Sustainable Economic Development Indices (SEDI) for Illinois Counties

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Abstract
This paper addresses the question, "how effective are Illinois counties in converting wealth (GDP) into wellbeing of residents". To address this question, a multi-item measure of wellbeing (SEDI) was constructed using publicly available data. Based on the multi-item measure, a wellbeing development index (WDI) was calibrated for each county. The SEDI and its derivative the WDI are relative measures, they highlight how a county performs relative to the entire universe of Illinois counties or individual peer groups (for example, economic development regions). To facilitate adaption of SEDI, a software is provided free for practitioners interested in assessing the wellbeing status of Illinois counties.
Keywords: Sustainability, Wellbeing, Illinois, County, Index number.

1.0. Introduction

The process of economic development in a region is assumed to be correlated with its residents' wellbeing (for example, escape avoidable morbidity, be well nourished, be able to read and write, etc. (Athiyaman, 2019; Sen, 1999)). A question that is of interest to policymakers is 'how effectively does a region convertswealth into wellbeing'.

The question is often addressed by constructing econometric models relating variables such as income and employment with investments in education and health and sustainability factors such as environment and social inclusion (see for example, Athiyaman and Walzer, 2008). Most economic developers at the county level may find calibration of econometric models difficult because of lack of data and knowledge about model specifications. This paper overcomes these difficulties by calibrating a cross-sectional, nonparametric model of SEDI for Illinois counties. To facilitate widespread adaption of the SEDI, an interactive software is also provided.

2.0. Methodology

SEDI is a county-level index, its measures tap into a county's economic, investments, and sustainability or ecological wellbeing. Economic strength is assessed using per-capita personal income and employment rate (for population aged 16-64). Investments denote spending on education, health, and infrastructure. Variables that capture investments in health include: life expectancy, prevalence of HIV, obesity rates, and number of physicians per 1,000 people; education investment was assessed using college and graduate program

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enrollment, and internet users in the population was the metric for infrastructure investments at the county. Metrics associated with sustainability include: Gini index of income and equality and air quality. Table 1 provides operational definitions of variables and their data sources.

Table 1: SEDI's Facets and Measures

Facet and Measures	Operational Definition[2]	Data Source
Economic Strength		
⇨ Income	Personal income per capita	BEA's personal income summary, 2017. Table: CAINC1
⇨ Employment	Employment rate, population aged 16-64 (%)	ACS 2017 5-year estimates, Table S2301
Investments in Health		
⇨ Life Expectancy	Mean length of life of a cohort exposed to mortality rate observed at 2017.	2015-2017 National Center for Health Statistics – Mortality files
⇨ HIV	HIV prevalence (numbers)	National Center for HIV, 2015
⇨ Obesity	Percentage of adults that report a BMI of 30 or more	CDC Diabetics Interactive Atlas, 2015
⇨ Physicians	Number of physicians per 1000 people	Area Health Resource File, AMA, 2016
Investments in Education		
⇨ Tertiary Education	Total college and graduate enrollment (%) in the 18-24 age group.	ACS 2017 5-year estimates, Table S1401
Investments in Infrastructure		
⇨ Internet Usage	% of Households with Internet connection	ACS 2017 5-year estimates, Table S2801.
Sustainability		
⇨ Equality	Gini index[3] of income inequality.	ACS 2017 5-year estimates, Table B19083
⇨ Air Quality	Average daily density of fine particulate matter in micrograms per cubic meter.	Environmental public heath tracking network, 2017.

[2] Wellbeing = Σ Investments in Health, Education, and Sustainability

[3] It measures the inequality among values of a frequency distribution, income in our case.

To facilitate comparison among the facets or dimensions of the SEDI, the variables were normalized using the min-max[4] algorithm and then converted into a 0-100 scale. Thus a score of zero implies that the county is relatively the worst performer in a measure and 100 signifies the best score[5]. All facets were assigned unit weights[6].

Insights into a region's effectiveness of converting income into wellbeing are gained by the wellbeing development index:

$$WDI = \frac{Investments\ in\ wellbeing}{Economic\ Strength}$$

The numerator is a compensatory measure (a linear combination) of all three investments and sustainability facets. The denominator is a linear combination of the income and the employment measures.

Finally, to understand the wellbeing morphology of Illinois counties, the eight wellbeing measures were subjected to a principal component analysis. The variance-covariance matrix of the eight variables was the data input. The component scores of the counties were used in the place of original scores to visualize the counties on a wellbeing map.

3.0. Results

Table 2 shows the results of SEDI for the Greater Peoria Region (GPR)[7]. The results were the output of the software that is provided with this paper, free for use for economic developers and regional scientists. Appendix 1 shows the SEDI scores for all the 102 Illinois counties classified into four clusters based on their quartile scores on the wellbeing development index.

Table 2 suggests that in the GPR, Woodford County is the most effective in converting income into wellbeing. Peoria County delivers the lowest level of wellbeing, poor performances in health and sustainability dimensions are the determining factors.

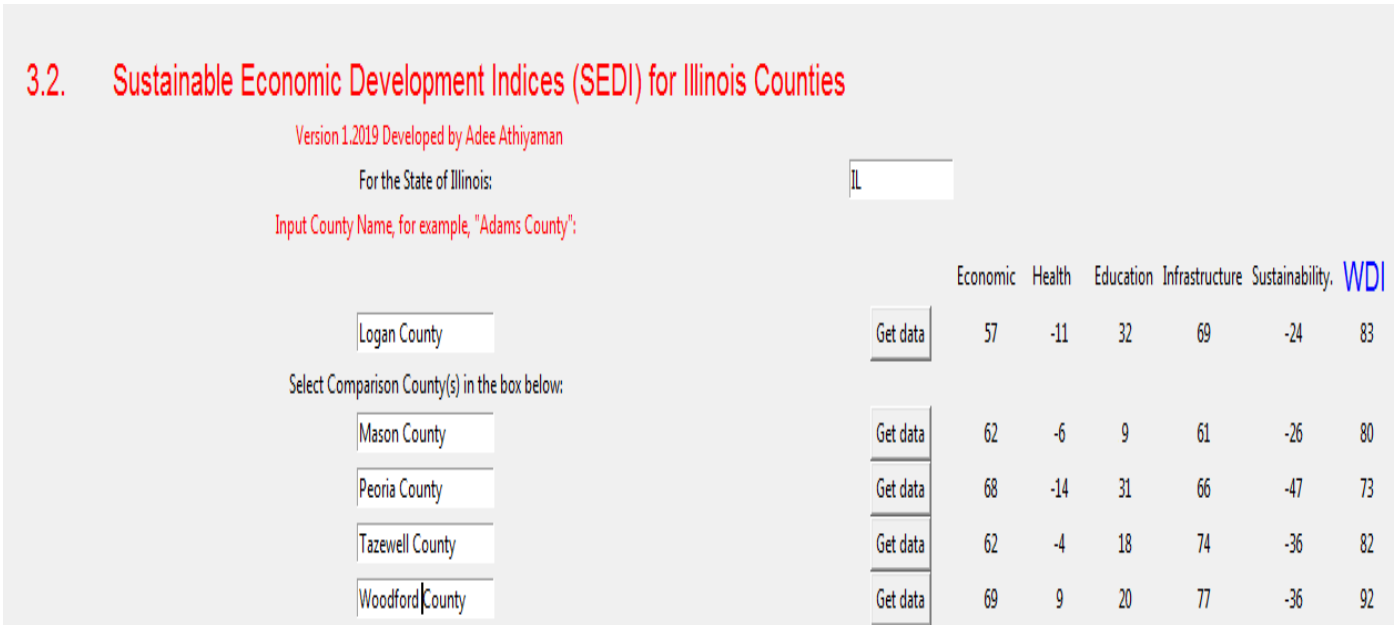
[4] The min-max normalization of a vector **x** involves the transformation of vector elements using the modifier: $\frac{x_i - x_{low}}{x_{max} - x_{low}}$

[5] To maintain polarity, four variables were reverse coded: HIV prevalence, obesity, equality and air quality.

[6] All the dimensions of SEDI were viewed as equally important for data analysis purposes.

[7] The greater Peoria region spans five counties: Logan, Mason, Peoria, Tazewell, and Woodford.

Table 2: SEDI for the Greater Peoria Region



3.2. Sustainable Economic Development Indices (SEDI) for Illinois Counties

Version 1.2019 Developed by Adee Athiyaman

For the State of Illinois: IL

Input County Name, for example, "Adams County":

Select Comparison County(s) in the box below:

		Economic	Health	Education	Infrastructure	Sustainability.	WDI
Logan County	Get data	57	-11	32	69	-24	83
Mason County	Get data	62	-6	9	61	-26	80
Peoria County	Get data	68	-14	31	66	-47	73
Tazewell County	Get data	62	-4	18	74	-36	82
Woodford County	Get data	69	9	20	77	-36	92

A principal component analysis of the eight wellbeing variables[8] resulted in two factors which explain the majority of the variance in the eight variables (>50%, Figure 1a); the eigenvalue greater than 1 rule suggests that the focus of data analysis should be on the first two principal components. Table 3 shows the component loadings for the two principal components, correlations between the principal components and the eight wellbeing variables. The correlations suggest that the first principal component captures investments in health, education, and infrastructure; and the second principal component is concerned with the sustainability dimension.

Table 3: Component Loadings: Correlations of Variables with Components

Variable	PCA 1	PCA 2
Life Expectancy	0.56	
HIV Prevalence	0.62	
Education	0.58	
Internet Usage	0.88	
Equality		0.34
Air Quality		0.63

Note: Two variables: obesity and physicians (see Table 1) loaded on both the factors, they were uninterpretable.

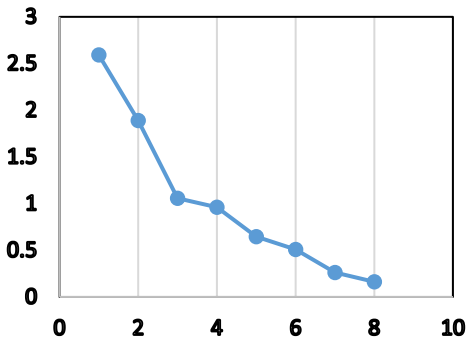
[8] These exclude economic variables (see Table 1).

The component scores for the counties on the first two factors were computed and plotted (see Figure 1b). The results suggest that the counties cluster into two groups: a large number of counties in cluster 1 with Ford County being a typical example of the cluster. Cluster 1 counties have higher scores on the sustainability dimension. The cluster 2 counties have higher scores on the investment dimensions, Coles County is an example of this cluster.

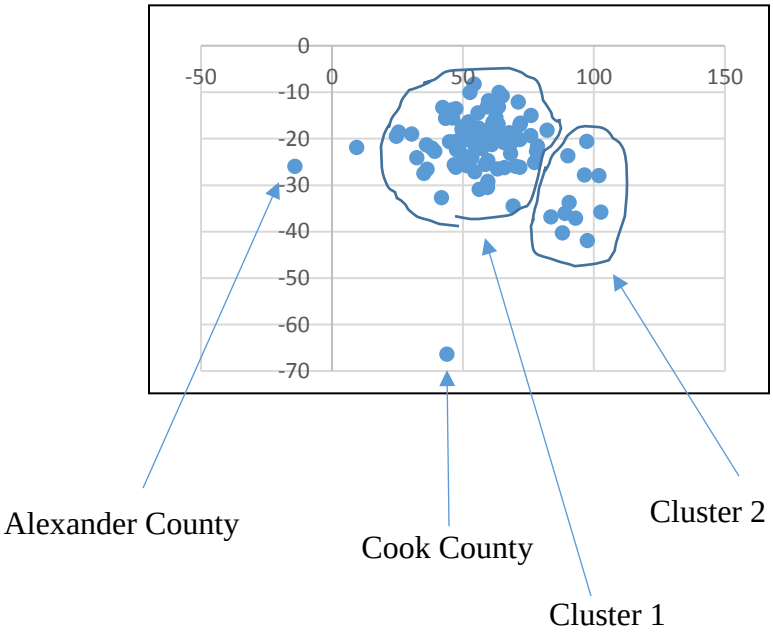
Cook County is an outlier, it has lower scores on the investments dimensions. Another outlier in Figure 1b is Alexander County, it has lower scores on both the investments and the sustainability dimensions.

Figure 1: Principal Component Analysis of the Eight Wellbeing Metrics

a. Eigenvalues



b. Component Scores of Counties



4.0. Summary and Conclusion

A question that is of interest to policymakers is 'how effectively does a region convert wealth into wellbeing'. The question is often addressed by constructing econometric models, but because of lack of data and knowledge about model specifications most practitioners may find it to be a difficult exercise. This paper overcomes the econometric-model-calibrating difficulty by developing a cross-sectional, nonparametric model of SEDI for Illinois counties. Results suggest that more work has to be done to effectively convert income into wellbeing, see Figure 1b and Appendix 1.

County wellbeing depends on improving investments in health, education, and infrastructure. Initiatives such as over subsidizing industry may hamper a county's wellbeing.

This research was built on the idea that understanding the relative magnitude of a problem is the starting point for addressing it. It is hoped that the results of this research will help county and local government decision makers to prioritize investments in wellbeing.

References

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Appendix 1: SEDI Scores for Counties

County	Econ[9].	Health[10]	Edu	Infra.	Sustain[11].	Wellbeing	WDI	Quartile
Hardin County	8	-12	12	42	-30	-7	0	1
Alexander County	48	-17	7	0	-43	-19	47	1
Vermilion County	54	-24	9	52	-37	-14	59	1
Cook County	78	-12	34	74	-91	-15	64	1
Pulaski County	59	-9	0	17	-37	-11	64	1
St. Clair County	64	-21	28	59	-51	-12	65	1
Union County	58	-13	13	42	-36	-9	69	1
Massac County	54	-9	2	38	-31	-7	70	1
Saline County	61	-8	6	51	-44	-8	70	1
Livingston County	64	-17	11	73	-36	-7	72	1
Madison County	63	-17	33	75	-49	-7	72	1
Clark County	50	-10	5	59	-32	-5	73	1
Peoria County	68	-15	31	66	-48	-7	73	1
Perry County	57	-7	12	55	-43	-6	73	1
Winnebago County	58	-16	20	75	-39	-6	73	1
Franklin County	57	-4	12	46	-41	-5	74	1
Iroquois County	62	-10	10	66	-37	-5	75	1
Jefferson County	55	-8	19	65	-43	-4	75	1
Kankakee County	53	-11	30	67	-41	-3	76	1
Greene County	53	-6	6	50	-27	-3	77	1
White County	68	-5	9	61	-40	-4	77	1
Montgomery County	54	-4	12	55	-34	-2	78	1
Cass County	51	-7	5	54	-23	-2	79	1
Crawford County	49	-4	16	64	-39	-2	79	1
Edgar County	55	-6	7	59	-30	-2	79	1

[9] Composite of income and employment (see Table 1).

[10] Average of the composite score based on the sum of life expectancy, HIV prevalence, obesity, and number of physicians in the county. HIV and obesity were reverse coded. Hence the final score may be positive or negative depending on the magnitude of the reverse-coded variables.

[11] It is an average of the linear combination of equality and air quality variables, both reverse coded and negative. The lower the value the higher is the county's sustainability.

Gallatin County	65	-3	16	46	-33	-2	79	2
Macon County	59	-2	22	69	-48	-2	79	2
Marion County	61	-7	13	65	-33	-2	79	2
Scott County	58	-6	2	62	-29	-2	79	2
Stephenson County	59	-11	12	68	-27	-2	79	2
Mason County	62	-6	9	61	-27	-1	80	2
Pike County	52	-3	6	47	-24	-1	80	2
Stark County	62	-2	12	57	-36	-2	80	2
Adams County	62	-7	17	64	-29	-1	81	2
Hamilton County	65	1	1	53	-33	-1	81	2
Henry County	63	-5	9	66	-29	0	81	2
Marshall County	61	-3	3	61	-29	-1	81	2
Christian County	60	-3	12	62	-31	0	82	2
Douglas County	69	0	8	59	-34	0	82	2
Ogle County	66	-7	17	71	-30	0	82	2
Tazewell County	63	-4	18	74	-37	0	82	2
Wayne County	60	3	8	46	-33	0	82	2
Clay County	54	-1	8	65	-33	1	83	2
Fayette County	54	3	20	42	-35	1	83	2
Knox County	59	-7	40	57	-33	1	83	2
Logan County	58	-12	32	69	-25	1	83	2
Richland County	53	0	17	64	-39	1	83	2
Whiteside County	59	-4	12	69	-30	1	83	2
Williamson County	60	1	20	59	-37	1	83	2
Clinton County	65	-4	21	67	-30	2	84	2
De Witt County	68	-4	13	66	-26	2	84	3
Sangamon County	65	-2	25	78	-42	1	84	3
Schuyler County	56	-9	5	69	-14	1	84	3
Cumberland County	62	2	5	57	-26	2	85	3
Edwards County	61	3	4	66	-30	3	85	3
Fulton County	56	-3	22	60	-28	2	85	3
Lawrence County	50	2	11	53	-28	2	85	3

Randolph County	57	1	16	55	-29	2	85	3
Wabash County	55	-2	22	65	-33	2	85	3
Will County	70	2	21	89	-47	3	85	3
Jasper County	63	4	3	58	-28	3	86	3
Jersey County	60	-8	32	58	-20	3	86	3
LaSalle County	62	3	16	71	-38	3	86	3
Lee County	63	-2	23	71	-33	3	86	3
Washington County	70	3	16	60	-29	4	86	3
Effingham County	63	6	13	72	-39	4	87	3
Henderson County	53	3	9	54	-25	3	87	3
McDonough County	58	-2	38	68	-36	3	87	3
Menard County	61	2	7	70	-27	4	87	3
Moultrie County	76	4	9	56	-22	5	87	3
Rock Island County	64	-3	29	71	-30	4	87	3
Ford County	71	5	11	68	-29	5	88	3
Macoupin County	60	0	24	70	-30	4	88	3
Boone County	66	2	17	82	-34	5	89	3
Bureau County	59	4	13	68	-29	5	89	3
Grundy County	67	2	14	83	-31	5	89	4
Lake County	97	18	22	91	-60	8	89	4
Mercer County	65	-1	11	68	-16	6	89	4
Monroe County	78	2	14	79	-28	6	89	4
Pope County	50	6	21	29	-21	4	89	4
Putnam County	77	5	19	64	-27	6	89	4
Coles County	61	1	80	73	-56	6	90	4
Kane County	69	11	19	88	-50	6	90	4
Shelby County	59	8	6	56	-25	6	90	4
Brown County	50	-1	27	58	-20	5	91	4
Calhoun County	62	8	17	39	-19	6	91	4
Piatt County	69	3	13	83	-27	7	91	4
Carroll County	63	8	9	66	-23	8	92	4
Jo Daviess County	66	6	14	69	-24	7	92	4
McHenry County	73	4	19	94	-32	8	92	4
Woodford County	70	10	20	77	-36	8	92	4

DuPage County	90	22	30	91	-58	12	93	4
Morgan County	56	2	43	67	-29	8	94	4
Hancock County	61	11	10	54	-17	9	95	4
Jackson County	56	7	100	66	-63	9	95	4
McLean County	69	4	66	84	-43	10	95	4
Johnson County	55	22	12	38	-30	10	97	4
Warren County	61	7	45	66	-25	11	98	4
Bond County	51	4	46	65	-25	10	99	4
Champaign County	65	10	96	84	-58	13	99	4
DeKalb County	60	5	72	86	-40	12	100	4
Kendall County	69	11	14	100	-23	14	100	4