

EVALUATION OF ECONOMIC WELL-BEING USING DEA MODEL

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Abstract:

Quality of life and well-being is the goal of every country. But what do we consider as crucial? Has economic growth or quality of life increased in recent years, and is it higher or lower in one country compared to others? These questions are traditionally answered by evaluating trends and comparisons of GDP per capita, but this is rather poor measure of quality of life or economic well-being. The goal of this paper is to present the analysis of measurement of economic well-being by the index of economic well-being. The paper outlines the trends in the four domains of economic well-being that create the index. The domains are consumption, wealth, economic equality, and economic security. Furthermore, it offers an analysis of the sensitivity of our results to the choice of weights assigned by means of data envelopment analysis (DEA) to these four domains and a description of the performance of the index of economic well-being compared to GDP per capita through the most recent recession that caused declines in both, real GDP per capita and the index of economic well-being.

Keywords: economic well-being, quality of live, IEWB, data envelopment analysis

1. INTRODUCTION

The most frequently used indicator of well-being is GDP per capita. GDP measurement is essential for many important policy purposes but the calculation of GDP omits many indicators which are important to individuals' welfare.

In the current period, is very commonly pointed out that in a globalized economy the indicator of GDP respectively GDP per capita is not sufficient for measuring well-being of individuals and there is a need to define new measurement that will remove its shortcomings. Although the creators of the national accounts may protest that indicator of gross domestic product measures the aggregate money value of economic output and this indicator has never been intended for use as a full measure of economic well-being, but it has often been used so. The scientific works such as Harris and England, 1998, Bleys, 2005, Van der Bergh, 2008 E. Goossens et al., 2007 pointed to a number of alternative indicators that have been created due to the criticism of using measurement of GDP per capita as an indicator of well-being. These indicators have had the ambition to replace or substantially supplement the use of this indicator.

In our opinion, generated alternative indicators can be divided into two groups, depending upon whether the indicators have been created to govern or to complement values of GDP or the indicators are designed to replace the GDP.

In this paper we focus on the index of economic well-being (IEWB). In 1998, the Centre for the Study of Living Standards (CSLS) released the first empirical estimates for Canada of the Index of Economic Well-being (Osberg and Sharpe, 1998), a composite index based on a conceptual framework for measuring economic well-being developed by Osberg (1985).

The index attempts to construct better measures of effective consumption and social accumulation. It combines different approaches which include the current prosperity that is based on consumption, sustainable accumulation, and social issues (reduction in inequalities and protection against social risks). Environmental issues are addressed by the cost of CO₂ emissions per capita and inequality is measured by the Gini index and a level of poverty.

Finally, four key social risks are identified, including unemployment, risk of disease, poverty, single parents and pensioner poverty. The costs are estimated as the probability that the individuals are currently in the state of financial emergency and there is a need for compensation by the social system e.g. risk of unemployment is assessed by multiplying the level of unemployment and average income of unemployed from the social system.

The advantage of the indicator is:

- by identifying all four components of the index, both developments can be recognized the average results as well as the diversity of the results

The disadvantages of the indicator are:

- lack of transparency
- the value of PPPs is changing very rapidly and is likely to be inaccurate or misleading
- it is impossible to completely define an objective index of social well-being, we are only able to organize data objectively in a reasonable way for assessment of subjective well-being
- the most controversial issue is the weighting scheme in the design of the composition of the index because the results can be very sensitive to the choice of weights assigned to it

The framework of the IEWB is based on two main ideas. First, economic well-being has multiple dimensions and an index should reflect that fact by aggregating measures of the various domains of economic well-being. Second, an index of economic well-being should facilitate public policy discussion by aggregating across the domains of economic well-being in a way that respects the diversity of individual values. Individuals differ (and have a moral right to differ) in the relative weights they assign to different dimensions of economic welfare, and an index should be useful to all individuals irrespective of those value differences (Osberg, Sharpe, 2011).

While focusing on the economic aspects of well-being we do not undervalue the importance of non-economic issues. Same as the authors of the IEWB, we are inspired by the idea that a better

measurement of a better standard of living is needed if economic and social trends are to be combined into an index with larger ambitions.

The hypothesis is that indices of well-being can help policy makers to come to reasonable answers about social choices if information is presented in a way that highlights the objective trends in major dimensions of well-being and thereby helps policy makers to come to judgments but also respects potential differences in values (Osberg, Sharpe, 2009).

2. METHODOLOGY AND DATA

For assessing the economic well-being we used data from the World Bank, UNSD Statistical Databases, and Databases of European Commission as well as data from Statistical Office of the Slovak republic. The assumption is based on the fact that current prosperity is based on consumption, sustainable accumulation, and social topics. Weights are assigned based on the Center for the Study of Living Standards – CSLS: per capita consumption (0.4), the stock of wealth (0.1), equality (0.25), and economic security (0.25). Although these weights reflected observed aggregate proportions for consumption and savings, the authors of this indicator were criticized for a bias against sustainability because of the low weight for the stocks of wealth. Therefore we also offer a sensitivity analysis of our results to the choice of weights allocated through DEA model and we describe the performance of the economic well-being compared to GDP per capita.

DEA method allows evaluating the effectiveness of individual producer within the given group of data. DEA method is in comparison with statistical and other methods relatively new non-parametric method, which is one of the possible approaches for evaluating the efficiency and productivity of homogeneous production units. DEA model allows an individual assessment of the effectiveness of individual production units with respect to the entire set of units, which belongs among its greatest advantages.

In addition to the allocation of units on effective and ineffective scale, we are able to identify the source of inefficiency for the ineffective organizational units and also identify the way in which the unit could reach efficient scale.

For purposes of calculating optimal weights is sufficient to use the modification of the basic model proposed by A. Charnes, W.W. Cooper, E. Rhodes (1978), named in accordance with the authors' names CCR. The idea is based on the evaluation of the efficiency as a proportion as of virtual aggregate output and virtual aggregate inputs. Adhere to the used terminology we assess the effectiveness of j individual decision-making units (DMU) transforming m inputs to n outputs. Each DMU (indicated by an index of 0) addresses optimization problems with a focus on outputs:

$$\min z_0(\mathbf{u}, \mathbf{v}) = \frac{\sum_{i=1}^m x_{i0} v_i}{\sum_{r=1}^s y_{r0} u_r} \text{ with restrictions}$$

$$\frac{\sum_{i=1}^m x_{ij} v_i}{\sum_{r=1}^s y_{rj} u_r} \geq 1 \quad (j = 1, 2, \dots, n)$$

$$u_r \geq \varepsilon \quad (r = 1, 2, \dots, s)$$

$$v_i \geq \varepsilon \quad (i = 1, 2, \dots, m),$$

where z_0 is the objective function expressing the efficiency of the inverse relationship in terms of inputs and outputs, x_{ij} input i used by j DMU and the element y_{ij} is the i output produced by DMU of j . ε is small positive number Added to the limits in order to identify so-called weak efficiency. The transfer of the problem to the linear form we achieve by the Charnes-Cooper transformation of variables using substitution:

$$\mu_r = t u_r \quad (r = 1, 2, \dots, s)$$

$$V_i = t v_i \quad (i = 1, 2, \dots, m),$$

$$t = \frac{1}{\sum_{r=1}^s y_{r0} \mu_r}$$

The resulting linear program has the form:

$$\min f_0(\mathbf{v}) = \sum_{i=1}^m x_{i0} v_i$$

with limitations

$$\sum_{i=1}^m x_{ij} v_i - \sum_{r=1}^s y_{rj} \mu_r \geq 0 \quad (j = 1, 2, \dots, n)$$

$$\sum_{r=1}^s y_{rj} \mu_r = 1$$

$$\mu_r \geq \varepsilon \quad (r = 1, 2, \dots, s)$$

$$v_i \geq \varepsilon \quad (i = 1, 2, \dots, m)$$

Standardization of outputs $\sum_{i=1}^m y_{r0} \mu_r = 1$ gives the output orientation of model.

The interpretation is based on the construction of indicator. Efficient units will be $f_0=1$. Given the limitation is the smallest possible value of effectiveness, ineffective thus define the unit of $f_0>1$.

For the purpose of construction of optimum weights of the IEWB we perceive individual states as independent decision-making unit and the output for the task are the individual sub-indices. For simplicity, the inputs will be put equal to 1. Since the IEWB is indicated in the scale from 0 to 1, it can be recognized as an efficiency index with fixed weights $\mu_r = 1/4$. Comparable index of efficiency we get as the inverse value of the objective function: $\varphi = 1/f_0$, which is also within the range of 0 to 1.

Condition $\sum_{r=1}^s y_{rj} \mu_r = 1$ gives scope for interpreting the results in a way that testifies about the contribution of each input (sub-indices) to overall efficiency. The sub-indexes weighted by optimal

weights $y_{rj} \mu_r$ are in the output of software referred to as Weighted Data. Ratio

$y_{rj} \mu_r / \sum_{r=1}^s y_{rj} \mu_r = y_{rj} \mu_r$ can be interpreted in a way that testifies about the relative contributions of individual sub-indices to the overall efficiency of composite index. It is evident that countries assess for themselves the 'good' indicators with higher weights.

The basic reason why this issue is important is fact that we measure variables that have in the ground state significantly different units. Otherwise, if we did not set weights, the composite index would focus on variables with high range and small but significant changes in the value will not significantly affected the composite index.

If the variables are aggregated without individual weights, higher explicit weights are with respect to the variables that have a larger extend as their percentage increases.

Our motivation for setting the weights using the method DEA in comparison with weights settled by authors is the fact that the increase in the value of some variables such as the flow of consumption is equivalent to an increase of total well-being, while increases in other variables such as unemployment are equivalent to decline in the overall welfare.

In this case, the variables are standardized in a way that an increase in standardized weights corresponds to an increase in overall well-being.

3. EVALUATION OF INDEX OF ECONOMIC WELL BEING AND GDP PER CAPITA

In this part of our paper we are comparing the results of Index of Economic Well-being with Gross Domestic Product (GDP) per capita which is often used as an indicator of well-being. We are focusing on the period from 2000 to 2013. Due to data limitations, values for some of the variables had to be extrapolated based on past data.

There are two ways how to measure progress in the Index of Economic Well-being: the absolute or the proportional (Osberg, Sharpe, 2009). For comparing the GDP per capita and the IEWB index we used compound annual growth rate calculated from date shown in table 1.

Table 1: GDP per Capita, Selected Countries of OECD, 2000-2013

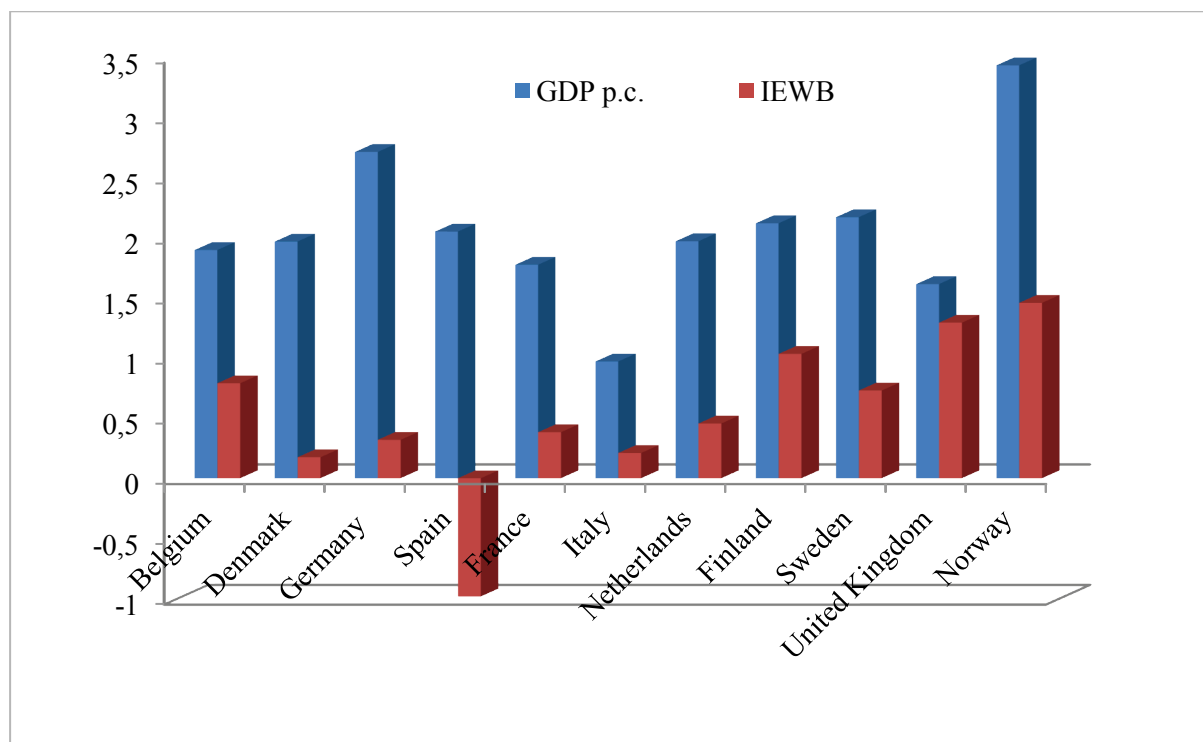
GEO/TIME	Belgium	Denmark	Germany	Netherlands	France	Italy
2000	24 600	25 700	23 100	27 400	22 600	23 200
2001	25 000	25 900	23 800	28 100	23 500	24 200
2002	26 300	27 000	24 300	29 000	24 400	23 800
2003	26 200	26 400	24 800	28 400	23 700	24 000
2004	26 900	27 900	25 800	29 800	24 500	24 200
2005	27 700	28 500	26 900	31 200	25 400	24 700
2006	28 600	30 300	28 200	33 200	26 300	25 900
2007	29 700	31 400	29 800	35 400	27 600	27 200
2008	29 600	31 900	30 000	36 100	27 500	27 300
2009	28 300	29 800	27 900	33 400	26 200	25 500
2010	30 300	31 900	30 200	34 200	27 400	26 300
2011	31 100	32 700	31 800	35 000	28 200	26 800
2012	31 600	33 100	32 500	35 300	28 300	26 600
2013	31 400	33 100	32 700	35 300	28 400	26 300
GEO/TIME	Spain	Finland	Sweden	United Kingdom	France	Norway
2000	18 900	23 000	25 500	23 800	22 600	32 000
2001	19 900	23 600	25 600	24 700	23 500	32 400
2002	21 100	24 300	26 300	25 700	24 400	32 200
2003	21 400	24 300	27 000	26 300	23 700	32 900
2004	22 300	26 200	28 800	27 900	24 500	36 400
2005	23 300	26 800	28 700	29 000	25 400	40 500
2006	25 100	28 100	30 600	30 000	26 300	44 500
2007	26 600	30 400	32 900	30 400	27 600	46 200
2008	26 300	31 000	32 700	29 500	27 500	48 800

2009	24 700	28 200	29 800	27 400	26 200	42 300
2010	24 700	29 200	31 800	27 400	27 400	44 900
2011	24 500	30 400	33 000	27 600	28 200	47 300
2012	24 600	30 600	33 400	28 600	28 300	50 300
2013	24 600	30 200	33 700	29 300	28 400	49 600

*GDP per capita in PPS

Source: Eurostat, Centre for the Study of Living Standards

Picture 1: Average Annual Growth of the Index of Economic Well-being and GDP per capita, Selected Countries of OECD, 2000-2013



Source: Table 1 and Table2, Eurostat, Centre for the Study of Living Standards.

According to Picture 1 the growth of GDP per capita was greater than the growth of the IEWB in all countries. The highest growth in terms of GDP per capita has Norway, it grew by 3.43 per cent per year, but only by 1.46 per cent per year in terms of overall well-being. Germany had the second highest growth of GDP per capita 2.71 per cent but only 1.03 per cent per year in terms of its IEWB. It was the highest difference between the growth of GDP per capita and its overall well-being experienced over the surveyed period of time, which is a difference of almost 2.4 percentage points.

Except for Norway and Netherlands, the rank positions for all countries are different between the two indicators. For example, Belgium was eighth in terms of GDP per capita level over the period of time in 2013, while it was fourth in terms of the level of the Index of Economic Well-being. Even more strikingly, Germany ranked second in GDP per capita and eighth in terms of the IEWB.

Among the eleven countries covered in the study, Norway had the highest overall Index of Economic Well-being in 2013, followed by United Kingdom and Belgium. On the other hand, Spain, Denmark and Italy had the lowest overall IEWB values in 2013.

Over the 2000-2013 period is shown that is not true in general that countries with fast growth of GDP per capita also experienced fast growth of IEWB growth and vice versa. This divergence shows that certain aspects of overall well-being are not included in the measurement of GDP per capita and have

grown slower and thus moderate the growth of overall economic well-being relative to GDP per capita growth.

As shows Table 1, the consumption flows and the wealth stocks values increased for all the surveyed countries, but the growth of overall economic well-being was narrowed by declines in the economic security and equality dimension. This is mainly due to changes in the poverty rate and the growth of inequality in income distribution.

The index of the economic equality declines in ten out of eleven countries. The largest decline by far was in the Netherlands where economic security fell 2.33 percent per year followed by Spain where it fell 1.12 per cent per year and Belgium fell 0.53 percent per year. Economic equality only increased in one country; the United Kingdom with 1.21 per cent annual growth rate leading the way.

Table 2: Overall Economic Well-being Index, Selected Countries of OECD, 2000-2013

Year	Belgium					Denmark				
	Consumption Flows	Wealth Stocks	Inequality Measures	Economic Security	Well-being Index	Consumption Flows	Wealth Stocks	Inequality Measures	Economic Security	Well-being Index
2000	0,5078	0,3600	0,7337	0,7782	0,6171	0,4431	0,3532	0,8003	0,8380	0,6221
2001	0,5252	0,3567	0,7926	0,7773	0,6382	0,4530	0,3856	0,8303	0,8389	0,6371
2002	0,5324	0,3616	0,7415	0,7586	0,6241	0,4625	0,3844	0,7878	0,8361	0,6294
2003	0,5348	0,3728	0,6645	0,7356	0,6012	0,4685	0,4050	0,7377	0,8295	0,6197
2004	0,5485	0,3721	0,7222	0,7385	0,6218	0,4740	0,4101	0,7937	0,8281	0,6361
2005	0,5594	0,3781	0,7779	0,7443	0,6422	0,4865	0,4355	0,7571	0,8378	0,6369
2006	0,5762	0,3940	0,7531	0,7379	0,6426	0,4961	0,4373	0,7635	0,8464	0,6446
2007	0,5898	0,4047	0,7537	0,7419	0,6503	0,5115	0,4208	0,7591	0,8462	0,6480
2008	0,6077	0,4222	0,7671	0,7457	0,6635	0,5295	0,4214	0,7508	0,8512	0,6545
2009	0,6172	0,4508	0,7570	0,7359	0,6652	0,5411	0,4404	0,6701	0,8250	0,6342
2010	0,6180	0,4762	0,7292	0,7382	0,6617	0,5607	0,4475	0,6578	0,8099	0,6360
2011	0,6430	0,4948	0,7498	0,7433	0,6799	0,5694	0,4657	0,5998	0,7958	0,6232
2012	0,6503	0,5092	0,7450	0,7338	0,6808	0,5768	0,4709	0,6027	0,7966	0,6276
2013	0,6544	0,5335	0,7391	0,7264	0,6815	0,5879	0,4809	0,6020	0,8060	0,6352
	Germany					Netherlands				
2000	0,5155	0,4126	0,8052	0,7422	0,6343	0,5562	0,3686	0,7418	0,7661	0,6363
2001	0,5306	0,4225	0,8060	0,7448	0,6422	0,5769	0,3881	0,7316	0,7667	0,6441
2002	0,5389	0,4215	0,8008	0,7384	0,6425	0,5987	0,3852	0,7273	0,7576	0,6492
2003	0,5476	0,4298	0,7955	0,7309	0,6436	0,6142	0,4098	0,6936	0,7422	0,6456
2004	0,5537	0,4359	0,7901	0,7180	0,6421	0,6273	0,4275	0,7011	0,7261	0,6505
2005	0,5560	0,4487	0,7846	0,7063	0,6400	0,6369	0,4292	0,7084	0,7066	0,6514
2006	0,5633	0,4632	0,7212	0,7090	0,6292	0,6503	0,4451	0,7442	0,7116	0,6686
2007	0,5727	0,4733	0,6459	0,7213	0,6182	0,6655	0,4368	0,7739	0,7028	0,6790
2008	0,5823	0,4775	0,6532	0,7303	0,6265	0,6747	0,4592	0,7710	0,6983	0,6831
2009	0,5815	0,4936	0,6799	0,7211	0,6322	0,6690	0,4848	0,7632	0,6715	0,6747
2010	0,5918	0,4994	0,7023	0,7257	0,6437	0,6755	0,4906	0,7816	0,6510	0,6774
2011	0,6045	0,5011	0,6992	0,7380	0,6512	0,6866	0,4953	0,7988	0,6301	0,6814
2012	0,6186	0,4790	0,7094	0,7374	0,6571	0,6901	0,5027	0,8123	0,6041	0,6804
2013	0,6310	0,4806	0,6983	0,7421	0,6606	0,6957	0,5144	0,8150	0,5640	0,6745
	France					Italy				
2000	0,5257	0,3036	0,7358	0,7538	0,6130	0,4782	0,2895	0,5233	0,7221	0,5316

2001	0,5348	0,3019	0,7850	0,7687	0,6325	0,4905	0,3049	0,4938	0,7333	0,5335
2002	0,5485	0,2962	0,7858	0,7647	0,6366	0,5013	0,3034	0,4835	0,7345	0,5354
2003	0,5447	0,3041	0,7866	0,7555	0,6338	0,5075	0,3006	0,4725	0,7366	0,5354
2004	0,5522	0,3072	0,7526	0,7513	0,6276	0,5207	0,3012	0,4608	0,7417	0,5390
2005	0,5607	0,3133	0,7874	0,7501	0,6400	0,5327	0,3140	0,5020	0,7455	0,5564
2006	0,5790	0,3277	0,7727	0,7478	0,6445	0,5491	0,3112	0,4969	0,7541	0,5635
2007	0,5879	0,3301	0,7783	0,7580	0,6522	0,5475	0,3156	0,5170	0,7619	0,5703
2008	0,5978	0,3219	0,7616	0,7606	0,6519	0,5704	0,3201	0,5519	0,7570	0,5874
2009	0,5881	0,3321	0,7341	0,7380	0,6365	0,5758	0,3205	0,5335	0,7454	0,5821
2010	0,5947	0,3353	0,7117	0,7357	0,6333	0,5861	0,3256	0,5351	0,7403	0,5858
2011	0,6044	0,3367	0,7256	0,7391	0,6416	0,5975	0,3284	0,4353	0,7328	0,5639
2012	0,6061	0,3327	0,7296	0,7315	0,6410	0,5957	0,3312	0,4548	0,7163	0,5642
2013	0,6063	0,3320	0,7414	0,7294	0,6434	0,6010	0,3318	0,3755	0,7097	0,5449
	Spain					Finland				
Year	Consumption Flows	Wealth Stocks	Inequality Measures	Economic Security	Well-being Index	Consumption Flows	Wealth Stocks	Inequality Measures	Economic Security	Well-being Index
2000	0,4766	0,2378	0,5801	0,7064	0,5361	0,3790	0,2006	0,8610	0,7625	0,5775
2001	0,4869	0,2490	0,5201	0,7294	0,5321	0,3960	0,2636	0,8398	0,7697	0,5871
2002	0,4807	0,2473	0,5576	0,7195	0,5363	0,4074	0,3011	0,8315	0,7685	0,5931
2003	0,4808	0,2473	0,5751	0,7002	0,5359	0,4167	0,3085	0,8269	0,7647	0,5954
2004	0,4898	0,2486	0,5204	0,6995	0,5258	0,4239	0,3359	0,8308	0,7682	0,6029
2005	0,5036	0,2632	0,4862	0,7121	0,5273	0,4309	0,3407	0,8242	0,7697	0,6049
2006	0,5116	0,2569	0,4699	0,7111	0,5256	0,4411	0,3438	0,8258	0,7784	0,6118
2007	0,5189	0,2420	0,4590	0,7109	0,5242	0,4525	0,3316	0,8131	0,7846	0,6136
2008	0,5261	0,2468	0,4995	0,6886	0,5321	0,4762	0,3678	0,8074	0,7822	0,6246
2009	0,5222	0,2416	0,4539	0,6281	0,5035	0,4942	0,3866	0,8138	0,7603	0,6299
2010	0,5185	0,2635	0,3939	0,6105	0,4848	0,5012	0,4045	0,8244	0,7611	0,6373
2011	0,5267	0,2738	0,4090	0,5988	0,4900	0,5207	0,4118	0,8170	0,7677	0,6456
2012	0,5389	0,2793	0,3161	0,5675	0,4644	0,5373	0,4181	0,8065	0,7662	0,6499
2013	0,5508	0,2850	0,3272	0,5573	0,4699	0,5547	0,4349	0,8181	0,7601	0,6599
	Sweden					United Kingdom				
2000	0,4306	0,2687	0,6941	0,8198	0,5776	0,5670	0,2731	0,5791	0,7793	0,5937
2001	0,4483	0,2913	0,7551	0,8137	0,6006	0,5721	0,2761	0,5752	0,7852	0,5965
2002	0,4657	0,2958	0,7443	0,8115	0,6048	0,5847	0,2811	0,5786	0,7827	0,6023
2003	0,4856	0,2957	0,7601	0,8122	0,6169	0,5987	0,2869	0,5925	0,7836	0,6122
2004	0,4918	0,2909	0,7745	0,8049	0,6207	0,6213	0,2822	0,5729	0,7921	0,6180
2005	0,4981	0,3128	0,7831	0,7950	0,6251	0,6295	0,2922	0,5522	0,7924	0,6172
2006	0,5098	0,3250	0,7036	0,7958	0,6113	0,6481	0,2815	0,5817	0,7826	0,6285
2007	0,5170	0,3490	0,7727	0,8064	0,6365	0,6754	0,2966	0,5938	0,7790	0,6430
2008	0,5324	0,3403	0,7789	0,8063	0,6433	0,6959	0,3227	0,5815	0,7779	0,6505
2009	0,5324	0,3432	0,7267	0,7811	0,6242	0,7150	0,3203	0,6242	0,7671	0,6659
2010	0,5424	0,3464	0,7751	0,7816	0,6408	0,7267	0,3240	0,5962	0,7730	0,6654
2011	0,5515	0,3523	0,7685	0,7850	0,6442	0,7487	0,3421	0,6043	0,7708	0,6774
2012	0,5555	0,3323	0,7355	0,7812	0,6346	0,7494	0,3226	0,6387	0,7763	0,6858
2013	0,5601	0,3341	0,7224	0,7797	0,6330	0,7575	0,3338	0,6767	0,7827	0,7012

	Norway										
2000	0,5363	0,5246	0,7058	0,8381	0,6530	2007	0,6395	0,7000	0,7053	0,8621	0,7176
2001	0,5585	0,5450	0,7430	0,8536	0,6771	2008	0,6600	0,7061	0,7293	0,8542	0,7305
2002	0,5731	0,5577	0,7716	0,8490	0,6901	2009	0,6869	0,7742	0,7461	0,8352	0,7475
2003	0,5999	0,5842	0,7932	0,8460	0,7082	2010	0,6989	0,8184	0,7699	0,8328	0,7621
2004	0,6087	0,6127	0,7889	0,8482	0,7140	2011	0,7085	0,8598	0,7754	0,8394	0,7731
2005	0,6159	0,6464	0,7137	0,8451	0,7007	2012	0,7161	0,8666	0,7762	0,8435	0,7780
2006	0,6296	0,6738	0,6790	0,8560	0,7030	2013	0,7391	0,9167	0,7637	0,8360	0,7872

Source: Centre for the Study of Living Standards, <http://www.csis.ca/iwb.asp>

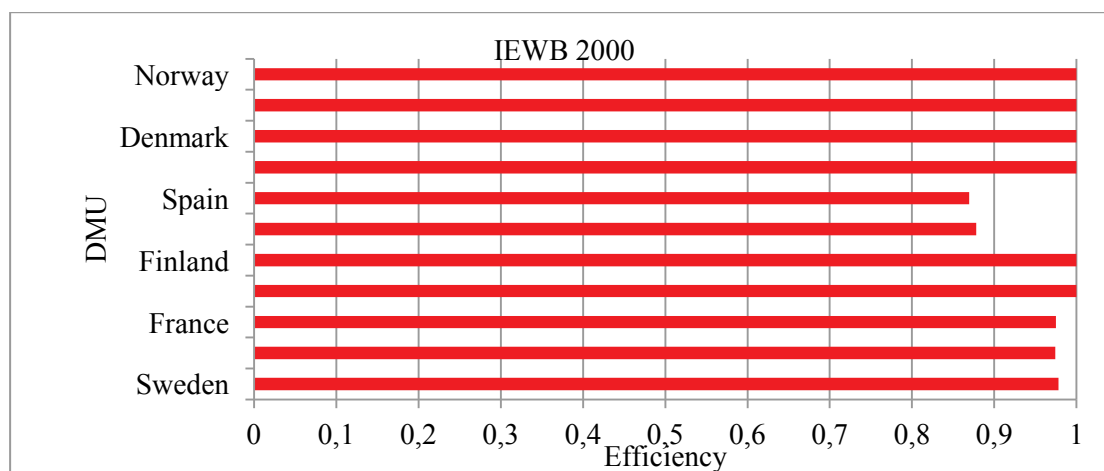
3.1. A non-parametric approach to evaluation

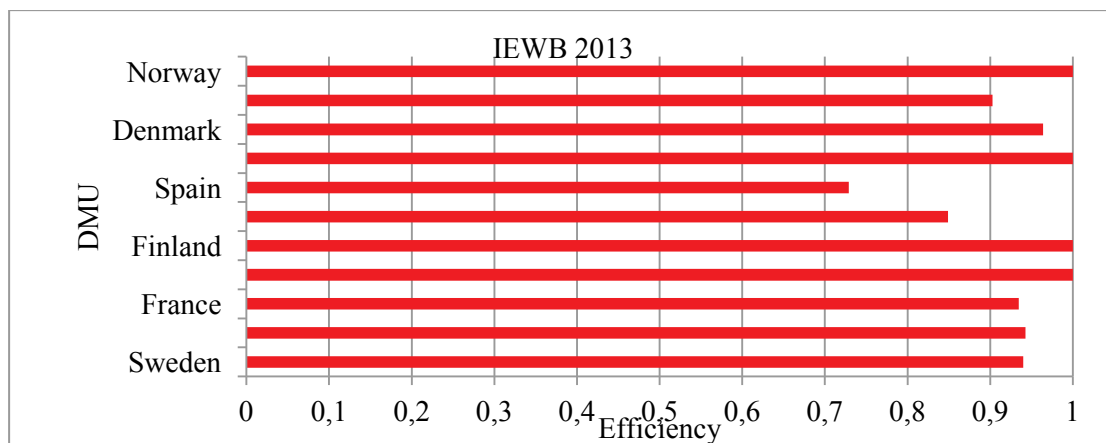
In this section, we explore the sensitivity of our results to the choice of the weights that are assigned to the four domains of well-being.

The aim of the analysis is through DEA method to evaluate the sensitivity of our results to the choice of the weights of these four domains, respectively what is the potential for improvement of their achieved level of economic well-being.

Non-parametric approach provides a relative measure that considered the selected set of DMU, which represents 11 countries included in the analysis. Inputs to the model are individual indicators of overall well-being (consumption flows, wealth stocks, inequality measures and economic security). Efficient scale is composed of countries that have managed to fully transform the achieved level of economic well-being to their economic performance. This means that countries located on the border of efficiency (according to Pareto-Koopmans interpretation) can increase their overall economic well-being only by reducing low quality of one of the four indicators of IEWB.

Picture 2: Effectiveness of selected OECD countries based on weights specified using the DEA model, 2000 and 2013





Source: Centre for the Study of Living Standards; own calculation

Efficient scale consists of countries that have managed to transform the achieved quality of their sub-indexes into their overall economic well-being. In 2000 the efficient scale consisted of six countries - Norway, United Kingdom, Finland, Netherlands, Denmark and Germany but in 2013 only four countries has been efficient - Norway, United Kingdom, Finland, Netherlands (Figure 2). We are able to conclude that DEA model identified four effective countries in 2013 and six in 2000 from eleven observed countries. If other countries would want to achieve the level of efficiency frontier they would have to reduce the low quality of other indicators of IEWB. In the case of countries which are below the level of efficiency it is possible to identify the potential for improvement. The potential for improvement is the percentage that is captured in Table 3 for both years.

Table 3: Decomposition of inefficiency of selected OECD countries, 2000 and 2013

2000 Rank	DMU	Well-being Index	Consumption Flows	Wealth Stocks	Inequality Measures	Economic Security
1	Norway	1	0,8890618	0,1109382	0	0
1	Germany	1	0,5167114	0,0983	0,3850049	0
1	Denmark	1	0	0,0922	0,7329203	0,1748837
1	United Kingdom	1	1	0	0	0
1	Netherlands	1	0,9302798	0,0697	0	0
1	Finland	1	0,1525022	0	0,8474978	0
7	Sweden	0,9781696	0	0	0,000895	0,9991049
8	France	0,974991	0,2991838	0	0,3850241	0,3157921
9	Belgium	0,9741954	0,2730929	0	0,3894896	0,3374175
10	Italy	0,8781527	0,5591578	0	0	0,4408422
11	Spain	0,8694694	0,6285728	0	0,0708	0,3006132
2013 Rank	DMU	Well-being Index	Consumption Flows	Wealth Stocks	Inequality Measures	Economic Security
1	Norway	1	0,9623236	0,0377	0	0
1	United Kingdom	1	1	0	0	0
1	Finland	1	0,0147	0	0,9853118	0
1	Netherlands	1	0,5022404	0	0,4977596	0
5	Denmark	0,9641148	0	0	0	1
6	Belgium	0,9426633	0,1520423	0	0,7380753	0,1098824
7	Sweden	0,940089	0	0	0,5638304	0,4361696

8	France	0,9347215	0,1420636	0	0,7466627	0,1112737
9	Germany	0,9026324	0	0	0,5676372	0,4323628
10	Italy	0,8489234	0	0	0	1
11	Spain	0,7288666	0,9839292	0,0161	0	0

Source: Centre for the Study of Living Standards; own calculation

As stated in Table 3, a strong need for improvements in IEWB can be mainly seen in Spain and Italy. Decomposition of inefficiency indicates that despite the differences in the achieved overall economic well-being in the surveyed economies, the potential for enhancement of various areas of IEWB indicators is not relatively equally distributed.

This means that improvements in the overall economic well-being must be understood comprehensively. The achieved well-being is not the result of only one indicator but has to be achieved by improvement in all four areas of well-being. Different values of overall well-being in countries reflect not only the differences in amenities of components of well-being of surveyed countries but also in quality of their economic performance. Based on data from the previous table, we are able to conclude that DEA model identified four effective countries in 2013 and six in 2000 from eleven observed countries.

As already mentioned before, based on weighted data we are able to interpret which relative contributions of individual sub-indices contribute to the creation of overall well-being. In general, by comparing the relative contributions of the various sub-indices, we can conclude that surveyed countries achieve their efficiency primarily based on consumption flow in 2000 and in 2013 achieved efficiency is result mainly of consumption flows and inequality measures. On the other hand, the economic security participates on the construction of overall well-being with the smallest share. Its share significantly decreased in the creation of overall economic well-being in 2013 compared to 2000, which is also due to a negative average growth rate of this sub-index (Table 2).

Value judgments regarding the importance of the different domains of economic well-being can matter, but in the alternative scenarios presented here, they have no significant effect on the rankings of countries according to the Index of Economic Well-being. Our main results are fairly robust comparing the overall well-being and the average annual growth of GDP per capita, but the results of these two scenarios of weighting scheme are almost similar. Norway has the highest Index value under both weighting schemes, followed by United Kingdom and Finland, while Spain is always on the bottom. The results for Denmark are particularly sensitive to the weights on economic equality and security relative to those on consumption and wealth (Table 3).

Table 4: The ranking of countries under the three ways of measuring economic well-being

Rank	Average annual growth of GDP per capita	Average annual growth of overall well-being	DEA model
1	Norway	Norway	Norway
2	Germany	United Kingdom	United Kingdom
3	Sweden	Finland	Finland
4	Finland	Belgium	Netherlands
5	Spain	Sweden	Denmark
6	Netherlands	Netherlands	Belgium
7	Denmark	France	Sweden
8	Belgium	Germany	France
9	France	Italy	Germany
10	United Kingdom	Denmark	Italy
11	Italy	Spain	Spain

Source: Table 1, Table 2, Table 3, own calculations

4. CONCLUSION

Although economic well-being has increased between 2000 and 2013 in every country under first weighting scheme (with the exception of Spain), under the second scheme overall well-being has decreased over the given period of time. Across the selected countries of OECD, rising economic well-being was driven by growth in consumption and stocks of wealth. In most of the countries, however, the growth of economic well-being was hindered by declines in economic equality and security. These trends were driven by rising income inequality and increased private expenditures on health care in most countries. An important objective of the Index of Economic Well-being is to make explicit value judgments that underline composite indicators of well-being by making the choice of weights for the four domains as transparent as possible. We tested the sensitivity of our baseline results to two alternative weighting schemes and found out that our key baseline results are not so different in almost all countries. In general, consumption and wealth have increased faster over time than economic equality and security (if the latter two increased at all), so economic well-being grows faster when the consumption and wealth domains are weighted heavily relative to the equality and security domains. In all eleven countries, the Index grew faster over the 2000-2013 period under the first weighting scheme than under the second scheme (in which equality and security receive the smallest weights among the domains).

Economic well-being has increased in every country over the 2000-2013 period except of Spain. Norway had always the highest level of economic well-being, while Spain always ranked in the bottom position.

The Index of well-being is still in progress, it needs to undergo further modifications for the choice of weights but it still captures more aspects of economic well-being than real GDP does, and therefore is a step ahead in the right direction.

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REFERENCE LIST

1. England, R. W., Harris, J. M. 1998. *Alternatives to Gross National Product (A Critical Survey)*. Medford (Massachusetts, USA): Tufts University, 1998.
2. Cooper, W. – Seiford, L. M. – Tone, K. (2007). *Data Envelopment Analysis. A Comprehensive Text with Models, Applications, References and DEA-Solver Software*. 2.vyd. Springer, 2007. ISBN: 978-0-387-45281-4.
3. Database of the Index of Economic Well-being for Selected OECD Countries and Alberta, 1980-2013, Retrieved from <http://www.csls.ca/iwb/oecd.asp>
4. Goosens, Y. a kol. 2007. *Alternative progress indicators to Gross Domestic Product (GDP) as a means towards sustainable development*. Luxemburg: Európsky parlament, 2007. Retrieved from <http://www.europarl.europa.eu>
5. Cooper, W. – Seiford, L. M. – Tone, K. (2007). *Data Envelopment Analysis. A Comprehensive Text with Models, Applications, References and DEA-Solver Software*. 2.vyd. Springer, 2007. ISBN: 978-0-387-45281-4.
6. Charnes, A., Cooper, W. W., Rhodes, E., 1978, Measuring the efficiency of decision making units, In *European Journal of Operational Research*, 1978, vol. 2, issue 6, pages 429-444
7. North, D. C. (1990). *Institutions, institutional change, and economic performance*. Cambridge University Press, Cambridge; New York. ISBN 978-05-2139-734-6.
8. North, D.C. (1991). Institutions. *The Journal of Economic Perspectives*, Vol. 5, No. 1. (Winter, 1991), pp. 97-112.

9. North, D. C. (1993). The new institutional economics and development. *Economic History Paper Series* 9309002, EconWPA. Retrieved from <http://129.3.20.41/eps/eh/papers/9309/9309002.pdf>
10. North, D. C. (1994). Economic Performance Through Time. *The American Economic Review*, 3, s. 359-368.
11. North, D. C. (2003). The Role of Institutions in Economic Development. *UNECE Discussion paper series*, No. 2003.2. Retrieved from http://www.unece.org/fileadmin/DAM/oes/disc_papers/ECE_DP_2003-2.pdf.
12. Osberg, L. a Sharpe, A. 2002. An Index of Economic Well-Being for Selected OECD Countries. In *Review of Income and Wealth*. Series 48. no.3. Retrieved from <http://www.roiw.org/2002/291.pdf>
13. Osberg, L. a Sharpe, A. 2011. CSLS Research Report 2011-12, *Moving from a GDP-based to a Well-Being based metric of Economic Performance and Social Progress? Results from the Index of Economic Well-Being for OECD Countries, 1980-2009* Retrieved from <http://www.csls.ca/iwb/oecd.asp>
14. Osberg, L. a Sharpe, A. 2009. CSLS Research Report 2009-11, *New Estimates of the Index of Economic Well-Being for Selected OECD Countries, 1980-2007* Retrieved from <http://www.csls.ca/iwb/oecd.asp>
15. Sharpe, A., Salzman, J., 2003. *Methodological Choices Encountered in the Construction of Composite Indices of Economic and Social Well-Being*, CSLC Retrieved from <http://www.csls.ca/events/cea2003/salzman-typol-cea2003.pdf>
16. Tone, K. 2001. A slack-based measure of efficiency in data envelopment analysis. *European Journal of Operational Research*, vol. 130, pp. 498–509.
17. Van Der Bergh, J., Pillarisetti, J.R., 2008. *Sustainable Nations: What Do Aggregate Indicators Tell Us?* Amsterdam: Tinbergen Institute, 2008. Retrieved from <http://www.tinbergen.nlcomings>