Article

Search for Measure of the Value of Baltic Sustainability Development: A Meta-Review

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Abstract: The purpose of the study is to identify a sustainability development measure. The United Nations announced 17 development objectives in Agenda 2030. This research attempts to identify a measurement which captures all of the UN objectives. It uses the Baltic Sea Region as a natural laboratory for the sustainability discussion. This paper provides an analysis of a sample from the population of 159 research papers, published between 1990 and 2019. With the application of citation count regression, the population of papers is reduced to a sample of the heterogenic papers. These papers were then analysed for the existence of an integrated sustainability development measurement. The results indicate that there is no available applied or theoretical model for an integrated measurement of sustainable development across all of the United Nation's goals. The study provides the framework for a further matrix in reference to gross domestic product. The results are robust in terms of different sample specifications. The identified research gap has a policy implication. There is a need to develop a universal and comprehensive sustainable value measure to support policymakers and their public choices.

Keywords: sustainability management; creating value; synthesis; review; regression of citation count; 2030 agenda; 17 objectives; Baltic Sea Region; individual transaction sustainability value; ODS ONU; negative externalities; indicators sustainability

1. Introduction

This study asks whether a common measurement of all the United Nation's sustainable goals exists.

The purpose of the study is to identify a sustainability development measure which captures the widest range of the United Nation's goals. The specific objective is to identify the basic results of diversity studies. The study is important for policymakers since without a common measurement, we are unable to compare the values created in different sustainable areas.

In order to achieve both objectives, different research approaches have been used; in the case of the basic objective, research populations have been identified based on a sociometric database. A purpose-driven sample of various studies was identified, with the application of citation count regression. The worldwide sustainable literature is vast, thus the geographic scope was narrowed to the Baltic Sea Region (BSR), as it is a natural laboratory for research on sustainable development.

This paper contributes to the literature in two areas, namely on sustainable development and synthesis, and on meta-analysis of scientific research. In the area of research on sustainable development, the results indicate tendencies towards an atomic rather than a holistic perception of problems and processes in the area of the BSR. In the area of meta-analysis and research synthesis, the results confirm the effectiveness of using citation count regression not only for population reduction in the area of auditing studies [1] but also in the area of sustainable development.

The remainder of the paper is organised as follows: section two discusses the literature and develops the testing hypothesis, section three outlines the methodological approach, section four is devoted to the data sets, section five discusses the findings, and the last section concludes the paper.

2. Literature Review

Sustainable development has attracted attention in numerous fields, e.g. risk management [2], resource management [3], economic development [4], and corporate responsibilities [5] to name a few.

The 2030 Agenda for Sustainable Development presented by the United Nations included 17 development objectives [6–9]. The United Nation's proposals do not include measures that would imply the level of achievement of the objectives [10]. Hence, different approaches have emerged in the literature concerning potential measures of sustainable development (e.g., reference [11]) and the need to integrate measurements [12]. The core discussion focus on the integration of the various aspects of economic, social, and environmental indications into a composite index [13,14]. The integration is applied at different levels of the potential cross section of the UN goal, for example, in city management [15,16], farming [17], waste management [18], and harbour traffic impacts on air quality [15]. The proposals apply different approaches, including correlation analysis and a transaction driven approach.

There is a lack of measures like the gross national product that aggregates results for all 17 objectives and offers policymakers an easy tool for allocating resources. A measure that integrates the 17 objectives would be extremely helpful in developing and implementing sustainable development policies. In this study, a synthesis of the literature on the BSR was used to search for such a measure. The synthesis allows for capturing research trends and directions of potential development, while the BSR is a natural laboratory concentrating on global problems. Therefore, the following working hypothesis has been formulated.

Hypothesis 1. *In the area of research on the BSR, a measure integrating all 17 objectives of Agenda 2030 was applied.*

While performing an initial review of the literature on sustainable development in the area of the BSR, synthetic works aimed at integrating research from various areas have not been identified. Although a literature review in reference [19] was used, no studies aimed at indicating a unified way of measuring sustainable development were identified. This research, however, tends to present a wider approach and draw the landscape of the entire spectrum of sustainable issues potential measurement. The existence of the uniform matrix is probably the key milestone for sustainable value management. Therefore, this study fills this gap and determines areas for further research.

3. Outline of the Test Method

The global discussion on the sustainability development is vast and comprehensive, thus this study's scope focused on studies relating to the Baltic region.

The BSR is a natural laboratory for research and sustainable development (see Figure 1). In addition to the countries with direct access to the Baltic Sea, the BSR also includes Norway, the Czech Republic, Slovakia, Belarus, and Ukraine. This is an area affected by two groups of countries: the first group is the European Community and Norway, and the second group is Russia, Belarus, and Ukraine. This is where the interests of individual municipalities, countries, international communities, and various social and economic systems clash. In view of the above, addressing transnational problems relating to sustainable development requires local, national, transnational, and intergovernmental consensus. Hence, the solutions developed in the area of the BSR may be generalised to global issues.
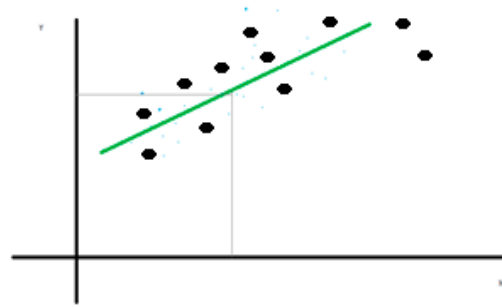
Figure 1. Baltic region countries.

The aggregation of the research results can be done with the application of various methods. The most common is a narrative discussion of selected papers. The narrative discussion is subject to the author selection bias. The alternative approach is a metanalysis, which allows the verification of the hypothesis by calculating the overall effect of all studies in a given literature. The metanalysis however requires a common hypothesis. The citation count regression avoids both methodological limitations. The citation count regression identifies a select number of important papers for a narrative literature review. It is not affected by researcher bias and does not require a common hypothesis among the literature in discussion. Since the synthesis method used was developed at the beginning of 2019, the papers that were published were not identified and would use the method of regression of the number of citations to reduce the population dimension. Hence, the presented study fills a research gap both in terms of the subject matter of the study and in terms of the research method. Next, the idea of using the regression of citation numbers as a supplement to meta-analysis and synthesis of literature will be presented.
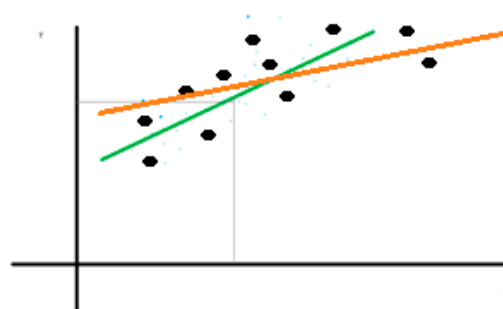
The method allows the reduction of a large group of articles to a smaller sample. The selection of the sample is not of a random nature, and selected articles should be characterised by a large substantive diversity. It applies the properties of linear regression and the number of citation count regression. It applies to the group of articles metadata, for example, the year of publication, an affiliation of the authors, etc. In the model, the number of citations is a dependent variable. The idea of selection is to choose such articles as leverage observations.

The analysis of a fit regression model utilised the fact that one observation (atypical) can significantly change the model parameter estimation. Figure 2 presents three situations: a lack of atypical observation (panel A), and two specific cases. Atypical observations can be leverage observations (panel B) or outliers (panel C). A combination of an outlier and the leverage can affect the accuracy of the model. Hence, during modelling, influential observations are not identified based on Diffts tests, Cook distances, or other measure.
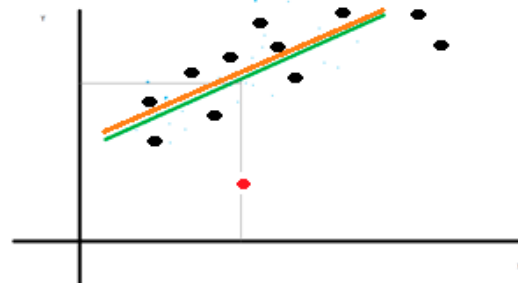
Panel A

Panel B

Panel C

Figure 2. Panel A – The regression line for a uniform set of observations. Panel B - The regression line for leverage observations. Panel C - The regression line for outlier observations.

In the discussed method, the scenario indicated in Figure 1 Panel B is used to reduce the group of articles for narrative description, such observations (articles) are selected from the regression of the number of citations, which have the character of leverage rather than influential citations. The choice is less dependent on the model's matching.

This study applies the following design: firstly, the population of the literature is defined with application of the key words research. Secondly, the entire population is coded with the citation count regression variables. Thirdly, the high leverage observation (the paper) estimated with the citation count regression constitutes the narrative sample. Finally, the sample is analysed against the null hypothesis. Based on the narrative review, the hypothesis is either rejected or accepted.

4. Dataset

Based on the Web of Science Clarivate Analytics sociometric database, research populations were identified. The database was searched according to the keyword "Baltic" and then "sustainability" covered the period from 1990 to 2019. Population identification was carried out in June 2019. The identified population of 159 scientific articles met the selection criteria. A list of articles making up the general population is available electronically (see Appendix A). Based on the analysis of article abstracts, metadata in the form of detailed variables were extracted. The list of variables and their definitions are presented in Table 1.

Table 1. Variables names and definitions.

Variable	Definition
TC/Year	The number of citations divided by the number of years (in the denominator the year of publication - one value)
Publication_Year	2019 + 1 minus year of publication natural number
Method	Binary variable value 1 for the survey when regression methods are used, 0 in other cases
Time_Span	The time range in the years of the sample
Sample	Size of the test sample in units of measurement
Agriculture	Binary variable value 1 for the agricultural survey, 0 in other cases
Transport	Binary variable value 1 for the transport survey, 0 in other cases
Fishing	Binary variable value 1 for the fishing survey, 0 in other cases
Energy	Binary variable value 1 for the energy survey, 0 in other cases
Pollution_Control	Binary variable value 1 for pollution damages, 0 in other cases
Business_Finance_Mgt	Binary variable value 1 for the finance business or economy survey, 0 in other cases

In contrast to the original study presenting the methodology used [1], the AngloSaxon variables (identifying whether the authors of the study have roots in the English-speaking culture) BigSample (identifying studies with more than 1000 observations in the sample) were not used, as well as the type of financing due to the fact that these variables had low discriminatory power and introduced approximate collinearity of the model. Extensions of meta-variables related to research fields were introduced due to the heterogeneity, contrary to the original proposal, of the subject of the study. A time-weighted number of citations was used as a dependent variable. The variables: Agriculture, Transport, Fishing, Energy, Pollution_Control, Business_Finance_Mgt define fields of research.

The following regression equation was applied:

$$TC\_Year = \beta_0 + \beta_1 Publication\_Year + \beta_2 Method + \beta_3 TimeSpan + \beta4 Sample + \beta_5 Agriculture + \beta_6 Transport + \beta_7 Fishing + \beta_8 Energy + \beta_9 Pollution\_Control + \beta_{10} Business\_Finance\_Mgt + \varepsilon \tag{1}$$

where

β_i is the coefficient of the variable i and ε is the error term.

Estimations were carried out using the classical method of the smallest squares (OLS) with the correction of heteroskedasticity.

5. Results

Table 2. presents the distribution of the population by the research area.

Table 2. Number of papers by areas.

Area	Number of Papers
Agriculture	7
Transport	6
Fishing	28
Energy	12
Pollution_Control	16
Business_Finance_Mgt	16
Unallocated	74
Sum	159

Of the total population there are only three articles that comprise more than one field, namely works V. Bobinaite [20] - energy and management, A. Sundkvist, A.M. Jansson, P. Larsson [21] - energy and pollution, and finally M. Hammer, A. Jansson, B.O. Jansson [22] - Governance and Fisheries. An important part of the population is the items that cannot be clearly attributed to the area. Descriptive statistics of the population are presented in Table 3.

Table 3. Descriptive statistics.

Variable	Mean	Med.	Min.	Max.	. Std. Dev.	Skew.	Kurt.	5% Perc.	95% Perc.
TC_Year	1.8	0.6	0.0	19.2	3.2	3.1	10.2	0.0	11.0
Publication_Year	9.1	7.0	1.0	27.0	5.9	0.9	0.1	1.0	23.0
Method	0.1	0.0	0.0	1.0	0.3	3.2	8.3	0.0	1.0
Time_Span	8.0	0.0	0.0	1000.0	79.4	12.4	152.1	0.0	14.0
Sample	113.5	0.0	0.0	18,000.0	1427.5	12.5	154.0	0.0	0.0
Agriculture	0.0	0.0	0.0	1.0	0.2	4.4	17.8	0.0	0.0
Transport	0.0	0.0	0.0	1.0	0.2	4.9	21.5	0.0	0.0
Fishing	0.2	0.0	0.0	1.0	0.4	1.7	0.9	0.0	1.0
Energy	0.1	0.0	0.0	1.0	0.3	3.2	8.3	0.0	1.0
Pollution_Control	0.1	0.0	0.0	1.0	0.3	2.7	5.0	0.0	1.0
Business_Finance_Mgt	0.1	0.0	0.0	1.0	0.3	2.7	5.0	0.0	1.0

The population is characterised by relatively high variability within the sample size range. Table 4 presents the estimated model of citation regression count together with model diagnostics.

Table 4. Model estimation results.

	Coefficient	Std. Error	t-ratio	*p*-Value	
Const.	1.65278	0.548219	3.0148	0.0030	***
Publication_Year	0.0240776	0.0463692	0.5193	0.6044	
Method	−0.49815	0.481207	−1.0352	0.3023	
Time_Span	−0.00156831	0.000483838	−3.2414	0.0015	***
Sample	−0.000111668	3.92137×10^{-5}	−2.8477	0.0050	***
Agriculture	−0.869443	0.719052	−1.2092	0.2285	
Transport	0.236317	1.2931	0.1828	0.8552	
Fishing	0.828027	0.790064	1.0481	0.2963	
Energy	−0.984779	0.469697	−2.0966	0.0377	**
Pollution_Control	0.181339	1.0242	0.1771	0.8597	
Business_Finance_Mgt	−1.07773	0.452412	−2.3822	0.0185	**
		Model diagnostics			
Mean dependent var	1.760225		S.D. dependent var.	3.205253	
Sum squared resid.	1553.164		S.E. of regression	3.239499	
R-squared	0.043168		Adjusted R-squared	−0.021483	
F(10, 148)	5.052342		P-value(F)	2.56×10^{-6}	
Log-likelihood	−406.8033		Akaike criterion	835.6065	
Schwarz criterion	869.3645		Hannan-Quinn	849.3153	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Model: OLS, using observations 1–159. Dependent variable: TC_Year. Heteroskedasticity-robust standard errors, variant HC1.

The model fit rates are low but this is not an obstacle to sample identification because the method is robust and depends primarily on the difference in the directional coefficients of the original model and the reduced model. Table 5 shows the leverage points (papers) for which the value of the test statistic exceeded the reference level, while Table 6 shows distribution by areas.

Table 5. Leverage papers.

No	First author	error u	leverage 0 < = h < = 1	Year	Ref.
1	Svanback, A	−0.79016	0.161 *	2019	[23]
2	Yatskiv, I	−1.9613	0.167 *	2017	[24]
3	Reidla, K	−0.85557	0.154 *	2017	[25]
4	Schroder, M	−1.2354	0.167 *	2016	[26]
5	Boonstra, WJ	3.3704	0.151 *	2016	[27]
6	Beifert, A	−0.62965	0.151 *	2016	[28]
7	Brankovic, N	−1.9854	0.167 *	2016	[29]
8	Proskurina, S	1.3984	0.167 *	2015	[30]
9	Streimikiene, D	−0.09024	0.161 *	2007	[31]
10	Urboniene, R	−1.2375	0.157 *	2015	[32]
11	Bobinaite, V	2.2094	0.189 *	2015	[20]
12	Lotz, C	−2.0095	0.167 *	2015	[33]
13	Dekker, W	0.001682	1.000 *	2013	[34]
14	Lindholm, M	5.7933	0.169 *	2012	[35]
15	Taagepera, R	0.14328	0.995 *	2011	[36]
16	Deutsch, L	−0.21117	0.147 *	2005	[37]
17	Sundkvist, A	−0.25419	0.170 *	2001	[21]
18	Valpasvuo-Jaatinen, P	0.45333	0.174 *	1997	[38]
19	Libert, B	−1.3371	0.174 *	1997	[39]
20	Hammer, M	−0.53465	0.148 *	1993	[22]

* Leverage observation.

Table 6. Distribution of the leverage papers by areas.

First author	Agriculture	Transport	Fishing	Energy	Pollution	Business finance
Svanback, A	1	0	0	0	0	0
Yatskiv, I	0	1	0	0	0	0
Reidla, K	1	0	0	0	0	0
Schroder, M	0	1	0	0	0	0
Boonstra, WJ	1	0	0	0	0	0
Beifert, A	0	1	0	0	0	0
Brankovic, N	0	1	0	0	0	0
Proskurina, S	0	1	0	0	0	0
Urboniene, R	0	0	0	0	1	0
Bobinaite, V	0	0	0	1	0	1
Lotz, C	0	1	0	0	0	0
Dekker, W	0	0	1	0	0	0
Lindholm, M	0	1	0	0	0	0
Taagepera, R	0	0	0	0	0	0
Streimikiene, D	0	0	0	0	0	0
Deutsch, L	1	0	0	0	0	0
Sundkvist, A	0	0	0	1	1	0
Valpasvuo-Jaatinen, P	1	0	0	0	0	0
Libert, B	1	0	0	0	0	0
Hammer, M	0	0	1	0	0	1

The selected sample includes all the articles in multiple domains and all the control variables are represented, including articles not assigned to domains.

6. Discussion

Descriptive statistics show a low degree of article differentiation between domains. Indeed, only three articles focused on more than one domain, namely V. Bobinaite [20], A. Sundkvist, A. Jansson and P. Larsson, [21], and M. Hammer et al. [22]. The result indicates tendencies for detailed analyses and silage of research within one or two fields. At the same time, a high percentage of articles not assigned to any of the fields suggests a strong development of the subject and scope of research. By far the most widely represented articles in the population are ones that are not assigned to a specific field, followed by articles on fishing, economics and management, environmental protection (pollution) and energy, agriculture, and transport.

The selected target sample does not reflect the population structure, because the broadest represented domain is transport (seven articles); followed by agriculture (six articles); other (i.e., fisheries, energy, and environmental protection (pollution), economics, and management); and not allocated (two articles each). While the thematic structure is not reproduced, the time range of the sample extends from 1993 to 2019 and almost coincides with the general population period, i.e., 1990–2019.

Agriculture

Reidla and Nurmet [25] analysed dairy farms and studied economic and social conditions of production, concluding that in comparison to other regions, dairy farms in the BSR do not differ significantly from other regions. Svanbäck et al. [23] addressed the links between animal production and the number of nutrients flowing into the Baltic Sea. They pointed to the relation between the concentration of animal production in the case of nitrogen and phosphate fertilisers applied in areas with a high concentration of animal production. The authors stated that the application of the EU common agricultural policy resulted in a decrease in the inflow of nutrients to the Baltic Sea in the period from 2000 to 2010. Boonstra et al. [27] conceptualised additional social-ecological traps beyond lack of adaptative capacity. They constructed a typology of human responses. Deutsch and Folke [37] noticed that the ecosystem areas appropriated (ArEAs) for agricultural production in Sweden have decreased from 1962 to 1994. The authors attributed the results to the fact that production in Sweden is supplied by ecosystems of other nations. Valpasvuo-Jaatinen et al. [38] called, in 1997, for a common standardised system for assessing the present and future sustainability of agriculture for the BSR, while Libert [39] showed the paths for agricultural transition towards sustainability in the western countries of the Baltic region. All of the mentioned papers in agriculture were dedicated to a specific issue, while Valpasvuo-Jaatinen et al. [38] tend to present the common standards, but limited to agriculture, thus in the agriculture subsample, the common universal value measurement for sustainable development was not identified.

Transport

Yatskiv and Budilovich [24] based on the study case of planning decisions for the passenger network in Riga City, showed the need for multi-modal passenger transportation sustainable development. Schroder and Prause analysed the economic, ecological, and social risks appearing in the context of handling and transportation of dangerous goods in a Green Transport Corridor, while Beifert [28] showed the different limitations of air-cargo transport for the local Baltic Sea airports. Brankovic, Salketic, and Ferizovic [29] described how Baltic-Adriatic transport flows could be affected by a single railway line. Proskurina et al. [30] identified an inherent limitation within the Russian pellet business, which faces constraints due to an oligopolistic market structure, inadequate infrastructure, and a lack of foreign investments. Lotz [33] showed the spatial interconnection between the railway network and accessible forest resources, and its trade-off for the forest sustainable management. Lindholm and Behrends [35] pointed out the lack of a methodology for analysing freight transport on the urban areas. The papers within the transport area touched on a number of different aspects of transportation. owever

similarly to for agriculture, there were no instances noted that proposed and unified measurement methods to determine a sustainability value.

Fishing, Energy, Pollution, Business, and others

Dekker and Sjoberg [29] examined the factors affecting stocks of European eel and concluded that the fishing impact on the eel population was less than 10%. Hammer et al. [22] claimed to conserve biodiversity in the fishing industry we need the resource-management systems, placing themselves at the edge of both the fishing and business areas. A similar linkage between business and energy can be observed in Bobinaite's research [20]. With the application of the Altman-like insolvency prediction model [40,41], Bobinaite identified the bankruptcy risk among the electricity producers in the BSR. This leads to the concern of energy security and need for cross-country cooperation. Sundkvist et al. [21] identified a problem on the intersection between energy and pollution. They contrast the local small-scale and centralised large-scale bread production. In doing so, they identified contradictory forces. Due to inefficient technology production, the local bakeries require more total energy input per kilogram of bread than an industrial bakery. Concurrently, the emissions of CO_2, SO_2, and NO_x are smaller from the local bakeries than from big bakeries. This is because the transportation routes are shorter in local bakeries and the oil is more frequently used for heating the ovens in large bakeries. Urboniene et al. [32] discussed the projection coverage of vegetation and morphometric parameters of the beach. The unallocated papers to the specific area represent Taagepera [36] and Streimikiene [31]. Taagepera shows the historical precondition for the national sustainable development, while Streimikiene points out the knowledge spill over in terms of energy cooperation across Baltic States. All of the studies mentioned above do not offer an integrated measurement of sustainable development across all of the United Nation's goals.

The findings of this study lead to the rejection of the initial hypothesis that in the area of research on the BSR, a measure integrating all 17 objectives of Agenda 2030 was applied. Consequently, it shows the discrepancy between the goals and the way we measure them. There is no one integrated sustainability goal value, thus policymakers must cope with the different aspects of sustainable development. Suppose there was one integrated measurement, meaning at the applied research and policy level, we would be able to compare different policy actions and their results. As per an analogy to gross domestic product, the desired measurement would integrate different levels of sustainability activity (goals) into one measurable indicator. We might expect that to provide such a measurement, we need to record all of the sustainable transactions (human interactions with the global environment) and assign to them a common measurement, then aggregate them to the country, region, or continent values. Let us call this desired measurement the Gross Sustainable Impact (GSI). Possession of such an aggregated and general indicator would support the policymakers and society with their decision. The GSI constitutes a precondition for general value measurement. In particular it might be subject to a reliability issue, (e.g., in sustainable reporting studies, Waniak-Michalak et al. [5] showed that entities may treat sustainability reports as a tool for legitimising their actions) which indicates a space for influence. A search for the concrete concept of the GSI and its practical application might be a goal for further studies.

Robustness of Results and Limitations

The above-stated results are conditioned on the sample selection methods and its stability as well as being subject to the metadata selected for regression analysis. Thus, a selection might be subject both to the sampling bias and the model variables selection bias. The original procedure [1] was proven to be stable, however, it was tested on other types of papers. Therefore, to test the stability of the results, an additional 11 papers were randomly sampled from the general population. The random sample consists of the following papers: Holma et al. [42], Siksnelyte et al. [43], Oleinikova et al. [44], Holmgren et al. [45], Jokikokko and Huhmarniemi [46], Zhang [47], Larsson and Granstedt [48], Orru and Orru [49], Hallemaa et al. [50], Heikinheimo et al. [51], and Raukas and Tavast [52]. Within

the random sample, there was no identified paper which applies or proposes the method to integrate all the United Nations goals. Thus, the primary results tend to be stable.

It is important to add a disclaimer here. As this article is written based on the Baltic region, it is not fully legitimate to claim that there is a lack of GSI measurements within all sustainable research areas globally. Nevertheless, if we accept the unique characteristic of the BSR as being representative of global issues, then the entire analysis of this research area becomes more plausible, however is not fully convincing.

7. Conclusions

The study focused on the search of the studies which would apply a common measurement to all of the United Nation's sustainability goals. It failed to present such a measurement in respect of the BSR, which is likely to hold true in terms of the global discussion. Without a common measurement method, we are unable to compare the values created across the different sustainable areas, thus the steering of the global human activities is subject to decision biases.

This study provides robust evidence on the sustainable development discussion on the BSR, which might be a starting point for discussion on the practical application of an index driven measurement.

This study proposes to develop an aggregated measurement based on the individual transaction sustainability value. The aggregation of the value of each transaction would inherit some characteristics of the gross domestic product concept and support policymakers with their social choices. The concept of the Gross Sustainable Impact and its practical application could be developed with further studies.

Appendix A

The papers included in the analysed population: DOI:10.17632/gvysfjrfp5.1

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