

**NSF CNH-Ex #1114931 Political Fragmentation Indicator Database
(Version 3.01)**

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NSF CNH-Ex #1114931 Project Team

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Introduction

This document is designed to provide a concise explanation of the political fragmentation indicator database (version 3.01), as an outcome of the NSF CNH-Ex #1114931: *Political Fragmentation in Local Governance and Water Resource Management* project. Database users should read this document in order to avoid any possible misuse or misinterpretation of the fragmentation indicator values in the database which are calculated primarily for the NSF CNH-Ex project. In particular, it should be noted that the data outside of the project's study area (i.e., the Interior Plains, demonstrated in figure 1) need to be carefully used, although the database covers the entire conterminous U.S. including 48 states and the District of Columbia.



Figure 1. Study Area: The Interior Plains

Since the database contains a variety of metric, representing the varying degrees of political fragmentation at multiple geographic scales, this document first describes the geographical scales and key approaches to measuring the political fragmentation for empirical research on the relationship between institutional settings (i.e., political fragmentation) and the effectiveness of natural resource management. Then, detailed descriptions of individual metrics and data sources follow. In addition, a set of correlation analysis outcomes is presented to show how the metrics are interrelated with each other (at a single geographical scale or over the hierarchy) to promote appropriate uses of the data with the consideration of the interrelationships among the indicators.

Geographical Scales

In the literature, political fragmentation in local governance has been typically defined and measured at aggregate levels, such as state and metropolitan area scales (see e.g., Bluestone 2008; Yeung 2009; Hendrick et al. 2011; Kim and Jurey, 2013). Although such aggregate-level metrics may be adequate for the examination of the political fragmentation's effects on the overall fiscal, economic, and social conditions in the regions (i.e., states or metropolitan areas), the metrics have limited usefulness in conducting a more spatially-explicit analysis, as they do not consider the spatial variation of the fragmentation within each region. Therefore, in the NSF CNH-Ex #1114931 project, site-specific fragmentation indicators have been employed, in addition to the traditional regional variables. More specifically, political fragmentation is measured at the following geographical scales:

- 1) Regional
 - i. State
 - ii. Economic Areas, defined by the US Bureau of Economic Analysis (BEA)
 - iii. Metropolitan Statistical Areas (MSA)
 - iv. County
- 2) Site-scale: 12-digit watershed

In the database file (i.e., NSF-CNH-EX1114931_PFI-DB_Ver3-01.accdb), each data table contains the fragmentation indicator values at each geographic scale. More specifically, *ST-scale*, *EA-scale*, *MSA-scale*, *CTY-scale*, and *HUC12-scale* tables provide the data ranging from states to 12-digit watersheds, respectively.¹ Another table, titled *ScaleBridgeTable*, is included to support the vertical integration of the data by presenting where a particular small site (i.e., 12-digit watershed) is located in terms of the upper scales.

Since the project attempts to examine the effects of political fragmentation in early 1990s (with an extensive use of 1992 Census of Governments data) on the resource management outcomes in following time periods, 1993 Office of Management and Budget (OMB) definitions of the MSAs (i.e., and 1995 BEA Economic Areas delineation are adopted. Regarding the MSA scale, it also needs to be noted that the New England metropolitan area delineations, as opposed to ordinary MSA boundaries, are utilized for the areas in the New England region to avoid the issue of the partially included counties. Furthermore, the counties, which are not included in any metropolitan areas, are grouped together in each state, and regarded as a metropolitan equivalent area to assign the MSA-level fragmentation indicator values to those rural places. In the database, each of these areas has a unique 6-digit identification number, structured as below.

- 1) MSAs or New England MSAs: "00" + 4-digit MSA/CMSA FIPS or 4-digit New England metropolitan area code (e.g., Wichita, KS MSA: 009040)
- 2) Non-metro areas: 2-digit state FIPS code + "9999" (e.g., Non-metro counties in Kansas: 209999)

¹ In addition to the political indicators, *HUC12-scale* table provides a set of land cover composition metrics, calculated through an area tabulation of the USGS NLCD (National Land Cover Database) 1992/2001 Retrofit Land Cover Change data.

Measurement Strategies

The NSF CNH-Ex #1114931 project utilizes various approaches to measuring political fragmentation at multiple geographical scales. For the regional scales (i.e., state, BEA economic areas, MSAs, and counties), it uses both a) traditional government counting approaches (see e.g., Hawkins and Dye 1970; Schneider 1986; Eberts and Gronberg 1988) and b) relatively more sophisticated diversification indexes that quantify the power distribution among government bodies in each region with the use of government expenditure data (see e.g., Grassmueck and Shields 2010; Hendrick et al. 2011; Lewis and Hamilton 2011), as follows.

1-A. Traditional government counting approaches

: One of the simplest, but powerful approaches to measuring political fragmentation is counting the number of local government units in each region (the more governments are, the more fragmented the local governance structure is). Although these approaches seem very straightforward at first glance, there are a few things to be carefully considered. Among others, counting the absolute number of government units may be problematic, as it does not consider different sizes of population or resources to be managed in different regions. In many cases, it would be better to normalize the number of government units by population or land areas of the regions. Another critical issue involved in these approaches is what kinds of government units need to be counted. One could consider all types of local governments, while some others may want to consider only general purpose government units (e.g., municipalities, townships, and counties). Given the issues, the present database takes a comprehensive approach and includes twelve (3×4) count variables by considering the following three choices of normalization and four selection criteria of government units at each regional scale.

- Normalization Options
 - i. no normalization (i.e., using the absolute number of government units)
 - ii. per thousand residents
 - iii. per squared miles
- Government unit selection criteria
 - i. all government units
 - ii. general purpose governments only
 - iii. special purpose governments only
 - iv. municipalities (i.e., incorporated places) only

Be advised that the government unit counting is conducted based upon 1992 Census of Governments data. Detailed descriptions of individual variables are provided in the next section of this document.

1-B. Diversification indexes

: Although the traditional counting approaches are simple and useful, they are somewhat limited in the sense that government units are equally treated (i.e., being counted as one unit) regardless of their sizes. In reality, political powers are not evenly distributed, and capturing the variation in the power distribution would be critical in representing the real political fragmentation in local governance. Therefore, this fragmentation indicator database employs two

diversification indexes that represent the level of power concentration (less fragmented) or dispersion (more fragmented) with the use of government expenditure information from 1992 Census of Governments. The first one is the Hirschman-Herfindahl index (HHI), designed to quantify the degree of the power balance among local governments within each region, as below (see p.646~647, Grassmueck and Shields 2010).

$$HHI_i = \sum_{j=1}^n \left(\frac{E_{ij}}{TE_i} \right)^2$$

where E_{ij} and TE_i represent the level of expenditure of government unit j in region i and the total government expenditure in region i , respectively, and n is the number of governmental units in the region. This index can have a value between $1/n$ and 1. A higher value indicates a lower level of fragmentation (i.e., expenditures are dominated by one or few local government bodies rather than being evenly distributed). Another index is the Power Diffusion Index (PDI) defined as follows.

$$PDI_i = \sum_{j=1}^n \left(\frac{E_{ij}}{TE_i} \right)^{1/2}$$

This index “gives greater value to the smaller players in government by taking the square root of the proportion of expenditures per government unit j in ... [region] i , while the [HH index] ... gives greater value to the larger players by squaring the proportion of expenditures. One advantage of using both [indexes] ... to measure vertical and horizontal government fragmentation is the ability to further investigate whether larger or smaller government units within a ... [region] in terms of expenditure amounts exert more influence” (p.647, Grassmueck and Shields 2010).

The present database also employs multiple strategies for measuring the political fragmentation at the site-scale (i.e., 12-digit watersheds). More specifically, the following four types of measurements are used: a) number of the intersected political units, b) mean section’s distance to the closest incorporated place, c) entropy indexes, and d) presence of the water resource management districts.

2-A. Number of the intersected political units

First, similar to regional scale measurements, an attempt is made to determine how many government units are involved in each watershed. This is accomplished by overlaying the USDA watershed shapefile and Census boundary files, and calculating the number of the intersected political units in individual 12-digit watersheds. As shown in the data tables, a considerable number of watersheds are found to be shared by more than several incorporated cities or towns, while there are numerous watersheds which are not intersected with any municipal unit.

2-B. Mean section’s distance to the closest incorporated place

Another spatially-explicit indicator included in the database is the mean section’s (1mile×1mile land area) distance to the closest incorporated place. This measurement is designed to discern different spatial positions of different

watersheds.

$$MSDIST = \sum_{k=1}^n \frac{minDist_k}{n}$$

where $minDist_k$ indicates the k -th section's distance to the closet incorporated city or town, and n is the number of sections in each 12-digit watershed (note that n varies by watersheds). The $MSDIST$ value will be small, if a watershed is surrounded by municipalities rather than out-positioned, and thus more likely to be under the influence of local political settings.

2-C. Entropy indexes

To represent the micro-level political power balance, the database utilizes the concept of entropy, originally developed in the field of thermodynamics, and further used in urban and regional studies (see e.g., Wilson 1970; Cervero 1989; Krizek 2003). In detail, the following entropy (i.e., ENT) and a modified entropy index (i.e., $ENTD2$), in which consideration is given to the three nearest municipalities (i.e., incorporated cities or towns) from each watershed, are utilized (see Kim and Hewings 2013 for more detailed explanations of these indexes).

$$ENT = \sum_{j=1}^3 \frac{-p_j \cdot \ln(p_j)}{\ln(3)} \quad \text{where } p_j = \frac{\left(\frac{1}{dist_j}\right)^2}{\sum_{j=1}^3 \left(\frac{1}{dist_j}\right)^2}$$

$$ENTD2 = ENT \cdot \left(\frac{1}{1 + dist_j}\right)^2$$

where $dist_j$ indicates the Euclidian distance between each watershed and j -th closest locality. The indexes, having the range of values between 0 and 1, can capture the level of power balances among three nearest jurisdictions. A higher value of the indexes indicates a more evenly balanced distribution of powers (i.e., a higher degree of political fragmentation). It needs to be noted that the search of the three closest localities is limited by 20-mile radius in calculating these index values. In other words, if a watershed has less than three municipalities within its 20-mile radius, the index value computation considers a fewer number of municipalities.

2-D. Presence of the water resource management district

This group of measurements is traditional dummy variables, designed to identify the presence of a formalized institution, responsible for the management of water resources. For these metrics, 1992 Census of Governments is utilized, given the absence of the source of relevant watershed-level information across states. Specifically, first special districts for water resource management are identified from the Census of Governments dataset along with their annual spending information and the counties in which the special districts were mainly based in the survey year (i.e., Year 1992). Then, if a watershed (or the majority part of the watershed in terms of physical area) is included in the counties with the water management districts or similar units, 1 is assigned, otherwise 0.

Variables: Descriptions & Data Sources

Table 1 presents all variables contained in the political fragmentation database (i.e., NSF-CNH-EX1114931_PFI-DB_Ver3-01.accdb). The following is a list of major data sources.

- 1992CoGov: 1992 Census of Governments
- BEA-REIS: Regional Economic Information System, provided by U.S. BEA
- DC: Decennial Censuses
- USDA-WBD: USDA Watershed Boundary Dataset
- Census-BF: Census Boundary Files
- NLCD92/01: USGS NLCD 1992/2001 Retrofit Land Cover Change Dataset

Table 1. List of the Variables

Scale	Variable	Description	Data Sources
State level	<i>STFIPS</i>	State FIPS code	-
	<i>ST_GOVALL</i>	Number of total government units in the state	1992CoGov
	<i>ST_GOVG</i>	Number of general purpose government units in the state	1992CoGov
	<i>ST_GOV5</i>	Number of special purpose government units in the state	1992CoGov
	<i>ST_GOVm</i>	Number of municipalities (i.e., incorporated places) in the state	1992CoGov
	<i>ST_PCGOALL</i>	Number of total government units per 1000 residents in the state	1992CoGov; BEA-REIS
	<i>ST_PCGOVG</i>	Number of general purpose government units per 1000 residents in the state	1992CoGov; BEA-REIS
	<i>ST_PCGOV5</i>	Number of special purpose government units per 1000 residents in the state	1992CoGov; BEA-REIS
	<i>ST_PCGOVm</i>	Number of municipalities (i.e., incorporated places) per 1000 residents in the state	1992CoGov; BEA-REIS
	<i>ST_PAGOALL</i>	Number of total government units per squared miles in the state	1992CoGov; DC
	<i>ST_PAGOVG</i>	Number of general purpose government units per squared miles in the state	1992CoGov; DC
	<i>ST_PAGOV5</i>	Number of special purpose government units per squared miles in the state	1992CoGov; DC
	<i>ST_PAGOVm</i>	Number of municipalities (i.e., incorporated places) per squared miles in the state	1992CoGov; DC
	<i>ST_PDIALLTR</i>	PDI Index based upon the total revenue distribution of the entire government units in the state	1992CoGov
	<i>ST_PDIGTR</i>	PDI Index based upon the total revenue distribution of the general purpose government units in the state	1992CoGov
	<i>ST_PDISTR</i>	PDI Index based upon the total revenue distribution of the special purpose government units in the state	1992CoGov
	<i>ST_PDIMTR</i>	PDI Index based upon the total revenue distribution of the municipalities (i.e., incorporated places) in the state	1992CoGov
	<i>ST_PDIALLTE</i>	PDI Index based upon the total expenditure distribution of the entire government units in the state	1992CoGov
	<i>ST_PDIGTE</i>	PDI Index based upon the total expenditure distribution of the general purpose government units in the state	1992CoGov
	<i>ST_PDISTE</i>	PDI Index based upon the total expenditure distribution of the special purpose government units in the state	1992CoGov
	<i>ST_PDIMTE</i>	PDI Index based upon the total expenditure distribution of the municipalities (i.e., incorporated places) in the state	1992CoGov
	<i>ST_HHIALLTR</i>	HH Index based upon the total revenue distribution of the entire government units in the state	1992CoGov
	<i>ST_HHIGTR</i>	HH Index based upon the total revenue distribution of the general purpose government units in the state	1992CoGov
	<i>ST_HHISTR</i>	HH Index based upon the total revenue distribution of the special purpose government units in the state	1992CoGov
	<i>ST_HHIMTR</i>	HH Index based upon the total revenue distribution of the municipalities (i.e., incorporated places) in the state	1992CoGov
	<i>ST_HHIALLTE</i>	HH Index based upon the total expenditure distribution of the entire government units in the state	1992CoGov
<i>ST_HHIGTE</i>	HH Index based upon the total expenditure distribution of the general purpose government units in the state	1992CoGov	
<i>ST_HHISTE</i>	HH Index based upon the total expenditure distribution of the special purpose government units in the state	1992CoGov	
<i>ST_HHIMTE</i>	HH Index based upon the total expenditure distribution of the municipalities (i.e., incorporated places) in the state	1992CoGov	

Table 1. List of the Variables (Cont.)

Scale	Variable	Description	Data Sources
BEA Economic Area level	BEA_EA95	US BEA (Bureau of Economic Analysis) 1995 Economic Area code	-
	EA_GOVALL	Number of total government units in the economic area	1992CoGov
	EA_GOVG	Number of general purpose government units in the economic area	1992CoGov
	EA_GOV5	Number of special purpose government units in the economic area	1992CoGov
	EA_GOVM	Number of municipalities (i.e., incorporated places) in the economic area	1992CoGov
	EA_PCGOALL	Number of total government units per 1000 residents in the economic area	1992CoGov; BEA-REIS
	EA_PCGOVG	Number of general purpose government units per 1000 residents in the economic area	1992CoGov; BEA-REIS
	EA_PCGOV5	Number of special purpose government units per 1000 residents in the economic area	1992CoGov; BEA-REIS
	EA_PCGOVM	Number of municipalities (i.e., incorporated places) per 1000 residents in the economic area	1992CoGov; BEA-REIS
	EA_PAGOALL	Number of total government units per squared miles in the economic area	1992CoGov; DC
	EA_PAGOVG	Number of general purpose government units per squared miles in the economic area	1992CoGov; DC
	EA_PAGOVS	Number of special purpose government units per squared miles in the economic area	1992CoGov; DC
	EA_PAGOVM	Number of municipalities (i.e., incorporated places) per squared miles in the economic area	1992CoGov; DC
	EA_PDIALLTR	PDI Index based upon the total revenue distribution of the entire government units in the economic area	1992CoGov
	EA_PDIGTR	PDI Index based upon the total revenue distribution of the general purpose government units in the economic area	1992CoGov
	EA_PDISTR	PDI Index based upon the total revenue distribution of the special purpose government units in the economic area	1992CoGov
	EA_PDIMTR	PDI Index based upon the total revenue distribution of the municipalities (i.e., incorporated places) in the economic area	1992CoGov
	EA_PDIALLTE	PDI Index based upon the total expenditure distribution of the entire government units in the economic area	1992CoGov
	EA_PDIGTE	PDI Index based upon the total expenditure distribution of the general purpose government units in the economic area	1992CoGov
	EA_PDISTE	PDI Index based upon the total expenditure distribution of the special purpose government units in the economic area	1992CoGov
	EA_PDIMTE	PDI Index based upon the total expenditure distribution of the municipalities (i.e., incorporated places) in the economic area	1992CoGov
	EA_HHIALLTR	HH Index based upon the total revenue distribution of the entire government units in the economic area	1992CoGov
	EA_HHIGTR	HH Index based upon the total revenue distribution of the general purpose government units in the economic area	1992CoGov
	EA_HHISTR	HH Index based upon the total revenue distribution of the special purpose government units in the economic area	1992CoGov
	EA_HHIMTR	HH Index based upon the total revenue distribution of the municipalities (i.e., incorporated places) in the economic area	1992CoGov
	EA_HHIALLTE	HH Index based upon the total expenditure distribution of the entire government units in the economic area	1992CoGov
	EA_HHIGTE	HH Index based upon the total expenditure distribution of the general purpose government units in the economic area	1992CoGov
	EA_HHISTE	HH Index based upon the total expenditure distribution of the special purpose government units in the economic area	1992CoGov
EA_HHIMTE	HH Index based upon the total expenditure distribution of the municipalities (i.e., incorporated places) in the economic area	1992CoGov	

Table 1. List of the Variables (Cont.)

Scale	Variable	Description	Data Sources
MSA level	<i>MSA90ID</i>	6-digit 1990 Metropolitan Statistical Area code	-
	<i>MSA_GOVALL</i>	Number of total government units in the MSA	1992CoGov
	<i>MSA_GOVG</i>	Number of general purpose government units in the MSA	1992CoGov
	<i>MSA_GOV5</i>	Number of special purpose government units in the MSA	1992CoGov
	<i>MSA_GOVM</i>	Number of municipalities (i.e., incorporated places) in the MSA	1992CoGov
	<i>MSA_PCGOVALL</i>	Number of total government units per 1000 residents in the MSA	1992CoGov; BEA-REIS
	<i>MSA_PCGOVG</i>	Number of general purpose government units per 1000 residents in the MSA	1992CoGov; BEA-REIS
	<i>MSA_PCGOV5</i>	Number of special purpose government units per 1000 residents in the MSA	1992CoGov; BEA-REIS
	<i>MSA_PCGOVM</i>	Number of municipalities (i.e., incorporated places) per 1000 residents in the MSA	1992CoGov; BEA-REIS
	<i>MSA_PAGOVALL</i>	Number of total government units per squared miles in the MSA	1992CoGov; DC
	<i>MSA_PAGOVG</i>	Number of general purpose government units per squared miles in the MSA	1992CoGov; DC
	<i>MSA_PAGOVS</i>	Number of special purpose government units per squared miles in the MSA	1992CoGov; DC
	<i>MSA_PAGOVM</i>	Number of municipalities (i.e., incorporated places) per squared miles in the MSA	1992CoGov; DC
	<i>MSA_PDIALLTR</i>	PDI Index based upon the total revenue distribution of the entire government units in the MSA	1992CoGov
	<i>MSA_PDIGTR</i>	PDI Index based upon the total revenue distribution of the general purpose government units in the MSA	1992CoGov
	<i>MSA_PDISTR</i>	PDI Index based upon the total revenue distribution of the special purpose government units in the MSA	1992CoGov
	<i>MSA_PDIMTR</i>	PDI Index based upon the total revenue distribution of the municipalities (i.e., incorporated places) in the MSA	1992CoGov
	<i>MSA_PDIALLTE</i>	PDI Index based upon the total expenditure distribution of the entire government units in the MSA	1992CoGov
	<i>MSA_PDIGTE</i>	PDI Index based upon the total expenditure distribution of the general purpose government units in the MSA	1992CoGov
	<i>MSA_PDISTE</i>	PDI Index based upon the total expenditure distribution of the special purpose government units in the MSA	1992CoGov
	<i>MSA_PDIMTE</i>	PDI Index based upon the total expenditure distribution of the municipalities (i.e., incorporated places) in the MSA	1992CoGov
	<i>MSA_HHIALLTR</i>	HH Index based upon the total revenue distribution of the entire government units in the MSA	1992CoGov
	<i>MSA_HHIGTR</i>	HH Index based upon the total revenue distribution of the general purpose government units in the MSA	1992CoGov
	<i>MSA_HHISTR</i>	HH Index based upon the total revenue distribution of the special purpose government units in the MSA	1992CoGov
	<i>MSA_HHIMTR</i>	HH Index based upon the total revenue distribution of the municipalities (i.e., incorporated places) in the MSA	1992CoGov
	<i>MSA_HHIALLTE</i>	HH Index based upon the total expenditure distribution of the entire government units in the MSA	1992CoGov
<i>MSA_HHIGTE</i>	HH Index based upon the total expenditure distribution of the general purpose government units in the MSA	1992CoGov	
<i>MSA_HHISTE</i>	HH Index based upon the total expenditure distribution of the special purpose government units in the MSA	1992CoGov	
<i>MSA_HHIMTE</i>	HH Index based upon the total expenditure distribution of the municipalities (i.e., incorporated places) in the MSA	1992CoGov	

Table 1. List of the Variables (Cont.)

Scale	Variable	Description	Data Sources
County level	<i>CTYFIPS_BEA</i>	5-digit County FIPS code (BEA-REIS coding system)	
	<i>CTY_GOVALL</i>	Number of total government units in the county	1992CoGov
	<i>CTY_GOVG</i>	Number of general purpose government units in the county	1992CoGov
	<i>CTY_GOVSV</i>	Number of special purpose government units in the county	1992CoGov
	<i>CTY_GOVMM</i>	Number of municipalities (i.e., incorporated places) in the county	1992CoGov
	<i>CTY_PCGOVALL</i>	Number of total government units per 1000 residents in the county	1992CoGov; BEA-REIS
	<i>CTY_PCGOVG</i>	Number of general purpose government units per 1000 residents in the county	1992CoGov; BEA-REIS
	<i>CTY_PCGOVSV</i>	Number of special purpose government units per 1000 residents in the county	1992CoGov; BEA-REIS
	<i>CTY_PCGOVMM</i>	Number of municipalities (i.e., incorporated places) per 1000 residents in the county	1992CoGov; BEA-REIS
	<i>CTY_PAGOVALL</i>	Number of total government units per squared miles in the county	1992CoGov; DC
	<i>CTY_PAGOVG</i>	Number of general purpose government units per squared miles in the county	1992CoGov; DC
	<i>CTY_PAGOVSV</i>	Number of special purpose government units per squared miles in the county	1992CoGov; DC
	<i>CTY_PAGOVMM</i>	Number of municipalities (i.e., incorporated places) per squared miles in the county	1992CoGov; DC
	<i>CTY_PDIALLTR</i>	PDI Index based upon the total revenue distribution of the entire government units in the county	1992CoGov
	<i>CTY_PDIGTR</i>	PDI Index based upon the total revenue distribution of the general purpose government units in the county	1992CoGov
	<i>CTY_PDISTR</i>	PDI Index based upon the total revenue distribution of the special purpose government units in the county	1992CoGov
	<i>CTY_PDIMTR</i>	PDI Index based upon the total revenue distribution of the municipalities (i.e., incorporated places) in the county	1992CoGov
	<i>CTY_PDIALLTE</i>	PDI Index based upon the total expenditure distribution of the entire government units in the county	1992CoGov
	<i>CTY_PDIGTE</i>	PDI Index based upon the total expenditure distribution of the general purpose government units in the county	1992CoGov
	<i>CTY_PDISTE</i>	PDI Index based upon the total expenditure distribution of the special purpose government units in the county	1992CoGov
	<i>CTY_PDIMTE</i>	PDI Index based upon the total expenditure distribution of the municipalities (i.e., incorporated places) in the county	1992CoGov
	<i>CTY_HHIALLTR</i>	HH Index based upon the total revenue distribution of the entire government units in the county	1992CoGov
	<i>CTY_HHIGTR</i>	HH Index based upon the total revenue distribution of the general purpose government units in the county	1992CoGov
	<i>CTY_HHISTR</i>	HH Index based upon the total revenue distribution of the special purpose government units in the county	1992CoGov
	<i>CTY_HHIMTR</i>	HH Index based upon the total revenue distribution of the municipalities (i.e., incorporated places) in the county	1992CoGov
	<i>CTY_HHIALLTE</i>	HH Index based upon the total expenditure distribution of the entire government units in the county	1992CoGov
	<i>CTY_HHIGTE</i>	HH Index based upon the total expenditure distribution of the general purpose government units in the county	1992CoGov
<i>CTY_HHISTE</i>	HH Index based upon the total expenditure distribution of the special purpose government units in the county	1992CoGov	
<i>CTY_HHIMTE</i>	HH Index based upon the total expenditure distribution of the municipalities (i.e., incorporated places) in the county	1992CoGov	

Table 1. List of the Variables (Cont.)

Scale	Variable	Description	Data Sources
12-digit Watershed level	<i>HUC_12</i>	12-digit Watershed code	USDA-WBD
	Political Fragmentation Indicators		
	<i>NUMST</i>	Number of the intersected states	USDA-WBD; Census-BF
	<i>NUMCO</i>	Number of the intersected counties	USDA-WBD; Census-BF
	<i>NUMPL</i>	Number of the intersected municipalities	USDA-WBD; Census-BF
	<i>MSDIST</i>	Mean section's distance to the closest municipality (miles)	USDA-WBD; Census-BF
	<i>ENT</i>	Entropy index of the watershed	USDA-WBD; Census-BF
	<i>ENTD2</i>	Modified entropy index of the watershed	USDA-WBD; Census-BF
	<i>MSENT</i>	Mean section's entropy index	USDA-WBD; Census-BF
	<i>MSENTD2</i>	Mean section's modified entropy index	USDA-WBD; Census-BF
	<i>WDALL</i>	Presence of any water districts located in the county primarily covering the watershed (1: Yes 0: No)	USDA-WBD; Census-BF; 1992CoGov
	<i>WD100+</i>	Presence of water districts with \$100,000+ annual spending located in the county primarily covering the watershed (1: Yes 0: No)	USDA-WBD; Census-BF; 1992CoGov
	Land Cover Compositions		
	<i>LC92_URB</i>	Share of urban (i.e., developed) land in 1992	USDA-WBD; NLCD92/01
	<i>LC92_AG</i>	Share of agricultural land in 1992	USDA-WBD; NLCD92/01
	<i>LC92_FOR</i>	Share of forest land in 1992	USDA-WBD; NLCD92/01
	<i>LC92_WWI</i>	Share of water, wetland, and ice/snow in 1992	USDA-WBD; NLCD92/01
	<i>LC92_OTH</i>	Share of other land covers (including barren and grassland/shrub) in 1992	USDA-WBD; NLCD92/01
	<i>LC01_URB</i>	Share of urban (i.e., developed) land in 2001	USDA-WBD; NLCD92/01
	<i>LC01_AG</i>	Share of agricultural land in 2001	USDA-WBD; NLCD92/01
	<i>LC01_FOR</i>	Share of forest land in 2001	USDA-WBD; NLCD92/01
	<i>LC01_WWI</i>	Share of water, wetland, and ice/snow in 2001	USDA-WBD; NLCD92/01
	<i>LC01_OTH</i>	Share of other land covers (including barren and grassland/shrub) in 2001	USDA-WBD; NLCD92/01

Correlation among Metrics

Since the political fragmentation in local governance has been quantified using a large number of metrics at multiple geographical scales, it is imperative to explore and understand how the various metrics are correlated with each other, particularly when using more than one metrics in a multivariate statistical analysis setting. To support data users, a set of correlation analyses are conducted to reveal the interrelationships among the metrics at a single geographical scale or over the hierarchy; and the analysis outcomes are presented below. Figure 2 demonstrates the analytical framework, adopted here to accomplish the exploration of the correlations among a large number of metrics (defined and measured at five different scales) in a systematic manner. In other words, the correlation calculation has been performed based on the framework with 19 sub-matrices. The correlation values in each sub-matrix are summarized in figure 3.

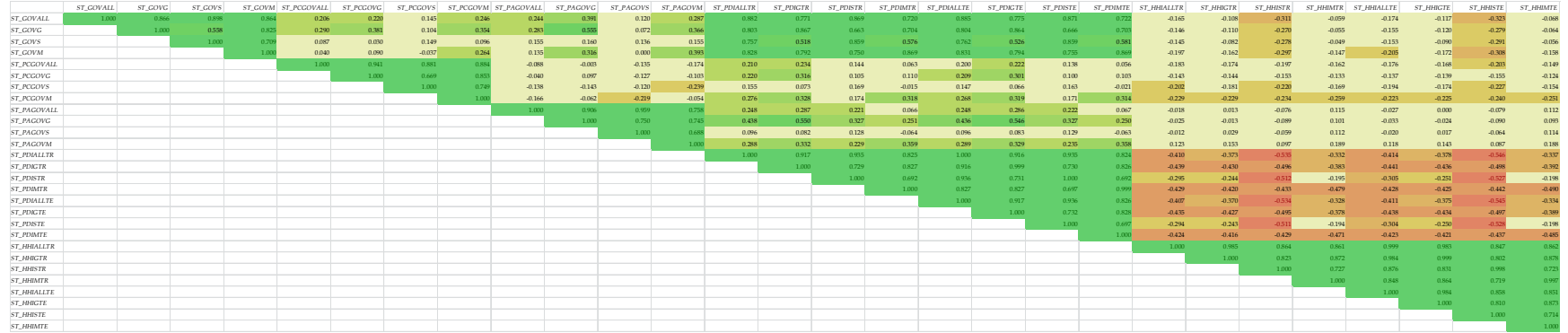
Scales	ST	EA	MSA	CTY	HUC12
ST	1			2	3
EA		4		5	6
MSA			7	8	9
CTY	10	11	12	13	14
HUC12	15	16	17	18	19

Notes:

- **White** (i.e., 1,4,7,13, and 19): Correlations at a single geographical scale
- **Light Grey** (i.e., 2,3,5,6,8,9, and 14): Correlations at a higher scale (by applying the mean values of the lower level metric to the higher summary level)
- **Dark Grey** (i.e., 10,11,12,15,16,17, and 18): Correlations at a lower scale (by applying the values of the higher level metric to the lower summary level)

Figure 2. Analytical Framework for Correlation Analysis

Sub-matrix 1



Sub-matrix 2

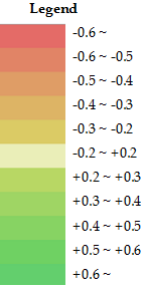
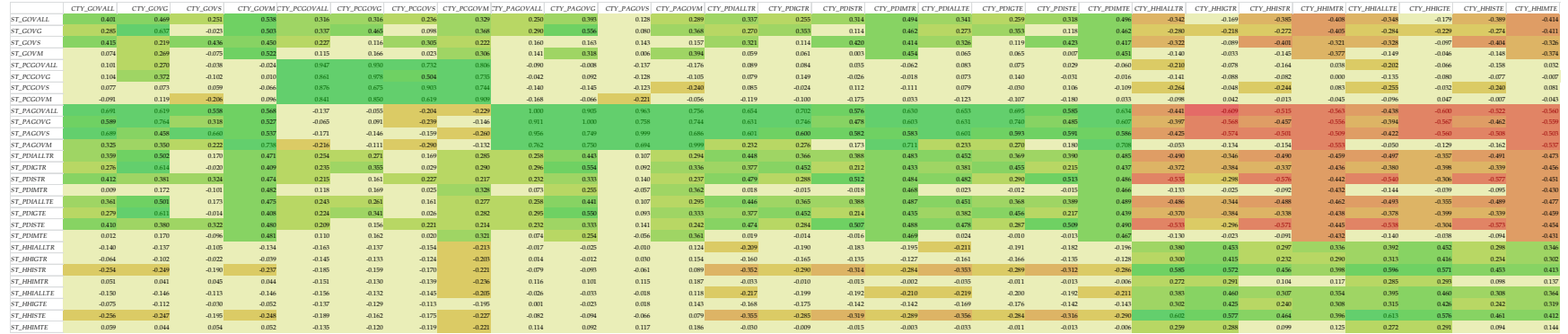


Figure 3. Correlation Values

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