and the compromise solution with the “advantage rate”.

ANALYSIS OF QUALIFICATION LEVELS AND TRANSITION TO EMPLOYMENT OF EUROPEAN UNION AND CANDIDATE COUNTRIES

The measurement of countries’ education performances can be evaluated with respect to many quantitative and qualitative criterions. In this study qualification levels and transition to employment of countries has been taken into consideration. The total of 28 countries (because of missing data Luxemburg excluded) included in this study. Selected total 19 educational and employment ratios of these 28 countries have gathered from the publications of the EURYDICE (<http://eacea.ec.europa.eu/education/eurydice>).

Table 1. The Criterion which used in Countries' Evaluation

MC1. Proportion of tertiary education qualifications awarded to women by field of educational/professional training	MC2. Proportion of people in employment by age group (25-39; 40-64),
SC1. Education and training	SC9. Low (25-39)
SC2. Humanities and arts	SC10. Low (40-64)
SC3. Social sciences, business and law	SC11. Medium (25-39)
SC4. Science, mathematics and computing	SC12. Medium (40-64)
SC5. Engineering, manufacturing and construction	SC13. High (25-39)
SC6. Agriculture and veterinary science	S14. High (40-64)
SC7. Health and welfare	
SC8. Services	
MC3. Tertiary education graduates in employment of females by occupational category (age 25-64)	MC4. Unemployment rates of females for the 25-64 age groups by educational attainment.
SC15. Professionals and manages	SC17. Low
SC16. Technicians and associate professionals	SC18. Medium
	SC19. Higher

APPLICATION OF VIKOR METHOD

Firstly the best f_i^* and the worst f_i^- values of all criterion functions were determinate from equation (1). After that with using the equation (2), (3) and (4) S_j , R_j and Q_j are calculated for each country $j=1,2,\dots,28$. (Q_j values are computed by selecting $v=0.75$). Table 2 gives the scores of countries and their corresponding rankings.

Table 2. S, R and Q Scores and Ranks of the Countries

Rank	S_j		R_j		$Q_j (v=0.75)$	
1.	Sweden	0,289	Bulgaria	0,0337	Sweden	0,096
2.	Finland	0,334	Czech Rep	0,0358	Portugal	0,142
3.	Portugal	0,344	Portugal	0,0375	Finland	0,193
4.	Slovenia	0,347	Hungary	0,0399	Slovenia	0,215
5.	Romania	0,356	Sweden	0,0410	Czech Rep	0,222
6.	Malta	0,358	Malta	0,0423	Bulgaria	0,224
7.	Estonia	0,370	Belgium	0,0424	Malta	0,230
8.	Denmark	0,373	Finland	0,0426	Romania	0,232
9.	Netherlands	0,397	Slovenia	0,0426	Belgium	0,336
10.	Austria	0,398	Croatia	0,0427	United Kg	0,348
11.	Czech Rep	0,406	Romania	0,0428	Estonia	0,348
12.	Germany	0,409	Latvia	0,0433	Latvia	0,365
13.	United Kg	0,421	United Kg	0,0434	Denmark	0,391
14.	Belgium	0,422	Estonia	0,0499	Hungary	0,395
15.	Bulgaria	0,424	Austria	0,0500	Austria	0,397
16.	Cyprus	0,428	Belgium	0,0500	Croatia	0,408
17.	Latvia	0,432	France	0,0506	Netherlands	0,430
18.	Italy	0,446	Greece	0,0508	Germany	0,433
19.	France	0,452	Germany	0,0513	Cyprus	0,482
20.	Croatia	0,462	Spain	0,0526	France	0,495
21.	Belgium	0,465	Lithuania	0,0526	Belgium	0,508
22.	Greece	0,474	Denmark	0,0526	Italy	0,512
23.	Hungary	0,477	Ireland	0,0526	Greece	0,533
24.	Lithuania	0,483	Italy	0,0526	Lithuania	0,572
25.	Slovakia	0,510	Cyprus	0,0526	Slovakia	0,618
26.	Ireland	0,557	Netherlands	0,0526	Ireland	0,696
27.	Spain	0,576	Slovakia	0,0526	Spain	0,728
28.	Turkey	0,740	Turkey	0,0526	Turkey	1,000

The best alternative, ranked by Q, is the one with the minimum value of Q. It can be seen that Sweden is the best alternative. Sweden satisfies condition C1 and C2. Because $Q(a'') - Q(a') = 0.142 - 0.096 = 0.046 \geq DQ = 0.037$ and this country is also the best ranked by S. Therefore Sweden has an acceptable advantage and acceptable stability in decision making with respect to the other countries. Note that the weight v has a central role in identifying the ranking. Some values (like $v=0$, $v=0.25$, $v=0.50$, $v=0.75$) between 0 and 1 tried in this study. When they are compared the value of 0.75 had give the best results for this study.

Conclusion

There are several methods especially statistical methods for evaluate and compare countries' various characteristics. In this study 28 countries were rated against to qualification levels and transition to employment. The indicators has selected from the Key Data on Education report which published by Eurydice Network. The ranking countries' list was acquired using, the multi-criteria analysis method, called VIKOR. After the application of VIKOR method Sweden is the best country among twenty eight countries with respect to qualification levels and transition to employment. It is not a surprise because according to the Current Situation of Gender Equality in Sweden – Country Profile (2013), the general employment rate of women in the Swedish labour market is the highest in the EU-27. Attainment of secondary education is higher for Swedish women (76.9%) than the EU-27 average (70.9%), and also higher than the rate of Swedish men (75.5%). The employment rate of women in Sweden (71.8%) was the highest in the EU-27 and consequently above the EU-27 average (58.6%). Women participated in the labour market nearly to the same degree as men (75.6%) in Sweden. These all information support the results which gathered by using VIKOR method. The second and third countries are Portugal and Finland respectively. Turkey is at the end of the list according to S, R and Q values.

In this study all indicators have equal priority. Further researches may try give different priorities to indicators. VIKOR method is very useful technique for ranking countries with respect to various indicators. Also further researches may try rank countries with choose different indicators.

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