THEORY AND HISTORY OF LAW AND STATE

DOI https://doi.org/10.30525/978-9934-26-005-6-1

STUDY APPROACH OF SIMPLE ADDITIVE WEIGHTING (SAW) AS A METHOD TO MEASURE FISCAL DECENTRALIZATION INDEX IN UKRAINE

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In particular, accumulated experience of developed countries shows the budget reform is a multi-stage, multi-year and complex processes accompanied with inevitable change and improve of specific tools and criteria upon assessing results and expenses. The empirical studies on fiscal decentralization depend significantly on the proper measurement of fiscal decentralization index. At the same time, the effectiveness of the toolkit itself is crucial and rather difficult to quantitatively identify in crisis [10]. Even the best practices of countries, on the one hand, have not accumulated sufficient empirical evidence to identify patterns in assessing the fiscal reform and the dynamics of socio-economic settings, and on the other hand, it reveals the successful implementation of budget reforms in some areas and 'failures' in others. All this leads to vital disparities in the estimates of the benefits from the constant fiscal reforms.

Apparently, the very case upon obtaining an assessment of the degree of decentralization can be considered as the first step towards achieving a more important goal, particularly for assessing the impact of decentralization on socio-economic development, the growth of the real sector of the economic situation in the regions, which is the subject of further research. In our case, the evaluation of overall fiscal

decentralization influence is actually an objective decision making with multiple attribute decision making [3; 4; 13].

Obviously, fixed effects objective attribute decision making differs from the traditional SAW method, as it is supposed to consider the influence of the other factors on decision outcomes. Here we check upon a simple additive weighting method (SAW) for fixed effect multiple attribute decision making that may automatically determine the weight coefficients among multi-indices in regions and also helps to avoid the uncertainty and the subjectivity by references – weighted sum model [6; 7].

The basic SAW method tends to find the sum of the weighted performance rating for each alternative on all attributes:

$$r_{ij} = \frac{x_{ij}}{Max(x_{ij})} \quad (1)$$

The formulas obtain the weights of attributed values:

$$w = \frac{C1}{C1+\cdots+C7} x\ 100\% \quad (2),$$

where rij is the normalized performance rating of alternatives on attribute Ci Ai; i = 1,2, ..., 24 and j = 1,2, ..., 24. Preference value alternative (vi):

$$V_i = \sum_{j-1}^{n} = 1\ w_j\ r_{ij} \quad (3).$$

Based on the references to Edwards, Newman et al. (1982) the study suggests a simple way to reach the weights for each criterion to show the relative value of the decision [2]. To mention, the attributes are ranked in order of its importance with the highest amount given to the least important quality. The final weights are normalized to the sum of the points to one.

Quantitative SAW evaluation methods are based on the matrix of the objective criteria, describing the compared attributes, statistical data R = ||rij|| and the criteria weights i_ , i = 1,..., m; j = 1,...,n, where m is the number of the criteria, n – the amount of the attributes (alternatives) compared.

For a start, we evaluate the fiscal decentralization attributes of 24 regions according to the statistical data supplied by the National

Bureau of Statistics of Ukraine (2011-2018), we have the fixed-effects set T = 2011,2012,2013,2014,2015,2016,2017,2018}, the alternative set A = {Vinnitsya, Volyn, …., Chernihiv}, the index set G = {Gi, G2, · · ·, G7}, where G\ ~ G7 respectively stands for the fiscal decentralization attributes (ratio): revenue decentralization (G1), expenditure decentralization (G2), revenue autonomy (G3), expenditure autonomy (G4), transfers attributes to revenues and expenditures (G5-G6), and production-revenue indicator (G7). Here out of 7 evaluation indices, all are the entire benefit-criteria index.

Table 1

Criteria Name for SAW Method

No	Criteria Name	Type	Weight	Value
1	G1	Benefit	Incomplete	1
2	G2	Benefit	Less complete	2
3	G3	Benefit	Quite complete	3
4	G4	Benefit	Almost Complete	4
5	G5	Benefit	Complete	5
6	G6	Benefit	More complete	6
7	G7	Benefit	Very complete	7

Source: own compilation

Next, to evaluate the value of the statistical preference given to the decision attribute value W = (7, 6, 5, 4, 3, 1), and to calculate the normalization matrix according to the formula below:

$$r_{ij} = \left\{ \frac{x_{ij}}{Max_i x_{ij}} \right\}$$

The original data for alternative value was modified by using the SAW method of fixed effect multiple attribute decision making, and we obtain the index weighting vector W* (Table 1) T and the time weighting vector a* in the range of a particular region. Under the framework of these two criteria, the fiscal decentralization benefit evaluation values in each region ranking and the final benefit

estimation values are all tabulated (Table 1/2). The index's values reveal the degree of local governments' control over their revenues and expenditures, ranging from 1 till 0 (Table 2).

By the same token, many weight determination methods range from the ranking the criteria, direct evaluation to AHP (Analytic Hierarchy Process) [1; 5; 8; 9; 12]. Here we apply a direct rank-sum method, when each rank is converted to weight. So far, the weight of each criterion is represented in a 1 to 24 range for the period 2011-2018. By that, the higher the weight the more critical the criterion is. So far, the total weight of criteria remains in a range from 1 to 0 – Table 2 [11, p. 179; 14].

Finally, we obtain the fiscal decentralization index (Z) that consists of 7 criteria and their subindexes – the weight of each criterion: decentralization attributes (ratio): G1 – G7; the more significant value in the benefit-criteria index indicates that the alternative is the best alternative decision using the SAW method.

For instance, from Table 2, we observe that Rivne, Luhansk, and Khmelnitsky regions are of about the same fiscal decentralization levels. But as far as the overall benefit is concerned, the Rivne region is slightly superior to Luhansk and Khmelnitsky region and ranks first. So, almost industrial or areas with a high level of population, urbanization, mostly central or eastern regions have much more substantial regional advantages such as more developed economics, more effective public management. Luhansk region ranks 5^{th} in 2018 and 3^{rd} in 2017 despite the hard economic situation and long-lasting crisis. The same potentially weak commercial basis, backward technology, and low-level management has Donetsk region and ranks the last 192^{nd} place in 2012, but in 2018 is 35^{th}. Both Luhansk and Donetsk regions are expected to be ranked lagging behind as to want of human, financial capital, backward technical innovation measures, and the negative influences of other subjective or objective factors.

Criteria Output for SAW Method (extracts)

A	B	G1	G1 rank	G2	G2 rank	G3	G3 rank	G4	G4 rank	G5	G5 rank	G6	G6 rank	G7	G7 rank	Z	RANK
Khmelnitsky region	2011	0,15407203	1	0,283763	2	0,522052	4	0,994125	1	0,872788	5	0,006023	8	0,240164	1	8,456216	2
Khmelnitsky region	2012	0,16147458	3	0,280983	1	0,508442	2	0,995515	4	0,884053	7	0,004605	5	0,241399	2	12,45854	39
Khmelnitsky region	2013	0,17920763	4	0,29018	3	0,536007	5	0,996457	8	0,861237	4	0,003644	1	0,254311	3	16,45059	128
Khmelnitsky region	2014	0,18200465	5	0,303604	4	0,516778	3	0,995762	6	0,877153	6	0,004352	3	0,263864	5	16,24464	122
Khmelnitsky region	2015	0,15995271	2	0,303725	5	0,500097	1	0,99638	7	0,89096	8	0,003722	2	0,255062	4	17,46867	143
Khmelnitsky region	2016	0,18935774	6	0,306536	6	0,570244	7	0,994921	3	0,832891	2	0,005211	6	0,268666	6	13,26087	69
Khmelnitsky region	2017	0,20352982	8	0,341174	8	0,567701	6	0,995698	5	0,835004	3	0,004418	4	0,296115	8	17,63393	145
Khmelnitsky region	2018	0,20112764	7	0,326149	7	0,593654	8	0,994529	2	0,813522	1	0,00561	7	0,285716	7	13,28203	70
Rivne region	2011	0,13722388	2	0,268008	2	0,492674	7	0,993677	6	0,897105	2	0,006479	3	0,22349	2	12,48187	40
Rivne region	2012	0,1388783	3	0,262929	1	0,466896	4	0,991892	1	0,918441	5	0,0083	8	0,220967	1	8,418615	1
Rivne region	2013	0,14365462	5	0,277357	4	0,450289	3	0,994256	8	0,932187	6	0,005889	1	0,231948	5	17,89137	149
Rivne region	2014	0,14626561	6	0,295748	6	0,430113	2	0,992321	2	0,948887	7	0,007862	7	0,244544	6	13,66146	78
Rivne region	2015	0,12041102	1	0,28146	5	0,405881	1	0,992917	5	0,968944	8	0,007254	4	0,225165	3	15,35424	102
Rivne region	2016	0,14179673	4	0,275874	3	0,47154	5	0,992794	4	0,914597	4	0,007379	5	0,230269	4	12,34004	37
Rivne region	2017	0,16153893	7	0,308294	8	0,489973	6	0,993792	7	0,899341	3	0,006362	2	0,258569	8	18,2728	158
Rivne region	2018	0,16280289	8	0,304393	7	0,514415	8	0,992354	3	0,879117	1	0,007829	6	0,256629	7	13,24805	68
Luhansk region	2011	0,35291696	6	0,427095	7	0,777731	8	0,998492	7	0,661159	1	0,001568	2	0,410198	7	21,85414	176
Luhansk region	2012	0,36722085	8	0,453652	8	0,731279	6	0,99836	6	0,699609	3	0,001703	3	0,432628	8	22,50978	178
Luhansk region	2013	0,3578204	7	0,419877	6	0,773452	7	0,993007	4	0,664701	2	0,007163	5	0,407641	6	18,22126	157
Luhansk region	2014	0,25771503	5	0,280333	5	0,682264	5	0,998063	5	0,740179	4	0,002006	4	0,279739	5	15,45931	104
Luhansk region	2015	0,11796375	4	0,150273	1	0,628425	4	0,999119	8	0,784742	5	0,000929	1	0,141827	1	15,19524	98
Luhansk region	2016	0,11258156	3	0,165793	2	0,615128	2	0,989496	3	0,795737	7	0,010744	6	0,149403	3	10,95091	11
Luhansk region	2017	0,11058448	2	0,188034	4	0,620799	3	0,976821	1	0,791053	6	0,023671	8	0,162561	4	9,398455	3
Luhansk region	2018	0,10318895	1	0,16622	3	0,587612	1	0,9844	2	0,818523	8	0,015941	7	0,145889	2	10,10981	5
Donetsk region	2011	0,89948806	6	0,915843	7	0,915438	7	0,983153	5	0,547178	2	0,017213	4	0,937066	6	29,91726	189
Donetsk region	2012	0,92458544	7	1	8	0,814924	5	0,98492	7	0,630375	4	0,01541	2	1	8	35,99348	192
Donetsk region	2013	1	8	0,903949	6	0,957253	8	0,984293	6	0,512567	1	0,01605	3	0,970067	7	34,33866	191
Donetsk region	2014	0,75236874	5	0,701673	5	0,841046	6	0,98785	8	0,608753	3	0,012422	1	0,743389	5	25,77491	187
Donetsk region	2015	0,38674133	1	0,458233	2	0,67404	1	0,982902	4	0,746986	8	0,017469	5	0,443363	2	12,85881	56
Donetsk region	2016	0,39801111	3	0,430275	1	0,768031	3	0,977133	1	0,669185	6	0,023353	8	0,43035	1	9,53782	4
Donetsk region	2017	0,41756325	4	0,532142	4	0,729222	2	0,98141	3	0,701309	7	0,01899	6	0,502168	4	15,23327	99
Donetsk region	2018	0,38902308	2	0,501683	3	0,770801	4	0,977983	2	0,666895	5	0,022486	7	0,471557	3	12,22881	35

Decentralization index – (Z); decentralization attributes (ratio) – G1 – G7; decentralization attributes (temporary rank) – G1-G7 rank; final rank – RANK;
Source: calculated by author

As it was stated before, the analysis of financial support of the regions showed that budget regulation in Ukraine constrains the socio-economic development of its regions and depends on the correct measurements [10]. The further implementation of fiscal decentralization on effective budgeting is a protracted process accompanied with the inevitable debugging of tools for the 'new public management' and constant consideration of changing conditions (international, country, regional and sectoral). By so, presented approach of decision support system using SAW is capable to display weighting, calculation and criteria in a straightforward way, which guarantees the testing on various cases to be run quickly and easily.

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