

Models Estimation of National Social and Human Capital Qualities

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Abstract Present paper studies models of the estimation qualities of national social and human capital. Input parameters of the social capital model are social-economic security, social cohesion, social inclusion and social empowerment. Model of the human capital describes by quality of education, health care, culture level of society, scientific and technical journal articles, innovations, patent applications field, labor productivity. Problem corresponding to the model is solved by proposed fuzzy method.

Keywords Quality of social capital • Quality of national human capital • Socioeconomic security • Social cohesion • Social inclusion • Social empowerment • Fuzzy methods

1 Introduction

Social and human capital plays significant role in economic development. Social and human capital influences economic growth not only directly but also through interaction with each-other. Social and human capital enables individuals, communities and firms to cope with the demands of rapid changes. Estimation of social and human capital quality is almost impossible by using traditional methods. We do attempt to estimate social and human capital quality by using fuzzy approach in this paper. Paper mainly consists of two parts—in the first part were investigate fuzzy model of social capital, in the second—fuzzy model for estimation of national

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human capital quality. Problems corresponding to the models are solved applying fuzzy method defining quality indices. World Development and Azerbaijan Indicators were used in the process of solution of the problems.

2 Fuzzy Model Estimation of Social Capital

In order to define social capital were used indicators social quality. The theory of social quality has been offered by U. Beck, V. Maesen, L. Thomese and A. Walker [1–3]. Social quality represents degree of participation of citizens in the social and economic life of a society in which their well-being and individual potential raises. Social quality defined on the base indicators of the four conditional factors—social-economic security, social cohesion, social inclusion, social empowerment.

Social-economic security indicators are following: number of square meters per household member (NSM); proportion of population living in houses with lack of functioning basic amenities (PPL); proportion of people covered by compulsory/voluntary health insurance (PHI); number of medical doctors per 10,000 inhabitants (MED); length of notice before termination of labor contract (LNT); proportion of employed workforce with temporary, non-permanent, job contract (PET); proportion of workforce that is illegal (PWI); number of fatal cases (NFC); number of nonfatal cases (NNC); number of hours a full-time employee typically works a week (NHE); proportion of pupils leaving education without finishing compulsory education (PLE); study fees in school as proportion of national mean net wage (SFS); study fees in high school as proportion of national mean net wage (SFH); proportion of students who, within a year of leaving school, are able to find employment (PSE); people affected by criminal offences per 10,000 inhabitants (CRI); ecocivilization index (ECC). Quality of socioeconomic security index (SESI) is the output indicator.

Social cohesion indicators are following: Extent to which most people can be trusted (TRU); Trust to authorities (TRA); Trust to religion (TRR); Number of cases being referred to European Court of Law (ECO); Respect for parents (IFA); Blood donation (%) (BLO); Multiculturalism (tolerance) (TOL); Willingness to pay more taxes if you were sure that it would improve the situation of the poor (WMT); Help elders (VOL); Membership (active or inactive) of political, voluntary, charitable organizations or sport clubs (MVO); Frequency of contact with friends and colleagues (CWF); Sense of national pride (NAP). Quality of social cohesion index (SCOI) is the output indicator.

Social inclusion indicators are following: proportion having right to vote in local elections (POV) and proportions exercising it (PPV); proportion with right to a public pension (PEN); proportion of ethnic minority groups elected or appointed to parliament, boards of private companies and foundations (ETH); proportion of women elected or appointed to parliament, boards of private companies and foundations (WPA); long-term unemployment (12+ month) (LTU); proportion of population with entitlement to and using public primary health care (PPH);

proportion homeless, sleeping rough (HLP); average waiting time for social housing (WAI); school participation rates and higher education participation rates (HED); proportion of people in need received care services (PPN); density of public transport system and road density (TRD); number of public sport facilities per 10,000 inhabitants (NPS); number of public and private civic and cultural facilities (e.g. cinema, theatre, concerts) per 10,000 inhabitants (NPC); duration of contact with relatives (cohabitating and non-cohabitating (PRC). Quality of social inclusion index (SIQI) is the output indicator.

Social empowerment indicators are following: extend to which social mobility is knowledge-based (SOM); percentage of population literate and numerate (PLN); availability of free media (FME); percentage of labor force that is member of a trade union (TRU); percentage of labor force covered by a collective agreement (LCA); percentage of employed labor force receiving work-based training (TRA); index of democracy (DEM); percentage of organizations/institutions with work councils (WCC); percentage of the national and local public budget that is reserved for voluntary, non-for-profit citizenship initiatives (CIL); proportion of national budget allocated to all cultural activities (CUL); percent expenses of national and local budgets devoted to disabled people (DIL). Quality of social empowerment index (SEQI) is the output indicator. Indicators of conditional factors of social quality were adopted from [3].

In order to estimation indices of factors of social quality were proposed method, which is based on L. Zadeh's composite rules of inference [4] and consist of the following steps:

- Development of a table describing parameters of the model on the basis of information obtained from international organizations and experts. In the first column of the table shows the input parameters of the model, and in the following columns—terms and their intervals. The last column specifies crisp meaning of input parameters for a fixed period.
- Definition of membership degrees of the crisp meaning of the input parameters to the relevant terms.
- Determination of the minimum degree of membership to the corresponding term of input parameters, i.e. $\max_i \left(\min_j \mu_{ij} \right)$.
- Determination of the maximum of the minimum values of the degrees of membership to the corresponding term, i.e. $\max_i \left(\min_j \mu_{ij} \right)$.

The obtained value will reflect the quality of the social factor.

The proposed methodology is tested on the basis of information on quality parameters of the model of socio-economic security (Table 1). The source materials are obtained from the international socio-economic organizations and the expert opinion data. Information on the socio-economic security of Azerbaijan in 2010, which is given in the last column of Table 1.

Table 1 Parameters of the model of social-economic security

Input variable	Terms and its intervals				Azerbaijan
NSM	L	M	H	VH	L
	0–15	14–20	18–30	28–70	12,6
PPL	L	M	H	VH	M
	0,5–0,25	0,24–0,15	0,14–0,1	0,09–0	0,15
PHI	L	M	H	VH	
	0–10	9–21	20–60	59–100	
MED	L	M	H	VH	H
	0–300	299–350	300–400	370–600	36,8
LNT	L	M	H	VH	H
	1–31	30–51	50–61	60–90	60
PET	L	M	H	VH	L
	100–50	49–20	19–10	9–1	68
PWI	L	M	H	VH	VH
	0,5–0,2	0,19–0,14	0,13–0,09	0,18–0	0,002
NFC	L	M	H	VH	VH
	10–8	7–5	4–2	1–0	0,00128
NNC	L	M	H	VH	VH
	10–8	7–5	4–2	1–0	0,00172
NHE	L	M	H	VH	M
	50–44	43–39	38–36	35–20	42
PLE	L	M	H	VH	M
	50–20	18–9	8–7	6–0	10
SFS	L	M	H	VH	M
	6–3	2,9–2	1–0,5	0,4–0	2,8
SFH	L	M	H	VH	L
	7–3	2,9–2	1–0,5	0,4–0	6
PSE	L	M	H	VH	VH
	0–5	4–10	9–20	19–100	30
CRI	L	M	H	VH	VH
	180–80	79–50	49–20	19–0	13,5
ECC	L	M	H	VH	H
	0–0,2	0,19–0,5	0,49–0,7	0,7–1	0,632

To calculate the quality of the social factors the following terms are used: low (L), medium (M), high (H) and very high (VH), which are scaled in the interval [0, 1].

In order to define linguistic variables intervals following calculations have been used, given in [5]. The second stage we have determined the degree of membership of national indicators of socio-economic security to the appropriate term. In determining the degrees of membership, we have used triangular membership functions.

At the task level membership of 16 indicators of the terms is as follows:

Low (L)	Mean (M)	High (H)	Very high (VH)
$\mu_{NSM} = 0,32$	$\mu_{PPL} = 0,25$	$\mu_{MED} = 0,64$	$\mu_{PWI} = 0,05$
$\mu_{PHI} = 0,4$	$\mu_{NHE} = 0,66$	$\mu_{LNT} = 0,18$	$\mu_{NFC} = 0,003$
$\mu_{PET} = 0,72$	$\mu_{PLE} = 0,22$	$\mu_{ECC} = 0,65$	$\mu_{NNC} = 0,003$
$\mu_{SFH} = 0,5$	$\mu_{SFS} = 0$		$\mu_{PSE} = 0,27$
			$\mu_{CRI} = 0,58$
min: 0,32	min: 0	min: 0,18	min: 0,003

Among the minimum values the maximum value is determined, which is equal to 0.32. This value corresponds to the term—“low”, thus defining quality index of socio-economic security: SESI as low. Likewise, the indices of the quality of social inclusion—SIQI is 0.86 (high), the index of the quality of social empowerment—SEQI is 0.9 (high), the index of the quality of social cohesion—SCQI is 1 (moderate). Estimated meanings of the conditional factors social quality give us possibility estimate social capital quality. In order to estimation social capital quality index (SCQ), we used fuzzy union operation, i.e.

$$\mu_{SCQ} = \max(\mu_{SESI}, \mu_{SIQI}, \mu_{SEQI}, \mu_{SCQI}) = \max(0.32; 0.86; 0.91) = 1(\text{moderate}).$$

The proposed model for estimation of social quality gives us possibility to define human capital quality.

3 Fuzzy Model Estimation Quality of National Human Capital

Human capital are one of the main factors, which provide development of the socioeconomic system. Fundamental concept of the human capital theory were founded by American economists, Nobel Prize Laureates, Shultz [6] and Becker [7]. According to definition of Organization Economic Cooperation and Development (OECD) experts human capital are “the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being” [8].

The conventional standard to measure human capital stock has been largely categorized into three parts [9]:

- School enrollments rates, scholastic attainments, adult literacy, and average years of schooling are the examples of output-based approach;
- Cost based approach is based on calculating costs paid for obtaining knowledge;
- Income-based approach is closely linked to each individual’s benefits obtained by education and training investment.

Professor Kwon [9] refers human capital is difficult to identify and measure directly. So many researchers have used indirect measures. Concept human capital needs to consider both of monetary and non- monetary characteristic. Human capital is closely linked to social capital. It is necessary to analyze the result of

human capital measurement within the socio-cultural framework of a society and all levels such as individual, organization, nation.

Human capital on the national level express intellectual potential of society.

In this paper investigated problem of estimation quality national level of human capital. With this purpose as recourses of human capital taken following elements:

1. Education quality–QUE;
2. Level of the health care development–QHC;
3. Cultural level of society–QSC;
4. Innovation index–INO;
5. Quantity of patent–PAT;
6. Quantity of articles–ART;
7. Labor productivity–PRO;
8. Socioeconomic security index–SEQ;
9. Social cohesion index–SCI;
10. Social inclusion index–SII;
11. Social empowerment index–SEI.

Estimation parameters choose–national human capital quality index.–NHCQI.

4 Formation Parameters of Fuzzy Model

Linguistic parameters of the level education, health care, culture of society were define by scaling these parameters in interval [0–10]. As factices meaning were used results of expert opinion of specialist, which deal in this sphere.

In order to define quality of science resident patent applications index, scientific and technical journal articles, patent application per million populations, innovation index were used. For this purpose corresponding world development indicators [10] and component knowledge economy applied [12]. Labor productivity indicators borrowing from [11]. Indicators socioeconomic security index, social cohesion index, social inclusion index, social empowerment index.

In order to definition linguistic variables intervals were following calculations used [14]:

- (1) Sort the values in the current dataset in ascending order $(x_1, \dots, x_n)$;
- (2) Compute the average distance between any two consecutive values in the sorted dataset and the corresponding standard deviation $(\Delta_1, \dots, \Delta_{n-1})$;
- (3) Compute the revised average distance between two remaining consecutive

values in the sorted dataset— $AD = \frac{1}{n-1} \sum_{i=1}^{n-1} |x_i - x_{i+1}|$ and standard deviation

$$\sigma = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n-1} (\Delta_i - AD)^2} \text{ for sorted dataset—}\Delta_i$$

- (4) Define the universe of discourse—U and its scope—R:

$$U = [\min - AD, \max + AD] = [LB, UB];$$

$$R = UB - LB$$

5 Calculating Method of the National Human Capital Quality Index

Using the information of Azerbaijan in 2010, which is given in the last column of Table 2, we have by the above methodology, the index is computed. To calculate the quality of the national human capital factors used in the following terms: very low (VL), low (L), medium (M), high (H) and very high (VH), which are scaled in the interval [0, 1].

The second stage determined the degree of membership of national indicators of human capital to the appropriate term. In determining the degrees of membership, we used triangular membership functions. At the task level membership of 11 indicators of the terms is as follows:

VL	L	M	H	VH
$\mu_{PAT} = 0.09$	$\mu_{QUE} = 1.00$	$\mu_{QHC} = 0.4$	$\mu_{SEQ} = 0.70$	$\mu_{SCI} = 0.26$
$\mu_{ART} = 0.14$	$\mu_{INO} = 0.90$	$\mu_{QSC} = 1.00$		$\mu_{SII} = 0.87$
$\mu_{PRO} = 0.95$		$\mu_{SEI} = 0.26$		
$\min : 0.09$	$\min : 0.9$	$\min : 0.26$	$\min : 0.7$	$\min : 0.26$

Among minimum values determined the maximum, which is equal to 0.9. This value corresponds to the term—“low”. Thus defined quality index of national human capital: NHCQI = low.

Table 2 Parameters of fuzzy model of definition national human capital quality

Input variables	Linguistic meaning and intervals input variables					Azerbaijan
1. QUE	VL 0–2	L 1.5–4	M 3.5–6	H 5.5–8	VH 7.5–10	L 2.75
2. QHC	VL 0–2	L 1.5–4	M 3.5–6	H 5.5–8	VH 7.5–10	M 4.00
3. QCS	VL 0–2	L 1.5–4	M 3.5–6	H 5.5–8	VH 7.5–10	L 4.75
4. INO	VL 0–2	L 1.9–4	M 3.9–6	H 5.9–8	VH 7.9–10	L 3.05
5. PAT	VL 0–543	L 534–1095	M 1076–1628	H 1619–2170	VH 2104–2800	VL 24,4
6. ART	VL 0–238	L 227–484	M 473–730	H 719–976	VH 965–1250	VL 17
7. PRO	VL 265–28734	L 26025–55080	M 52371–86844	H 84135–115599	VH 112890–142245	VL 20842
8. SEI	VL 0–0.2	L 0.17–0.4	M 0.37–0.6	H 0.57–0.8	VH 0.77–1	M 0.4
9. SCI	VL 0–0.2	L 0.17–0.4	M 0.37–0.6	H 0.57–0.8	VH 0.77–1	VH 0.885
10. SII	VL 0–0.2	L 0.17–0.4	M 0.37–0.6	H 0.57–0.8	VH 0.77–1	VH 0.90
11. SEQ	VL 0–0.2	L 0.17–0.4	M 0.37–0.6	H 0.57–0.8	VH 0.77–1	H 0.650
NHCQI	VL 0–0.2	L 0.17–0.4	M 0.37–0.6	H 0.57–0.8	VH 0.77–1	

6 Conclusion

Proposed approach to estimation of social and national human capital quality gives possibility to define country's level compared to the world development indices. It is necessary to further develop this idea on the individual and organizational level for the forthcoming investigation of the social and human capital quality.

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