



Differential Growth of Covid-19 in Illinois Counties: A Quantitative Assessment using the Shift Method

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The Illinois Institute for Rural Affairs (IIRA) has been publishing a steady stream of research on Covid-19 for the use of stakeholders such as community economic developers and healthcare practitioners². Most of these publications provide absolute and relative changes in the growth of the virus over time, statistics stakeholders view as important when they examine changes to Covid-19 numbers in their communities³. However, caution should be exercised in the use of these statistics when one is interested in the differential growth of the virus in communities. For example, during June 1, 2020 to June 14, 2020, the number of Covid-19 cases in Pike County increased by 100%, and in Cook County by 8%. In absolute numbers, these represent one new case for Pike County, and 6,411 cases for Cook County. In general, absolute numbers overstate the growth of the virus in larger geographies and understate the growth in smaller communities. In contrast, percentage measures tend to overstate the growth of Covid-19 in smaller regions and understate the growth of the virus in larger regions. The shift method that is used in this paper to assess changes in number of Covid-19 cases in Illinois is touted as a remedy for issues with absolute and percentage change metrics⁴.

The Shift Method

This method has been designed to measure the relative size of the change of a variable compared with a benchmark, for example, a growth norm⁵. To calibrate Covid-19 shift

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² IIRA has published ten papers on the topic since April 4, 2020; see <http://www.iira.org/2020-2021-publications/>

³ Inferred from discussions with a convenience sample of stakeholders.

⁴ See Perloff et al. (1960). *Regions, Resources, and Economic Growth*. Baltimore: The Johns Hopkins Press.

⁵ See Oyewole, P. (2016). Regional Competition in the International Market for Services: A Shift-Share Analysis. *Journal of Global Marketing*, 29(1), 3-14.

indices for Illinois counties, we categorize counties as metro and nonmetro, and for each of these regions, define the following variables:

- (i) Actual change of Covid-19 cases in county i (ΔV_i):

$$V_{i,t} = \text{number of cases of Covid - 19 for county } i \text{ at time } t;$$

$$\Delta V_i = V_{i,t} - V_{i,t-1}.$$

If $\Delta V_i < 0$, the i th county experienced a decline in Covid - 19 cases,
 $\Delta V_i = 0$, the i th county experienced no change in Covid - 19 cases,
 $\Delta V_i > 0$, the i th county experienced an increase in Covid - 19 cases.

- (ii) Total growth rate (K) for the region:

$K = \frac{\sum_{i=1}^m V_{i,t}}{\sum_{i=1}^m V_{i,t-1}}$, where $\sum_{i=1}^m V_{i,t}$ number of cases of Covid-19 for all counties in the region at time period t ; the denominator is the sum of Covid-19 cases in the region at time $t-1$.

- (iii) Expected value ($E(V_i)$ and $E(\Delta V_i)$):

The expected value of Covid-19 cases at time period t for a county in the region is the product of the actual value of Covid-19 cases at time $t-1$ and the rate of change for all the counties in the region (K):

$$E(V_{i,t}) = KV_{i,t-1}.$$

The expected change in the value of Covid-19 is the difference between $E(V_{i,t})$ and $V_{i,t-1}$; formally:

$$\begin{aligned} E(\Delta V_i) &= E(V_{i,t}) - V_{i,t-1} \\ &= V_{i,t-1}(K - 1) \end{aligned}$$

- (iv) Net Shift in Covid-19 cases for county i (N_i):

It is the difference between actual and expected change in number of Covid-19 cases:

$$N_i = \Delta V_i - E(\Delta V_i)$$

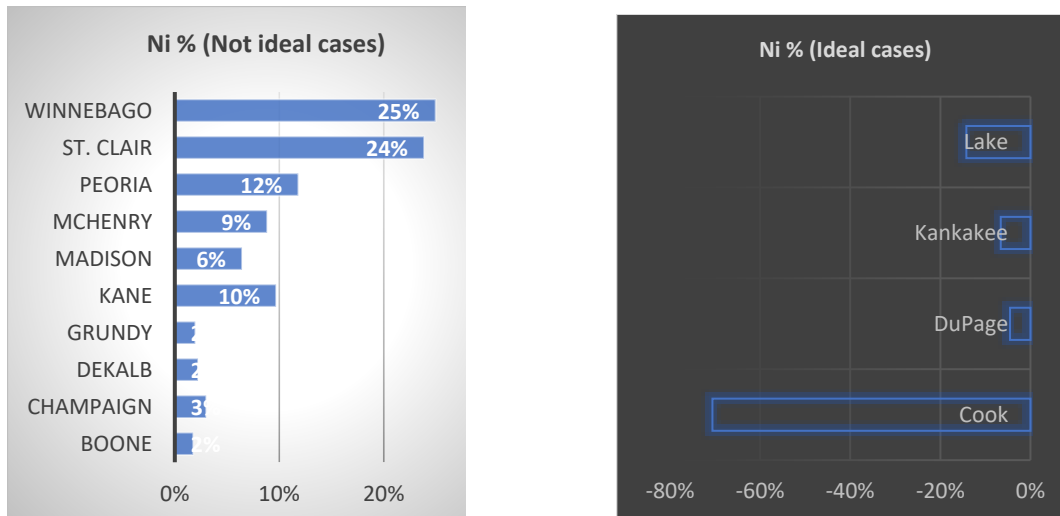
Percentage net shift is the relative increase or decrease in Covid-19 cases for a particular county (see Table 1).

To calibrate net shift metrics for Illinois, we classify each of the 102 counties as metro or nonmetro, calculate change norms (see the metrics for *K* above), and compute net shift scores. In all, 61 counties were classified as nonmetro, and 41 as metro⁶.

Results

During the period June 1, 2020 to June 14, 2020, the total absolute increase in Covid-19 cases for the metro region was 10,857; nonmetro counties witnessed 334 new cases. The percentage increase for the metro was 9%, 12% for the nonmetro. Table 1 shows the expected number of Covid-19 cases for the counties. In the metro region, 13 counties registered less-than-expected number of cases; these counties are containing the spread. Of the remaining 28 metro counties with more than expected number of Covid-19 cases, Winnebago, St. Clair, Peoria, and Kane counties register the most deviation from the expected number of cases; deviations range from a low 10% for Kane and a high 25% for Winnebago. Figure 1 shows the distribution of variation in percentage net shift across metro counties, only counties with $\pm 2\%$ net shift scores are shown⁷.

Figure 1. Variation in Percentage Net Shift: Metro Counties

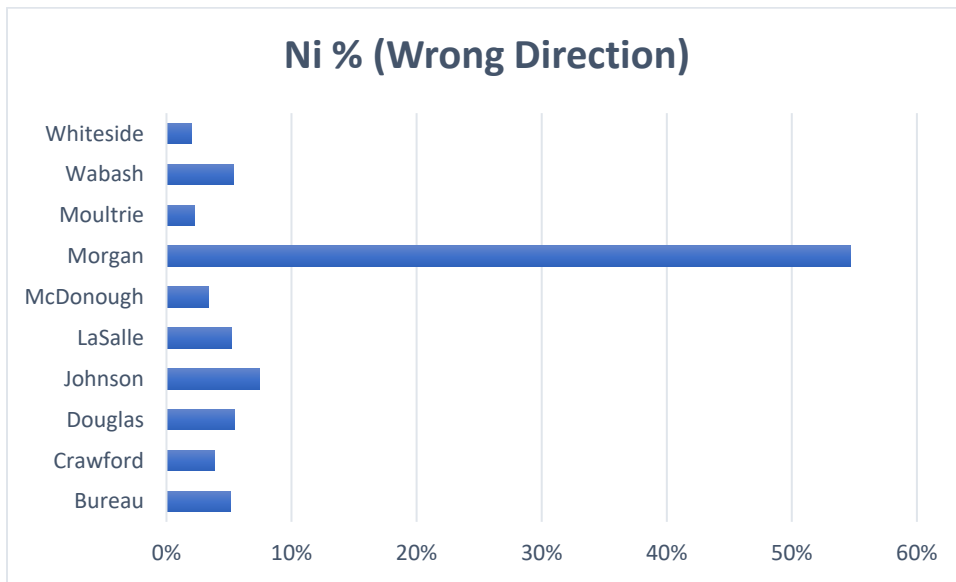


⁶ See https://www.ers.usda.gov/webdocs/DataFiles/53180/25568_IL.pdf?v=39329.

⁷ The median net shift score of 2% was used to choose counties for display.

In the nonmetro, some of the not-so-ideal cases, that is, counties with more Covid-19 cases than predicted by the net-shift analysis, had outbreaks in long-term care facilities⁸ (for example, Morgan, and McDonough; see Figure 2). In general, the virus growth in a majority of the nonmetro counties (84%) is contained; Randolph County is a case in point, the county's actual number of Covid-19 cases were 21% lower than the expected number.

Figure 2. Variation in Percentage Net Shift: Nonmetro Counties with Higher than Expected Number of Covid-19 Cases



Conclusion

This paper was designed to alert economic development practitioners about pitfalls in comparing communities' Covid-19 cases using absolute and/or relative measures of change; the net shift method is recommended for such comparisons. Net shift computations involve measuring the relative size of increases or decreases in Covid-19 cases in counties vis-à-vis the regional norm.

⁸ See <https://www.dph.illinois.gov/covid19/long-term-care-facility-outbreaks-covid-19>

Table 1: Covid-19 Cases: Absolute Change and Net Shift from June 1, 2020 to June 14, 2020

Metro County	No. of Cases: June 1, 2020	No. of Cases: June 14, 2020	Actual Change (Δv_i)	Expected Change ($E(\Delta v_i)$)	Net Shift (N_i)	Scaled N_i % ⁹
Alexander	8	17	9	1	8	1%
Bond	12	12	0	1	-1	0%
Boone	463	524	61	42	19	2%
Calhoun	1	1	0	0	0	0%
Champaign	646	737	91	59	32	3%
Clinton	186	209	23	17	6	1%
Cook	78495	84906	6411	7164	-753	-71%
DeKalb	431	494	63	39	24	2%
DeWitt	4	4	0	0	0	0%
DuPage	7773	8434	661	709	-48	-5%
Ford	20	22	2	2	0	0%
Grundy	99	129	30	9	21	2%
Henry	69	72	3	6	-3	0%
Jackson	289	315	26	26	0	0%
Jersey	24	28	4	2	2	0%
Kane	6461	7154	693	590	103	10%
Kankakee	1186	1224	38	108	-70	-7%
Kendall	832	906	74	76	-2	0%
Lake	8456	9076	620	772	-152	-14%
Macon	195	209	14	18	-4	0%
Macoupin	45	46	1	4	-3	0%
Madison	597	720	123	54	69	6%
Marshall	5	5	0	0	0	0%
McHenry	1608	1849	241	147	94	9%
McLean	220	241	21	20	1	0%
Menard	21	22	1	2	-1	0%
Mercer	17	19	2	2	0	0%
Monroe	96	109	13	9	4	0%
Peoria	241	389	148	22	126	12%
Piatt	12	12	0	1	-1	0%
Rock Island	700	779	79	64	15	1%
Sangamon	356	378	22	32	-10	-1%
St. Clair	1257	1626	369	115	254	24%
Stark	3	3	0	0	0	0%
Tazewell	74	91	17	7	10	1%
Vermilion	40	44	4	4	0	0%
Will	5641	6140	499	515	-16	-1%
Williamson	67	83	16	6	10	1%
Winnebago	2290	2765	475	209	266	25%
Woodford	22	25	3	2	1	0%

⁹ $N_i \% = \frac{N_i}{S} \times 100$, where, $S = \frac{\sum_{Region} |\Delta v_i - E(\Delta v_i)|}{2}$

Nonmetro County	No. of Cases: June 1, 2020	No. of Cases: June 14, 2020	Actual Change (Δv_i)	Expected Change ($E(\Delta v_i)$)	Net Shift (N_i)	NI %
Adams	45	46	1	6	-5	-4%
Brown	11	11	0	1	-1	-1%
Bureau	15	23	8	2	6	5%
Carroll	16	19	3	2	1	1%
Cass	73	77	4	9	-5	-4%
Christian	35	37	2	4	-2	-2%
Clark	11	13	2	1	1	1%
Clay	3	3	0	0	0	0%
Coles	127	142	15	16	-1	0%
Crawford	11	17	6	1	5	4%
Cumberland	10	10	0	1	-1	-1%
Douglas	28	38	10	3	7	5%
Edgar	1	1	0	0	0	0%
Edwards	2	2	0	0	0	0%
Effingham	7	8	1	1	0	0%
Fayette	21	22	1	3	-2	-1%
Franklin	12	12	0	1	-1	-1%
Fulton	11	12	1	1	0	0%
Gallatin	2	2	0	0	0	0%
Greene	5	7	2	1	1	1%
Hamilton	3	3	0	0	0	0%
Hancock	17	18	1	2	-1	-1%
Hardin	1	1	0	0	0	0%
Henderson	8	8	0	1	-1	-1%
Iroquois	132	137	5	16	-11	-9%
Jasper	48	48	0	6	-6	-5%
Jefferson	101	104	3	12	-9	-8%
Jo Daviess	32	34	2	4	-2	-2%
Johnson	9	19	10	1	9	7%
Knox	101	113	12	12	0	0%
LaSalle	153	178	25	19	6	5%
Lawrence	4	4	0	0	0	0%
Lee	81	89	8	10	-2	-2%
Livingston	34	39	5	4	1	1%
Logan	11	11	0	1	-1	-1%
Marion	50	55	5	6	-1	-1%
Mason	18	18	0	2	-2	-2%
Massac	7	7	0	1	-1	-1%
McDonough	89	104	15	11	4	3%
Montgomery	39	41	2	5	-3	-2%
Morgan	36	106	70	4	66	55%
Moultrie	11	15	4	1	3	2%
Ogle	218	231	13	27	-14	-11%
Perry	42	44	2	5	-3	-3%
Pike	1	2	1	0	1	1%
Pope	1	1	0	0	0	0%
Pulaski	56	61	5	7	-2	-2%

Nonmetro County	No. of Cases: June 1, 2020	No. of Cases: June 14, 2020	Actual Change (Δv_i)	Expected Change ($E(\Delta v_i)$)	Net Shift (Ni)	NI %
Putnam	2	2	0	0	0	0%
Randolph	270	278	8	33	-25	-21%
Richland	3	4	1	0	1	1%
Saline	7	7	0	1	-1	-1%
Schuyler	13	13	0	2	-2	-1%
Shelby	16	16	0	2	-2	-2%
Stephenson	209	231	22	26	-4	-3%
Union	155	174	19	19	0	0%
Wabash	5	12	7	1	6	5%
Warren	117	127	10	14	-4	-4%
Washington	18	20	2	2	0	0%
Wayne	11	11	0	1	-1	-1%
White	2	3	1	0	1	1%
Whiteside	143	163	20	18	2	2%