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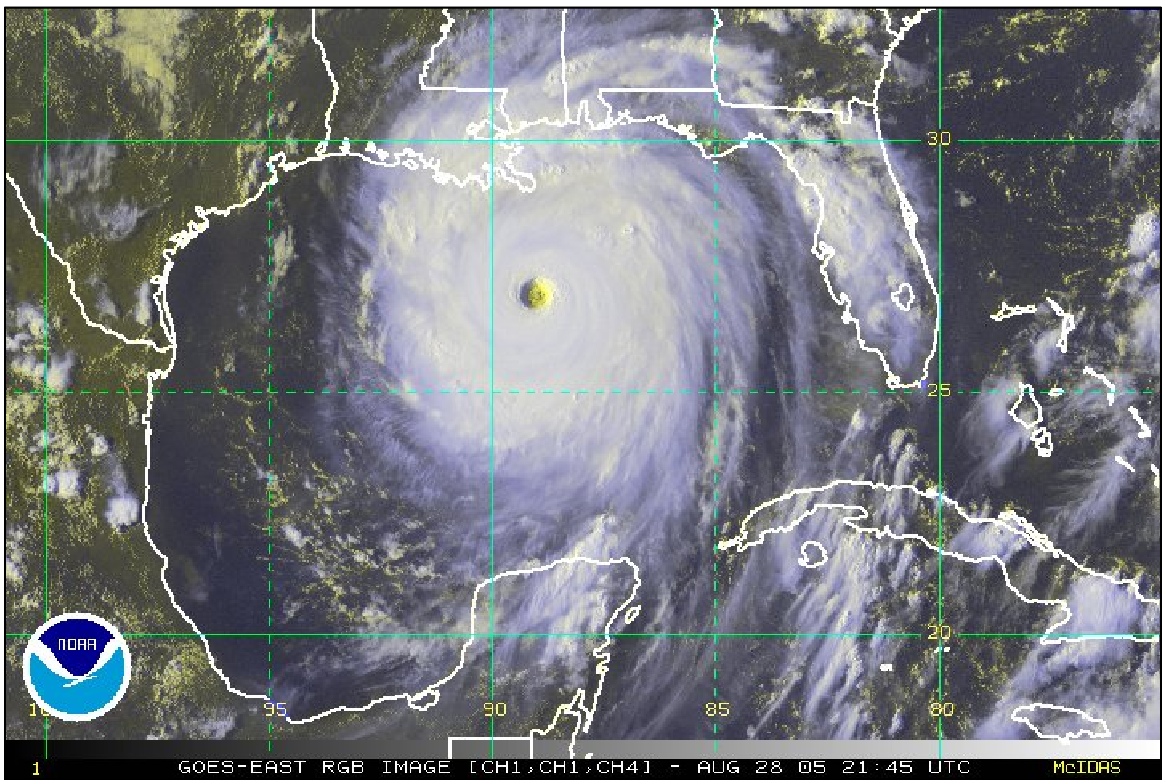
BOEM 2015-003

Coastal Marine Institute

Assessing Impacts of OCS Activities on Public Infrastructure, Services, and Population in Coastal Communities Following Hurricanes Katrina and Rita



U.S. Department of the Interior
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

Cooperative Agreement
Coastal Marine Institute
Louisiana State University

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

STUDY OVERVIEW

PARISH PROFILES

In Chapter One, our approach to analyzing community social, economic, and demographic capacity in Louisiana involves the development of three inter-related community profiles. These profiles use fuzzy set techniques to group similar parishes together and to differentiate among parishes that differ fundamentally on the specified profile element. In total, we have developed 38 elements through which to compare and contrast Louisiana parishes. We do not claim these are comprehensive, but we do argue that these 38 profile elements allow us to get a very good sense of how the parishes in this state compare in relation to characteristics that may be relevant to gaining a better understanding of how the oil and gas industry affects these regions. The elements are grouped into three profiles.

1. A General Community Profile that describes the general situation of each parish in the state, with a particular emphasis on those parishes within the U.S. Department of Interior Bureau of Ocean Energy Management (BOEM) identified impact areas.
2. An Education Profile that compares parishes with respect to key education indicators.
3. A Socio-economic and Demographic Profile that allows for comparisons in terms of their labor force characteristics.

Data

The profiles rely on secondary data that are available at the national or state level. Much of these data are gathered and published annually, allowing for regularly updating the profiles as they are constructed. The specific data sources for each profile element are detailed in the profile descriptions below. In addition, we include a spreadsheet in Appendix A with hyperlinks to the data for each profile element.

Fuzzy-Set Approach

We employ a fuzzy-set approach to developing the community profiles, in which we seek to group together parishes that are conceptually similar for a given profile element and differentiate among parishes that are clearly different. In this way, the fuzzy sets require us to think carefully about differences that matter “more” compared with differences that matter “less”. For example, in our general profile we define “large parishes” as those with large populations. We categorize all 14 parishes with populations greater than 100,000 as fully in the set of large parishes, and so we are less interested in population differences among this group; in fuzzy-set terms they are conceptually similar.

Fuzzy-sets allow us to make key decisions about grouping that are grounded in the conceptualization of the profile element, rather than in the distribution of the data. Users are asked to think critically about the way each profile element is constructed and to recommend clarification and revisions if necessary. It is relatively easy to “reconstruct” a fuzzy set, so the critical element involves the ability to defend its conceptual construction.

Each fuzzy set is constructed based on three critical boundaries or cut-off points. The first point defines the cut-off point where any case with that score or higher is definitely IN the set; all parishes that are definitely in a set get a score of 1. The second cut-off point defines the line where any case with a score that is at or lower is definitely OUT of the set; all parishes that are definitely out of a set get a score of 0. All points between those two cut-off points are said to be PARTIALLY IN the set. The final cut-off point defines the score that distinguishes between partial set members that are MORE OUT THAN IN (score is > 0 and < 0.5) and partial set members that are MORE IN THAN OUT (score is > 0.5 and < 1).

All of the fuzzy set parish profile element descriptions below define the three cut-off points and group parishes according to the four categories (or two, in the case of binary elements). In the main body of the report, we provide the following for each profile element: (1) a complete definition; (2) a summary discussion of the distribution of cases that are fully in, fully out, or partial members of each fuzzy set; (3) descriptive tables of each element for all Louisiana parishes and for the 32 parishes included in the BOEM impact areas; and (4) a map of Louisiana identifying which fuzzy set value each parish received for a given profile element.

General Profile

The General Profile is composed of 16 elements that provide a picture of the overall population, demographic, education, income, natural, and geographical environment of Louisiana parishes. The elements are organized into four categories.

Parish Population Statistics

This category includes four elements: Large Population, Small Population, Emerging or Growing Population, and Declining Population. Note that, in fuzzy-set terms, these elements are all conceptually distinct from one another. For example, Small Population is not simply the inverse of Large Population, and it is possible for a parish to be neither Large nor Small. For the state as a whole, only 10 of the 64 parishes were defined as definitely Large, while 27 were defined as definitely Small. Further, only seven parishes were defined as definitely Emerging/Growing, while 33 were defined as definitely Declining or Stagnating.

Parish Demographic Information

This category includes additional information about the racial/ethnic diversity and age structure across parishes. The three profile elements are Low Diversity, Old or Aging, and Young. Only 12 parishes in the state and only 4 in the BOEM-defined region met the standards to be considered Low Diversity. In terms of age, 33 parishes are Old or Aging, while 39 are Young. Note that several parishes met both thresholds: they are both Old and Young, having high percentages of older and younger demographics.

Parish Education and Income

This category contains four elements: Wealthy, Poor, High Crime, and High Adult Education Level. Four parishes met the standard for being Wealthy, while another eight were "more in than out" of that set. Conversely, we used a fuzzy-set definition that classified 43 of the 64 parishes in Louisiana as being Poor, with a substantial percentage of the population in each of these parishes fitting the federal definition of poverty. Eight parishes met the standard to be considered High Crime parishes. Finally, four parishes were classified as Educated, based percentages of the adult population with at least a high school education.

Parish Location and Geographic Factors

The final five profile elements were all binary, and they were grouped together into a category that aims to describe locational and geographic features of parishes. First, the Urban/Rural classification included 29 parishes that were classified by the U.S. Census Bureau as urban; 35 parishes were classified as rural. The second element in this category, Parish with Noteworthy Natural Amenities, seeks to describe whether a parish is a desirable place to live. According to our classification system, 27 of the 64 parishes had Noteworthy Natural Amenities. The third element, also binary, simply assigned a 1 to any parish with an interstate highway traversing through it. There are 30 such parishes in Louisiana; 34 parishes do not contain an Interstate Highway. The next element, Coastal Parish, included the 13 parishes that lie along the Gulf Coast. Finally, 14 parishes had Major Ports.

Labor Market Profile

The Labor Market Profile included 11 elements that have been developed to provide a descriptive-comparative perspective on how Louisiana's labor market varies across parishes. The elements have been grouped into four categories as described below.

Labor Market Resources

The fuzzy set elements in this category describe the contours of the labor market in some detail. The first Element, Substantial Mining Employment, seeks to compare parishes in connection with the numbers of employees in the mining sector. A total of 11 parishes have been classified as having substantial mining employment, with another six parishes in the More In Than Out category. The second element in this category, Small Business Intensive, serves to focus attention on the small business sector, and make comparisons based upon the firm-level characteristics. Thirty of the 64 parishes are classified as Small Business Intensive because more than three-quarters of the firms in each of these parishes have 10 or fewer employees. By contrast, the next element, Large Business Presence, makes comparisons across parishes based on the number of firms with 100 or more employees. There are 14 parishes in which 40 or more firms have 100+ employees; 10 of these parishes are located in the southern third of the state.

Labor Market Outcomes

We included two elements that focus attention on key labor market outcomes: High Unemployment and Job Growth. We found that 19 parishes are classified as having high unemployment (>9% in 2010), and only nine parishes realized job growth of 2% or higher from 2009 to 2010.

Labor Force Characteristics

This category of the labor market profile contains one element that focuses on the characteristics of the labor force. Competitive Per Capita Personal Income is an element that makes comparisons on the basis of where average personal income for each parish ranks in comparison to other parishes. All parishes with average incomes at or above the state level are fully in the set (12 parishes).

Education Profile

The education profile draws on data that are published annually by the Louisiana State Department of Education to provide a district-level comparative picture of the education situation in the state. For 63 of 66 parishes in Louisiana, the school district is coterminous with the parish. The remaining three parishes consist of two or more school districts as follows:

- Washington Parish: Washington Parish and City of Bogalusa School Districts
- Ouachita Parish: Ouachita Parish and City of Monroe School Districts
- East Baton Rouge Parish: East Baton Rouge Parish, City of Zachary, City of Baker, and City of Central School Districts.

In these cases, we have aggregated data to the parish level where possible. We divide the 16 elements in the education profile into four categories as follows.

Resources

These profile elements attempt to compare Louisiana school districts according to the resources they have to invest in public schooling, as well as the focus of their educational investments. First, Competitive Teacher Salary compares parishes by average teacher salary, focusing on whether the average salary in the parish meets or exceeds the Southern Regional Education Board (SREB) average. No adjustments were made for cost of living differences across parishes. Second, Substantial Local Capacity compares parishes on their capacity to secure local educational investments through taxation. Third, Onshore Oil and Gas Industry influence compares the extent to which parishes can access onshore oil and gas revenues to support public education. These are sometimes referred to as Sixteenth Section land resources. Fourth, Focus on Instruction is an element that compares parishes by the proportion of their educational expenditures, whatever they may be, that are devoted to instructional categories in the expenditure budget.

Educational Outcomes

This category compares parishes/school districts according to various educational outcomes. Adequate School District Performance separates parishes that are performing up to national (No Child Left Behind) and state expectations. Note that district level performance scores are based partly on aggregated school-level performances and partly on district education office performance measures. Second, to get a better sense of within district school-level inequality, we included an element entitled, Few Low-Performing Schools which identifies those parishes that have been able to at least avoid having many low-performing schools (irrespective of how good the average and high-performing schools are doing). Third, District Performance is another measure of adequate performance that uses the state-defined “star” system as opposed to aggregated school performance. Fourth, High College Attendance utilizes more recently available data to compare the proportion of recent high school graduates that went on to become first-time freshmen the following year. While the measure is imperfect because data is limited to those who enrolled in Louisiana colleges (and, therefore, those who enrolled out of state are scored equally as those who did not enroll at all, due to lack of data on out-of-state enrollments) we believe the measure works well for comparative purposes if the assumption is that out-of-state enrollments are distributed relatively equally across school districts.

Student Characteristics

We included two student characteristics that have high relevance for the state of Louisiana. First, we compare parishes with high percentages of At Risk Students. These are defined as students who are eligible for free lunch or reduced cost lunch at public schools due to their household income status. Second, we compare parishes with high proportions of African-American Students. These two measures exhibit significant overlap.

District Processes

This final category in the educational profile includes six elements that attempt to depict interesting differences in the way parishes and school districts "process" students. The first three elements focus on districts with High Dropout Rates, Many Disciplinary Cases, and Many Grade Repeaters. The next two categories simply define large and small school districts, with the assumption that district structure (large or small) may affect how schools operate and how students, therefore, are processed. Finally, we compare parishes according to whether or not there is Substantial Nonpublic School Enrollment. Large nonpublic school enrollments could reduce commitment to the public school system.

In addition, we summarize lessons learned from our meetings with local state and educational officials. In total, we visited 33 officials from 16 parishes, beginning in the summer of 2008 and ending in the fall of 2009. We spoke by phone to officials in other parishes, and examined parish and school board web pages in order to get a good sense of the issues facing local parish school boards. A descriptive summary of the lessons we learned from these visits is detailed in Appendix A.

ANALYZING EMPLOYMENT CHANGE FOLLOWING HURRICANES KATRINA AND RITA

The second chapter of this report focuses on one specific economic characteristic, employment, analyzing employment change during a period prior to the 2005 hurricane season (2001–2004) and a period that includes and immediately follows Hurricanes Katrina and Rita (2004–2006). In particular, employment change over these two time periods is evaluated for two major industry categories, Mining and Food Services, for the BOEM-defined onshore areas of South Louisiana.

To address employment change, we apply a specific tool to decompose employment change called shift share analysis. This widely used method decomposes employment change in a given region (e.g., parish) into three elements: employment change due to the overall growth (positive or negative) of the national (U.S.) economy; change due to the growth (positive or negative) of the specific industry nationally; and, growth (positive or negative) due to the local (parish specific) effects. The national effect is sometimes called “aggregate growth”. It assumes that an overall rising (expansionary) or receding (contractionary) tide of a national economy has a similar positive or negative effect on all industries in an economy. The growth of the specific national industry (sometimes called the industry mix or business mix) effect suggests that while the growth of the overall economy plays some role in an industry’s growth, specific industries nationally grow at differing rates and this differential should contribute to a specific industry’s growth locally. Finally, a region’s growth that is not accounted for by national growth and national industry growth is considered the local (or competitive) effect. This residual is sometimes called the competitive effect because it may be indicating some type of comparative advantage or disadvantage of the particular region due, for example, to natural site location, natural resource base, logistic advantage (e.g., transportation), or some type of pecuniary (price) advantage such as low cost labor.

In this chapter, the authors extend this analysis by constructing an augmented shift share analysis that substitutes the industry’s regional growth (neighboring-region) effect for its national industry mix effect. This (and other similar variations) has been described as “spatial shift share analysis”. The regional growth effect is included because there may be regional factors at play that are beyond the control of the individual parish that are more influential than national industry trends. In fact all of its growth may be due to external regional effects. An example of such regional effects might be investments made by nearby parishes in such infrastructure as roads, education, and health care. The reference parish need not invest to receive positive spillover benefits. Hence the spatial shift share approach aims to disentangle regional comparative advantage from local comparative advantage.

This distinction is important for both a regional and sectorial perspective. From a sectorial perspective, a spatial shift share analysis can identify how a sector may be linked spatially. That is, it can help to map out a supply chain in geographic space for a given industry. From a regional perspective, the approach can identify the key parish or parishes that drive employment activity for a given region, not in terms of just the direct jobs it provides from its own parish, but the jobs the parish may leverage or support in other parishes.

Overall results are presented in Chapter Two; some of the key highlights are presented here. In Figure 2.1, we highlight BOEM onshore areas that are more or less influenced by their neighboring regions’ industry in the immediate period before the storm. We see that, during this period, some of the parishes with medium and large ports that directly and indirectly support deepwater oil and gas activities, including Plaquemines, Lafourche, St. Mary, and Iberia Parishes, generated positive local effects with negative neighboring effects. In the case of Lafourche, St. Mary, and Iberia Parishes, their positive local effects outweighed national and negative neighboring region growth effects that result in overall mining employment growth for each of these respective parishes between 2001 and 2004. In Figure 2.2, between 2004 and 2006, we see additional patterns emerging. In particular, there are a larger number of parishes experiencing both positive neighboring region effects and positive local effects. In particular, we see pockets of this in three key areas: (1) around the deepwater support hubs of Terrebonne and Lafourche Parishes, (2) the shallower water support hub of Cameron parish, and (3) collection of parishes along the Interstate 10 corridor encompassing measurable portions of the Baton Rouge and Lafayette Metropolitan Statistical Areas. These results suggest that a combination of growing deepwater activity from the gradual shift of drilling from shallow water to deepwater in the Gulf combined with mining support activities for both offshore and onshore activities including repair and reconstruction following Hurricanes Katrina and Rita may be a contributing factor explaining these spatial patterns.

In addition, since the incorporation of neighboring region effects through spatial shift share analysis, there has been no research testing whether a neighboring region effect is, in fact, a distinct effect. We performed a correlation analysis and tested whether correlations between the various effects were statistically significant. We found that for the Mining sector, the correlation between the competitive effect and industry mix effect was statistically significant suggesting that the traditional shift share model did not fully disentangle national industry growth effects from local growth effects. However, also for the Mining sector, no significance was found on the correlation between the neighboring region effect and local effect suggesting the neighboring region effect was truly a distinct effect.

MODELING THE LOCAL LABOR MARKET

In Chapter Three, we present the first of two modules of the Louisiana Community Impact Model (LCIM), the labor force module. This module forecasts changes in labor force which is the third step in the LCIM impact assessment (see Figure 3.1). In particular, after an economic scenario is identified (e.g., number of wells drilled), and a model (such as MAGPLAN, IMPLAN, or other decision making tools) translates the economic scenario into a change in employment, this change in employment is applied to the variables in the labor force module.

Six equations are estimated as a part of the labor force module system: wages, population, unemployment, in-commuters, out-commuters, and labor force. To maximize the amount of information available in the data, we performed a sensitivity analysis by estimating each of these equations in the labor force module using traditional ordinary least squares regressions using data from the year 2008 and a panel data and three-stage least squares regressions for the time period 2000–2008. In addition to estimating these three different models, we performed both in-sample and out-of-sample forecasts between 2001 and 2008 using model results. Basic forecasts such as the labor force variable in Figure 3.6 showed that for the ordinary least squares model, forecast accuracy declined as the time lapse between the forecast year and model year source data increased. The panel data model that was based on data from 2000 through 2008 showed less variability in forecasting performance.

In addition, we performed a mean comparison test between the ordinary least squares, three-stage least squares, and panel data models. Results from this test suggested that for most of the equations, the panel data model outperformed the ordinary least squares model. At the same time, there was a general disappointment that the labor force module did not perform as well as the authors would have hoped. Mean absolute percent errors exceeding 20% were common. The authors believed much of this error was due to large fluctuations in the labor force in these coastal parishes following the 2005 hurricane season. The large fluctuations forced the authors to move away from traditional equations to the use of lagged variables in the model that captured most of the variation in the dependent variable in these equations leaving less variation to be captured by traditional labor market demand and supply conditions.

MODELING LOCAL GOVERNMENT EXPENDITURE

In Chapter Four, we focus on modeling the fiscal sector, the fourth and final section of impact assessment from the Louisiana Community Impact Model. In particular, we focused on modeling the changes in expenditure demands driven by a changing labor market. We evaluated variables, such as commuting, on impact revenue capacity equations that drive changes in the level of public expenditures that occur in a given local parish government.

Similar to the labor force module, we conduct sensitivity analysis to alternative model specifications. In addition to an ordinary least squares model based on 2007 data and a panel data model based on data from 2004–2007, we include a quantile regression model using 2007 data. In simple terms, quantile regression divides parishes up based on the level of expenditures one is trying to model. At a fundamental level, it assumes that parishes that have similar spending patterns for public services respond similarly to changes in demand for that service

Using these three models, we estimate four categories of public service expenditure: general government, health and welfare, public safety, and public works. Our public expenditure data are derived from audited financial statement data provided to the Louisiana Legislative auditor. These data are seen as an improvement over the model constructed by Fannin et al. (2008) which used U.S. Census of Governments (COG) data. COG occurs every five years, so it limits the ability to estimate panel data models. Further, it does not receive 100 percent cooperation from all parish governments, so some data reported in COG are imputed estimates and thus have some level of imputation error included.

Unfortunately, traditional models that include public service demand and supply causal factors did not generate reasonable forecasts for the in-sample year (2007). The ordinary least squares generated a mean absolute percent error that ranged from 34% to 68%, the panel data model from 37% to 88%, and the quantile regression model from 27% to 225%.

The authors reviewed the model and some alternative conceptual frameworks to reconstruct the model were considered and incorporated. The authors re-estimated the fiscal module under an alternative conceptual framework, the bureaucratic model. In this model, local government elected officials are assumed to use the previous year's budget either entirely, or as a starting point, in developing the budget for the present year. As a result, expenditure levels in a given year are driven in large part by the previous year's spending levels in a given category.

As a result, we developed three additional empirical models to incorporate the bureaucratic model conceptual framework. First, we include a simple naïve model that includes only the previous year's expenditures in a given category to estimate expenditure in the current year. Second, we include a naïve plus model that incorporates the previous year's expenditures plus revenue capacity variables as a proxy for the expected revenue the local government is to receive in the current year. Finally, we add a modified naïve model which is basically our original model plus the previous year expenditure variable.

Results of these models showed vast improvements in forecasting performance. When averaging over the entire 2004–2009 forecast period, the naïve model showed mean absolute percent errors that ranged from 16% to 37%, the naïve plus model errors between 12% and 19%, and modified naïve models between 12% and 17%. In addition, a mean comparison test on these models showed that all three models based on the bureaucratic model generated significantly improved forecasts as compared to the base ordinary least squares model. The naïve plus and modified naïve models also generated statistically lower forecast errors than the simple naive model in all but the public works expenditure equation. However, there was no statistical difference found between the means of the forecast errors of the naïve plus and modified naïve models. These results suggest at least over the forecast window analyzed (2004–2009), knowing last year's expenditure levels and a forecast for the present year's revenue stream generated reasonable forecasts of public sector expenditure for parish governments in Louisiana.

FORECASTING LOCAL GOVERNMENT EXPENDITURE CHANGE FROM GULF OF MEXICO OIL AND GAS ACTIVITIES

In Chapter Five, we present a scenario where we evaluate the fiscal impact in terms of local government expenditure change from oil and gas operations in the Gulf of Mexico for a given year. First, the authors estimate the number of oil and gas wells that will be drilled in the Gulf of Mexico. Based on that forecast, the number of wells drilled is applied in an Exploration and Development (E&D) Scenario in the Gulf of Mexico MAG-PLAN model (Saha, Manik, and Phillips 2005). From this model an estimate of employment change is then applied to the labor force module. Finally changes in major labor force module variables are then applied to the revenue capacity equations which are finally applied to the fiscal module to estimate changes in key local government expenditure categories.

From this table, we applied the 2011 forecasted number of wells drilled (119) to the E&D Scenario in MAG-PLAN for the South Central Louisiana BOEM region. We applied the estimated 3,600 jobs generated from MAGPLAN to the Labor Force and Fiscal Modules of LCIM for Lafayette Parish, Louisiana, dominate employer for the offshore oil and gas industry for the region. The 3,600 jobs were treated as lost jobs if the 119 wells were not drilled.

As can be seen from Table 5.1, there was about 11 percent change in per capital health and welfare expenditure when moving from 2009 to 2010 and around 15 percent change when moving from 2010 to 2011. Thus, there was a difference of about four percent, which accounts for the spending effects as evaluated by the difference in the growth rates between years. Assuming the local government growth rate between 2009 and 2010 would have occurred without the wells drilled, the reduction in wells drilled would have resulted in loss in per capita spending in health and welfare of four percent. For other categories of expenditure, these effects are one, two, and five percent reductions for general government, public safety and public works expenditures per capita respectively. Overall, these per capita reductions would have resulted in approximately $41 million in reduced spending in the parish.

However, expenditures between 2010 and 2011 actually grew by $27 million. The poor performance of the model was explained by three key factors. First, the labor force and fiscal modules applied to this scenario were based on source data that had measurable volatility during Hurricanes Katrina and Rita creating forecasting challenges. Second, it appeared anecdotally that much of the oil and gas industry did not have the measurable decrease in payrolls due to the short-term government restrictions on drilling in the Gulf of Mexico during this period that the Louisiana COMPAS model would not have incorporated. Third, recent research suggests that during short-term periods of short-term revenue decline, local governments are less likely to reduce local government expenditures. Rather, they find alternative ways to finance these expenditures until revenues rebound. Each of these factors should be taken into account in future modeling and application of COMPAS type models in oil and gas-related scenarios.

CHAPTER 1. PARISH PROFILES USING FUZZY SET APPROACH

The initial objective of this research project is to develop a socio-economic baseline and assessment of public sector infrastructure and services of coastal communities in Louisiana through an extensive collection of data on local socio-economic conditions. This objective is partially addressed in Chapter 1 in the organization and presentation of data through the fuzzy set approach. The remainder of the objective is addressed in Chapter 2 through the use of shift share analysis.

Fuzzy-set analysis has its origins in the 1960s in the conceptualization of the fuzzy set in mathematical formulations as an extension classical set theory. Previously, sets were considered in binary terms, an element was either in a set or out of it, but fuzzy sets allowed for partial membership in sets (Zadeh 1965). Since then, fuzzy set theory has been applied in different academic disciplines. In social sciences, fuzzy set analysis was presented as an extension of binary comparative methods for analyzing similarities and differences across cases (Ragin 2001). Fuzzy-set and regression analyses address similar questions but with strongly contrasting approaches. Regression analysis seeks to isolate effect that each potential factor has on a certain dependent variable. Fuzzy-set analysis seeks to determine whether cases of “success” or “failure” are connected to particular causal conditions, or particular groupings of causal conditions. Fuzzy set analysis is particularly appropriate when theory suggests multiple, conjectural causation, sometimes referred to as pathways or configurations.

Fuzzy-set procedures involve: (1) defining a desired outcome in fuzzy-set terms; (2) defining potential causal conditions in fuzzy-set terms; (3) using fuzzy-set analysis that isolates groups of causal conditions leading to specified outcomes; (4) employing a minimization process to “essentialize” groups of causal conditions by excluding all redundancies; and (5) organizing the reduced groupings into necessary and sufficient conditions. Necessary conditions are those that are *almost always required* for a successful outcome. Sufficient conditions are those that *almost always lead* to a successful outcome. Conditions, either on their own or in combination, may be both necessary and sufficient, neither necessary or sufficient, or necessary but not sufficient. The approach allows for the possibility that multiple combinations of conditions (sometimes called pathways) may lead to the same outcome. An alternative, related approach involves the assessment of the strength of the connections between conditions and outcomes in terms of consistency (the degree to which an outcome has been approximated by one or more subsets) and coverage (the relevance of a consistent subset), which is analogous to analyzing variance in regression analyses (Ragin 2006).

Ragin and other practitioners argue that fuzzy set approaches are “at once” qualitative and quantitative when they are properly developed. First, fuzzy sets should be grounded in conceptualizations based on theory and not data. For example, an analysis of the impact of the oil and gas industry would first have to define, conceptually, the details of the term “impact” in specific dimensions. Second, researchers can pursue either qualitative/subjective or quantitative/objective approaches (or combine both) to assigning membership in developing fuzzy sets (Verkullen 2005). This allows researchers to achieve optimal precision in measurement, taking advantage of quantitative data when it exists without ignoring conceptually important characteristics due to data limitations. Third, fuzzy set approaches are increasingly being integrated with traditional quantitative approaches. For example, Smithson (2005) developed statistical methods to assist in the evaluation of fuzzy set inclusion criteria (whether or not a case is in, out, or a partial member). In addition, fuzzy set techniques are increasingly being incorporated into statistical software. For example, STATA now has a Fuzzy command that can be used to perform fuzzy set analysis.

The Fuzzy Set profiles represent the initial task of creating fuzzy sets based on concepts, using available data but transforming it in ways that are consistent with our conceptualization of key elements in the profiles. The approach involves the grouping of similar parishes into one of the four categories of fuzzy sets that are created by establishing three key markers: (1) the cut-off that marks the point beyond which all parishes are considered "in the set"; (2) the cut-off that marks the point beyond which all parishes are considered "out of the set"; and (3) the cut-off that distinguishes among the partial members of the set which are "more in than out" and which are "more out than in". Fuzzy set approaches recognize that social analysis is a dynamic process that need not be constrained by initial conceptualizations. If, after reviewing the evidence for and against, these conceptualizations change in the midst of a study, the fuzzy sets can and should be reconfigured to reflect the latest conceptualization. What we have tried to do is to explain in detail how we developed all the fuzzy set profile elements, so that others can understand our rationale. However, we do not claim to have developed comprehensive profiles or even "the best" profiles. The profiles are probably best viewed as examples of how parishes can be categorized by transforming available data in ways that allow for conceptually meaningful comparisons across parish.

1.1. General Community Profile

The following profile elements are intended to present a broad description of a parish to provide initial context for subsequent analysis. The fuzzy set approach is generally qualitative and focuses on making meaningful distinctions across sets of units, in this case, among parishes in Louisiana and BOEM-defined impact areas. The approach can help to group quantitative data into meaningful categories of set membership.

We organize our profile into four sections (see the outline below). Each section contains a range of fuzzy set profile elements. This report focuses on the presentation of the fuzzy set profile elements shown below.

General Profile Outline

- Parish Population Statistics
  - Large Population
  - Small Population
  - Emerging or Growing Parish
  - Declining or Stagnating Parish
- Parish Demographic Information
  - Parish Diversity
  - Old or Aging Parish

  - Young Parish
- Parish General Social and Economic Indicators
  - Wealthy Parish
  - Poor Parish
  - Parish with High Adult Education Level
  - High Crime Parish
- Parish Location and Geographic Factors
  - Urban or Rural Parish
  - Parish with Noteworthy Natural Amenities
  - Parish with Interstate Highway
  - Coastal Parish
  - Parish with Major Ports

1.1.1. Parish Population Statistics

This first set of measures group together similar parishes based on population characteristics. Note that, with fuzzy sets, each measure is independent of other members. For example, Large Population and Small Population fuzzy sets are independent of one another; meaning that Small Population is not simply the negation of Large Population. It is possible for a given parish to be in neither set (i.e., Neither Large Population nor Small Population). Taken together, the four measures provide a way of comparing both population levels and changes across Louisiana's parishes.

1.1.1.1. Large Population

Definition. The tables below show detailed information about the population of Louisiana Parishes and define individual parishes as having a large population if there were more than 100,000 inhabitants as of July 1, 2009. In addition to identifying large parishes, the data below identify non-large parishes and parishes that are partially large with respect to their inclusion in the fuzzy set. All parishes with a population below 50,000 were considered fully out of the set of parishes with a large population; parishes with a population between 50,000 and 100,000 were considered partial members of the set and assigned fuzzy set values respective to their population. Data were obtained from the U.S. Census Bureau's 2009 population estimate.

Discussion and Description. Among all Louisiana parishes, 14 parishes fit the definition of a large parish and are considered fully part of the fuzzy set. A further eight parishes are considered partially within the fuzzy set to varying degrees based on the size of their population and 42 parishes have a population that places them fully outside of the large population fuzzy set.

Among parishes BOEM-defined impact areas, 10 fit the definition of a large parish and are considered fully within the fuzzy set. An additional seven can be considered partially within the set based on the size of their population and another 15 can be considered outside of the large population fuzzy set. Descriptive statistics and a layout of fuzzy set membership are included in Tables 1.1–1.2 and Figure 1.1 below. For Figure 1.1, as with all figures in the General Community Profile section, parishes shaded in dark blue are fully in a set, those in light blue are more in than out of the set, in pink are more out than in the set, and in red are fully out of the set.

Table 1.1. Large Population fuzzy set membership for all Louisiana parishes (2009).

Parishes with a Large Population	Verbal Level	Fuzzy Set Membership Score	Number
100,00 or more parish inhabitants	Fully in set	1	14
Between 75,000 and 100,000 inhabitants	More in set than out of set	0.5-0.999	3
Between 50,000 and 75,000 inhabitants	More out than in set	0.001-0.49	5
Fewer than 50,000 inhabitants	Out of set	0	42

Table 1.2. Large Population fuzzy set membership for BOEM-defined parishes (2009).

Parishes with a Large Population	Verbal Level	Fuzzy Set Membership Score	Number
100,00 or more parish inhabitants	Fully in set	1	10
Between 75,000 and 100,000 inhabitants	More in set than out of set	0.5-0.999	2
Between 50,000 and 75,000 inhabitants	More out than in set	0.001-0.49	5
Fewer than 50,000 inhabitants	Out of set	0	15

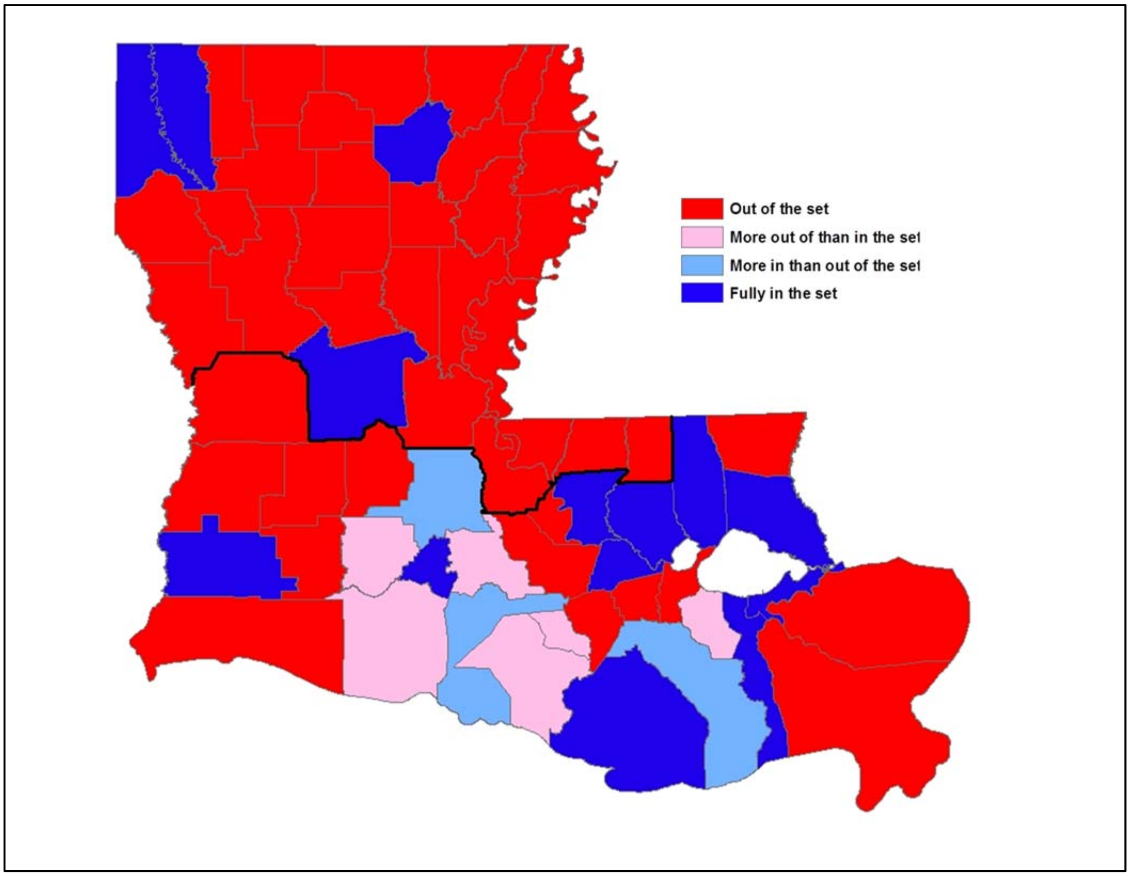

Figure 1.1. Large Population fuzzy set membership.

1.1.1.2. Small Population

Definition. The definition of a large or small parish is somewhat problematic as there is no universally agreed upon measure for what constitutes a large or small one. For the purpose of this study, parishes are defined as fully within the set of parishes having a small population if they had 25,000 or fewer inhabitants. If they had between 25,000 and 50,000 the parish is considered partially in the set in relative proportion based on population size. If a parish had more than 50,000 inhabitants it is considered outside the small parish set.

Discussion and Description. In the state of Louisiana, 27 parishes have fewer than 25,000 inhabitants; these parishes are considered fully within the small population fuzzy set. There are 15 parishes with between 25,000 and 50,000 inhabitants that are considered partially in the fuzzy set proportionally based on their population. There are 22 parishes with more than 50,000 inhabitants that are considered outside of the small parish fuzzy set.

Within the BOEM-defined parishes, only six are fully within the small parish fuzzy set, and an additional nine are partially within the set at varying degrees based on population size. The majority of the parishes in the BOEM-defined set (17) are considered fully outside of the small parish set. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.3–1.4 and Figure 1.2.

Table 1.3. Small Population fuzzy set membership for all Louisiana parishes (2009).

Parishes with a Small Population	Verbal Level	Fuzzy Set Membership Score	Number
25,000 or fewer parish inhabitants	Fully in set	1	27
Between 25,000 and 37,500 inhabitants	More in set than out of set	0.5-0.999	7
Between 37,500 and 50,000 inhabitants	More out than in set	0.001-0.49	8
More than 50,000 inhabitants	Out of set	0	22

Table 1.4. Small Population fuzzy set membership for BOEM-defined parishes (2009).

Parishes with a Small Population	Verbal Level	Fuzzy Set Membership Score	Number
25,000 or fewer parish inhabitants	Fully in set	1	6
Between 25,000 and 37,500 inhabitants	More in set than out of set	0.5-0.999	5
Between 37,500 and 50,000 inhabitants	More out than in set	0.001-0.49	4
More than 50,000 inhabitants	Out of set	0	17

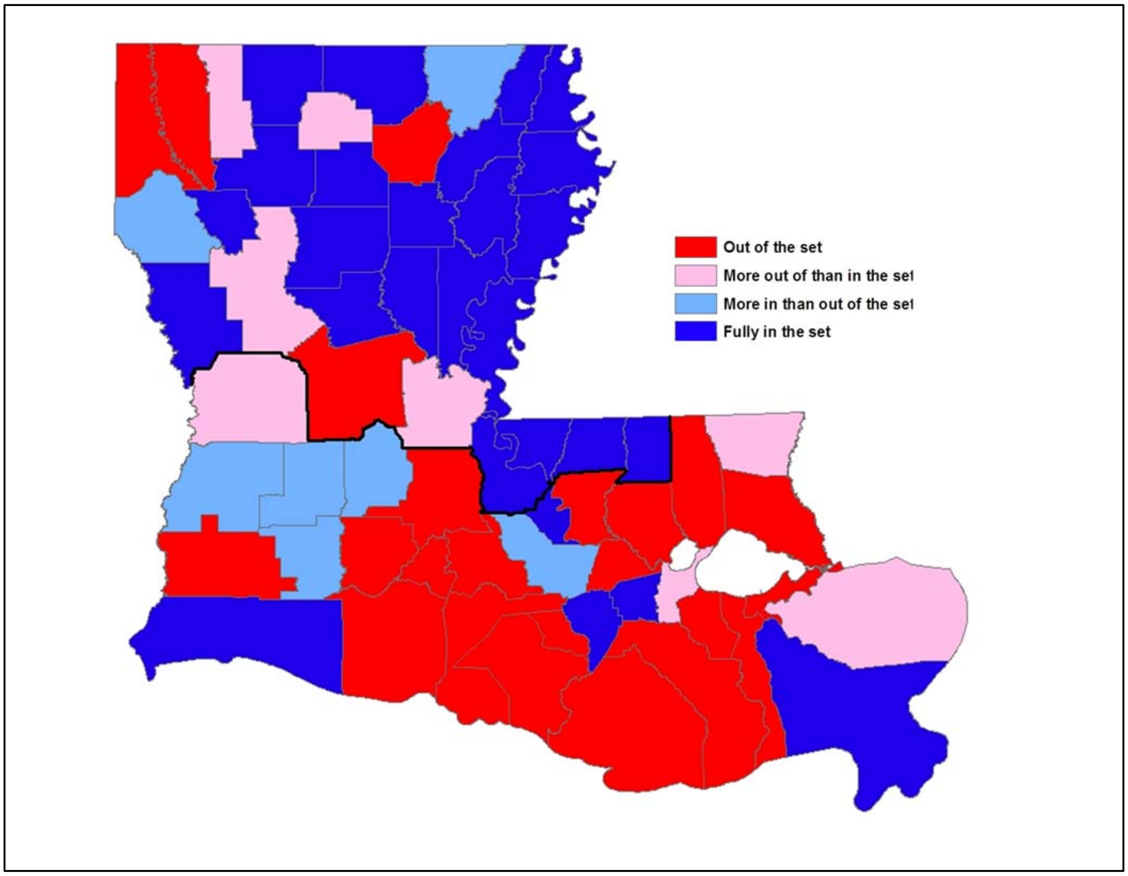

Figure 1.2. Small Population fuzzy set membership.

1.1.1.3. Parishes with Growing Populations

Definition. The U.S. Census 2009 measure of population growth rate is used to measure if a parish was emerging or growing in comparison to the decennial census from 2000. Within Louisiana, emerging or growing parishes have population growth rates above the national average of 9.1% to be considered fully within the fuzzy set definition of a growing parish. Parishes with a growth rate above 0.5% but below 9.1% are considered partially within the set at varying degrees based on their respective growth rates. Any parish with a growth rate below 0.5% is considered fully out of the fuzzy set.

Discussion and Description. In the state of Louisiana, seven parishes are defined as emerging with population growth exceeding the national average. Currently, 22 parishes are partially within the emerging growth category with growth rates exceeding the state average but below the national average for growth. The remaining 35 parishes had growth rates below 0.5% or were experiencing population decline.

Among the BOEM-defined parishes, six experienced population growth above the national average of 9.1% and are considered to be fully within the fuzzy set for the purpose of this analysis. An additional 14 parishes are considered partially within the fuzzy set and 12 parishes fail to experience population growth and are considered fully outside of the fuzzy set.

Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.5–1.6 and Figure 1.3.

Table 1.5. Population Growth fuzzy set membership for all Louisiana parishes (2009).

Parish with Population Growth	Verbal Level	Fuzzy Set Membership Score	Number
Parish population growth rate greater than 9.1%	Fully in set	1	7
Parish population growth rate between 4.8% and 9.1%	More in set than out of set	0.5-0.999	9
Parish population growth rate between 0.5% and 4.8%	More out than in set	0.001-0.49	13
Parish population growth rate less than 0.5%	Out of set	0	35

Table 1.6. Population Growth fuzzy set membership for BOEM-defined parishes (2009).

Parish with Population Growth	Verbal Level	Fuzzy Set Membership Score	Number
Parish population growth rate greater than 9.1%	Fully in set	1	6
Parish population growth rate between 4.8% and 9.1%	More in set than out of set	0.5-0.999	7
Parish population growth rate between 0.5% and 4.8%	More out than in set	0.001-0.49	7
Parish population growth rate less than 0.5%	Out of set	0	12

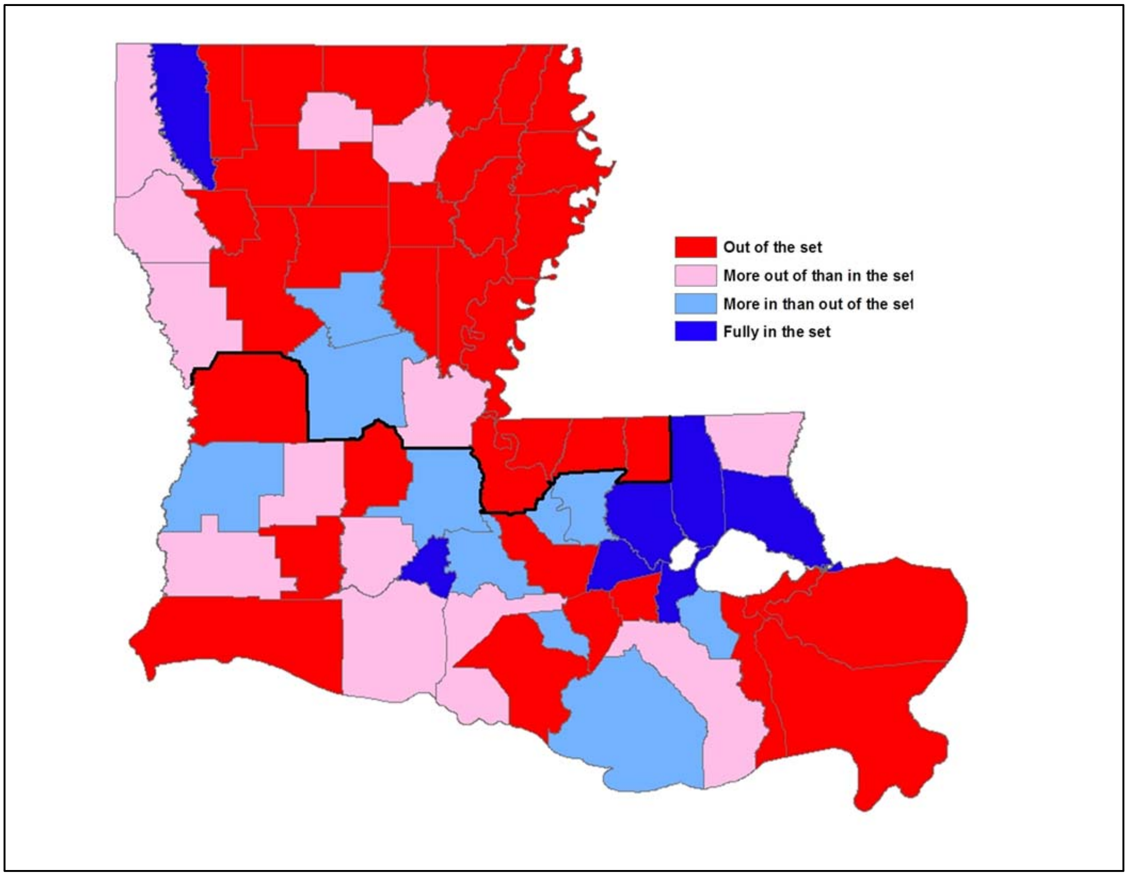

Figure 1.3. Population Growth fuzzy set membership (emerging parishes).

1.1.1.4. Parishes with Declining or Stagnating Populations

Definition. The U.S. Census 2009 estimate of population growth rate is used to determine if a parish was declining or stagnating in comparison to the decennial census from 2000. Within Louisiana, declining or stagnating parishes are defined as parishes that had had no population growth or a negative population growth rate. For the purpose of this analysis, parishes are divided into two categories reflecting their status as either declining or stagnating or as not declining or stagnating.

Discussion and Description. In the state of Louisiana, 33 parishes are currently experiencing stagnation or declining population levels, and 31 parishes are experiencing growth ranging from 0.2% to 36.8%. Within the BOEM-defined parishes, 12 parishes can be considered to be experiencing zero or negative growth and 20 parishes experiencing some level of growth over the past decade. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.7–1.8 and Figure 1.4.

Table 1.7. Declining or Stagnating Parish fuzzy set membership for all Louisiana parishes (2009).

Parishes with Population Decline	Verbal Level	Fuzzy Set Membership Score	Number
Zero or negative growth	Fully in set	1	33
Any growth	Out of set	0	31

Table 1.8. Declining or Stagnating Parish fuzzy set membership for BOEM-defined parishes (2009).

Parishes with Population Decline	Verbal Level	Fuzzy Set Membership Score	Number
Zero or negative growth	Fully in set	1	12
Any growth	Out of set	0	20

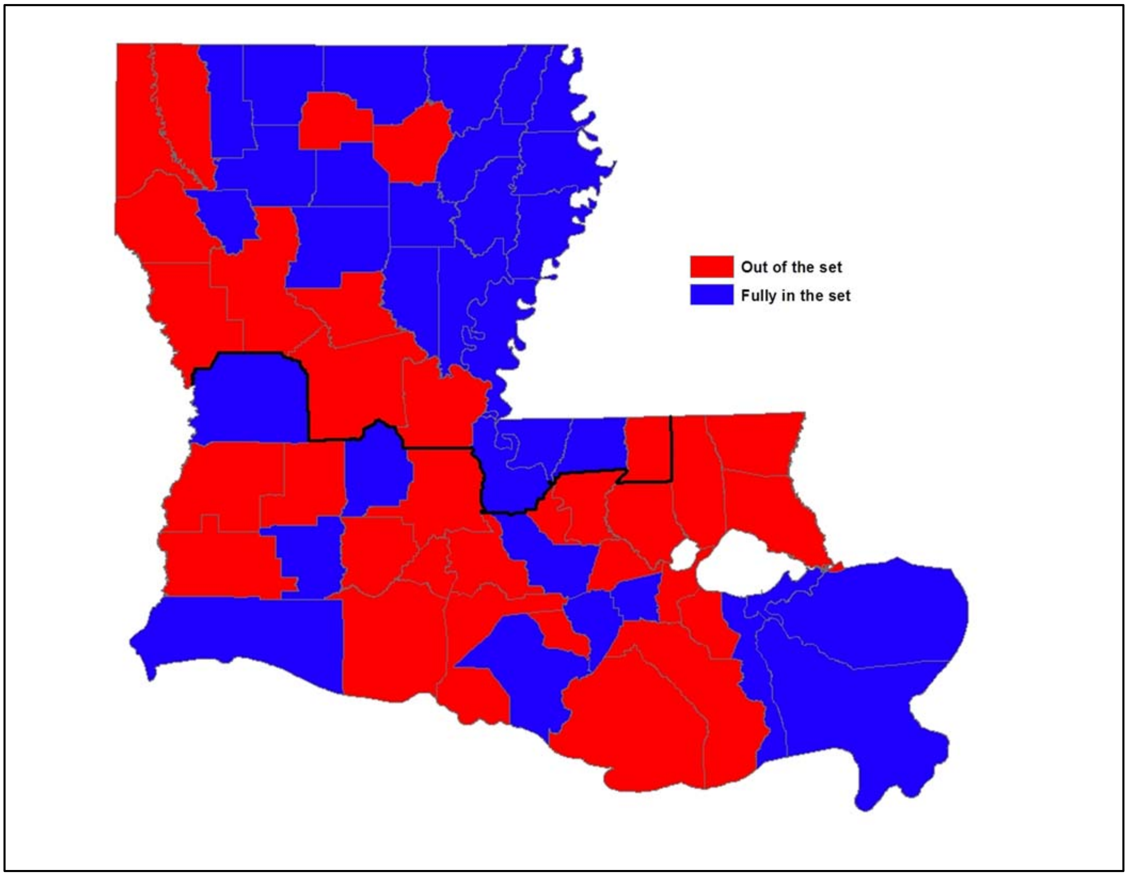

Figure 1.4. Declining/Stagnating Populations fuzzy set membership.

1.1.2. Parish Demographic Information

This second set of fuzzy set profile elements distinguishes between different parishes and groups together similar parishes based on demographic data.

1.1.2.1. Low-Diversity Parish

Definition. Though there are several methods for measuring diversity, we draw upon the Theil index because it measures the uneven structure of the spatial distribution of the six major population subgroups within census tracts within counties. The measure ranges from 0 to 1 with a lower score indicating counties with low diversity. For the purpose of this report, the definition of a parish with low racial and ethnic diversity is defined as a parish with a Theil index score below .10 to be considered fully in the set, parishes with a score below .12 yet above .10 are considered to be partial members based on their distribution within this range.

Discussion and Description. In the state of Louisiana, 12 parishes can be considered fully within the fuzzy set and considered to have low levels of racial diversity. An additional 10 parishes are considered to be partially within the fuzzy set, having a Theil index score above 0.12 but below the 0.10 cut-off point. A full 42 parishes are considered outside of this set.

Within the BOEM-defined parishes, four parishes can be considered to have low levels of racial diversity and can be considered fully within the fuzzy set. An additional three parishes are considered partial members of the set to varying degrees based on their Theil index score. A total of 25 parishes can be considered fully outside of the fuzzy set of parishes with low racial diversity. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.9–1.10 and Figure 1.5.

Table 1.9. Low Racial Diversity fuzzy set membership for all Louisiana parishes (2010).

Racial Diversity	Verbal Level	Fuzzy Set Membership Score	Number
0.10 or less	Fully in set	1	12
0.11 to 0.10	More in set than out of set	0.5-0.999	5
0.12 to 0.11	More out than in set	0.001-0.49	5
Greater than 0.12	Out of set	0	42

Table 1.10. Low Racial Diversity fuzzy set membership for BOEM-defined parishes (2010).

Racial Diversity	Verbal Level	Fuzzy Set Membership Score	Number
0.10 or less	Fully in set	1	4
0.11 to 0.10	More in set than out of set	0.5-0.999	3
0.12 to 0.11	More out than in set	0.001-0.49	0
Greater than 0.12	Out of set	0	25

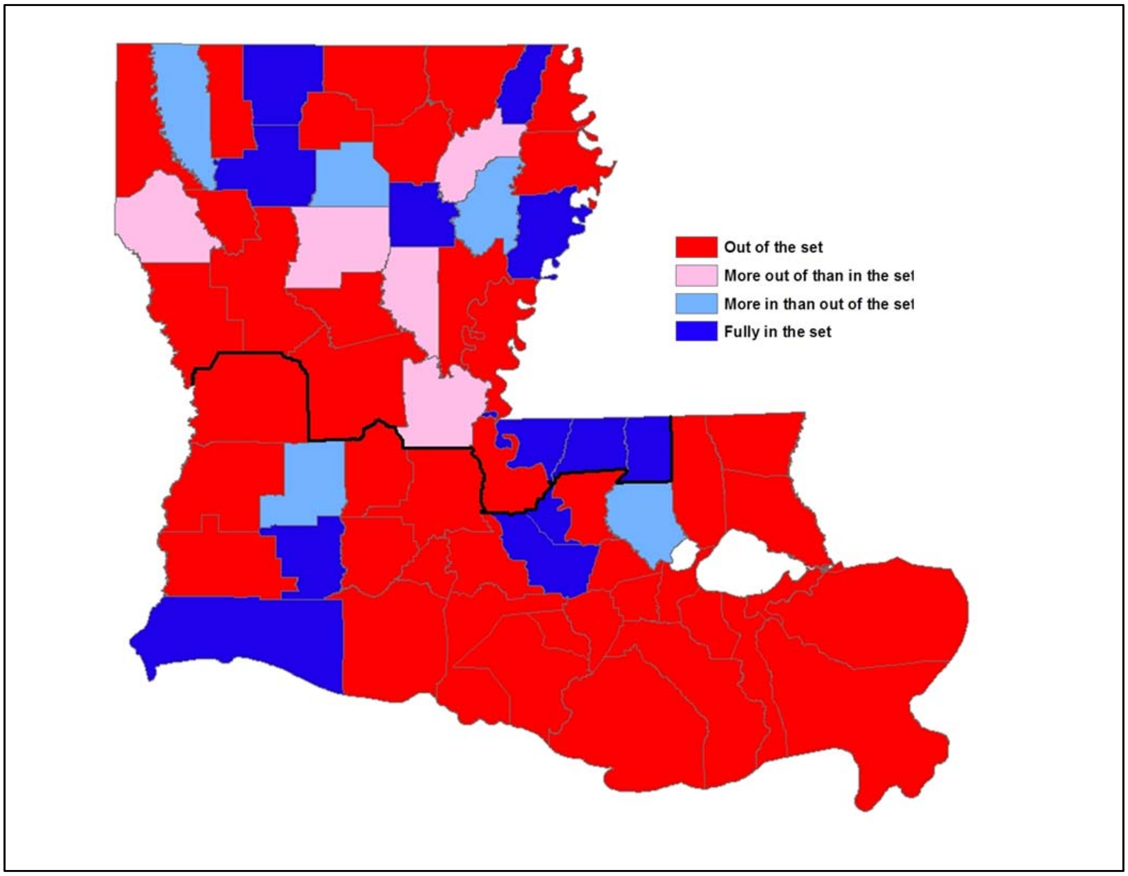

Figure 1.5. Low Racial Diversity fuzzy set membership.

1.1.2.2. Old or Aging Parish

Definition. Using U.S. Census 2009 estimates of parish population, we were able to use the percentage of individuals within each parish over the age of 65 as an indicator of the parish having a large proportion of old or aging residents. For the purpose of this study, any parish with a proportion of old people higher than the nation average of 12.9% of their population was considered to have a large proportion of old or aging residents and as such was considered fully within the old or aging parish fuzzy set. Those parishes with a rate between the Louisiana state average of 12.3% and the national average of 12.9% were considered partially within the fuzzy set to the degree that their respective measures allow. Those parishes with less than 12.3% of their population over the age of 65 were not considered to be members of the fuzzy set.

Discussion and Description. In the state of Louisiana, 33 parishes have a sufficient proportion of their population above the age of 65 to be considered fully within the fuzzy set. Additionally, seven parishes can be considered partially in the fuzzy set to varying degrees, depending on the overall proportion of residents over the age of 65 in the parish. There are 25 parishes fully outside of the fuzzy set. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.11–1.12 and Figure 1.6.

Table 1.11. Old or Aging fuzzy set membership for all Louisiana parishes (2009).

Percent of Population 65 Years of Age and Older	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 12.9%	Fully in set	1	33
12.6 to 12.9%	More in set than out of set	0.5-0.999	4
12.4% to 12.6%	More out than in set	0.001-0.49	3
Less than 12.3%	Out of set	0	25

Table 1.12. Old or Aging fuzzy set membership for BOEM-defined parishes (2009).

Percent of Population 65 Years of Age and Older	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 12.9%	Fully in set	1	7
12.6 to 12.9%	More in set than out of set	0.5-0.999	3
12.4% to 12.6%	More out than in set	0.001-0.49	3
Less than 12.3%	Out of set	0	20

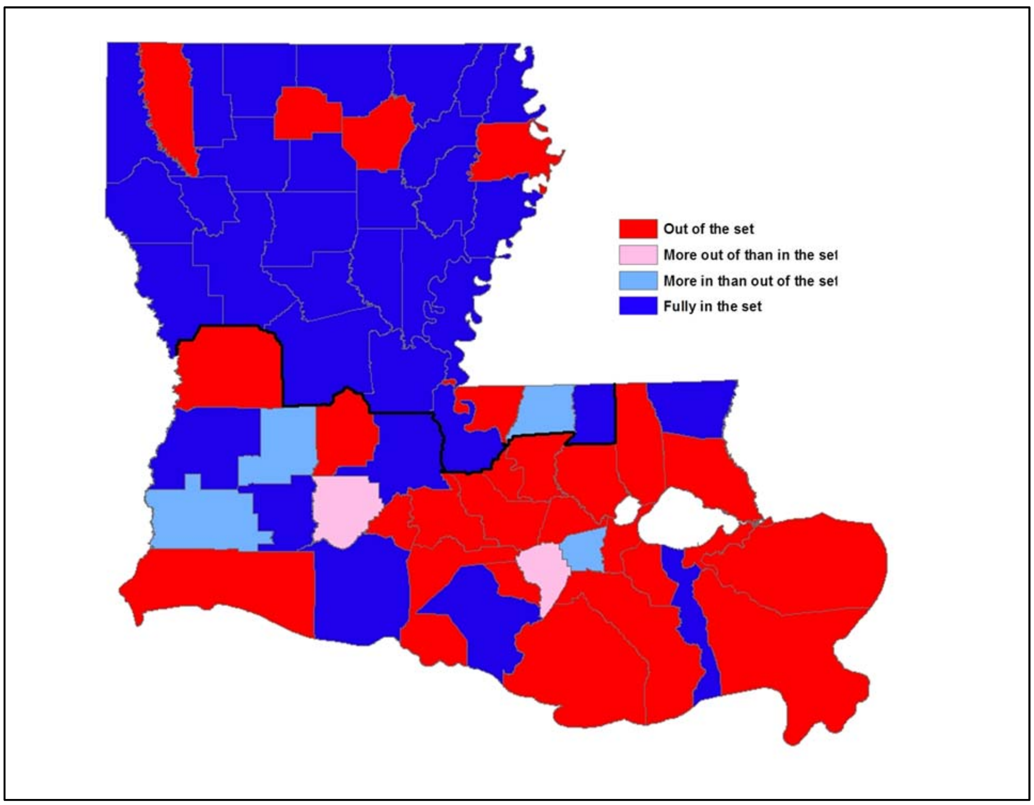

Figure 1.6. Old or Aging fuzzy set membership.

1.1.2.3. Young Parish

Definition. Using U.S. Census 2009 estimates of parish population, we were able to use the percentage of individuals within each parish aged 18 or below as an indicator of the parish having a large proportion of young residents. For the purpose of this study, any parish with a proportion of young people higher than the national average of 24.9% of their population was considered to have a large proportion of old or aging residents and as such was considered fully within the old or aging parish fuzzy set. Those parishes with a rate between the Louisiana state average of 24.4% and the national average of 24.9% were considered partially within the fuzzy set to the degree that their respective measures allow. Those parishes with less than 24.4% of their population aged 18 years or younger were not considered to be members of the fuzzy set.

Discussion and Description. In the state of Louisiana, 39 parishes have a sufficient proportion of their population aged 18 years or younger to be considered fully within the fuzzy set. Additionally, four parishes can be considered partially in the fuzzy set to varying degrees, depending on the overall proportion of residents aged 18 years or younger. There are 21 parishes fully outside of the fuzzy set.

Within the BOEM-defined parishes, 24 parishes have a sufficient proportion of their population aged 18 years or younger to be considered fully within the fuzzy set. Additionally, there is one parish that can be considered partially in the fuzzy set. There are seven parishes fully outside of the fuzzy set. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.13-1.14 and Figure 1.7.

Table 1.13. Young Population fuzzy set membership for all Louisiana parishes (2009).

Percent of Population 18 Years of Age and Younger	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 24.9%	Fully in set	1	39
Between 24.7% and 24.9%	More in set than out of set	0.5-0.999	1
Between 24.4% and 24.7%	More out than in set	0.001-0.49	3
Less than 24.4%	Out of set	0	21

Table 1.14. Young Population fuzzy set membership for BOEM-defined parishes (2009).

Percent of Population 18 Years of Age and Younger	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 24.9%	Fully in set	1	24
Between 24.7% and 24.9%	More in set than out of set	0.5-0.999	0
Between 24.4% and 24.7%	More out than in set	0.001-0.49	1
Less than 24.4%	Out of set	0	7

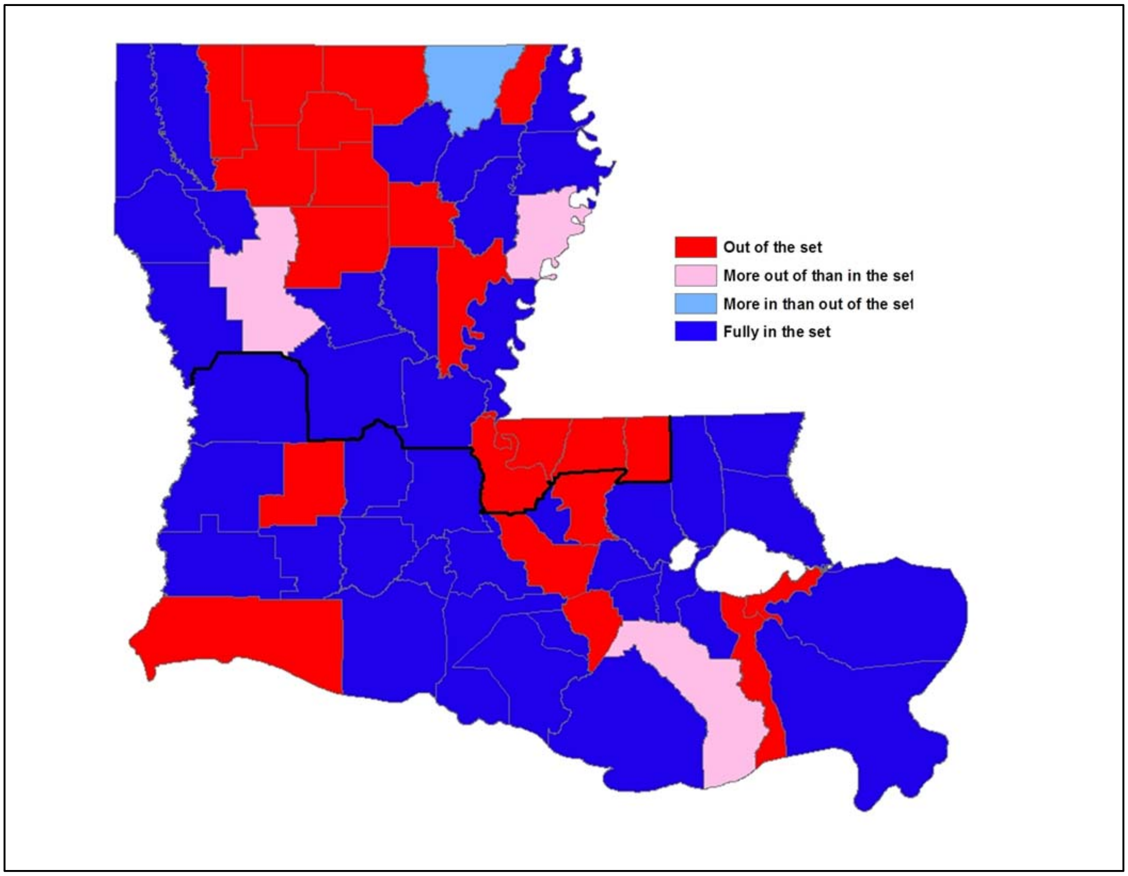

Figure 1.7. Young Population fuzzy set membership.

1.1.3. Parish General Economic and Social Indicators Income

The following four indicators provide a way of grouping similar parishes together based upon general measures of income, education, and crime.

1.1.3.1. Wealthy Parish

Definition. Using U.S. Census 2008, estimates of parish median household income were used as an indicator of the overall wealth of a parish. For the purpose of this study, any parish with a median household income above the national median household income of $52,000 was considered to be a wealthy parish and considered fully within wealthy parish fuzzy set. Those parishes with a median household income between the Louisiana median of $44,000 and the national median of $52,000 were considered partially within the fuzzy set to the degree that their respective measures allow. Those parishes with a median income of less than $44,000 were not considered to be members of the fuzzy set.

Discussion and Description. In the state of Louisiana, four parishes have a median household income sufficient to be considered fully within the fuzzy set. Additionally, 13 parishes can be considered partially in the fuzzy set to varying degrees depending on the overall median household income. There are 47 parishes fully outside of the fuzzy set.

Within the BOEM-defined parishes, four parishes have median household income sufficient to be considered fully within the fuzzy set. Additionally, 10 parishes can be considered partially in the fuzzy set. There are 18 parishes fully outside of the fuzzy set. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.15-1.16 and Figure 1.8.

Table 1.15. Wealthy Population fuzzy set membership for all Louisiana parishes (2008).

Median Income	Verbal Level	Fuzzy Set Membership Score	Number
Greater than $52,000	Fully in set	1	4
$48,000–$52,000	More in set than out of set	0.5-0.999	8
$44,000–$48,000	More out than in set	0.001-0.49	5
Less than $44,000	Out of set	0	47

Table 1.16. Wealthy Population fuzzy set membership for BOEM-defined parishes (2008).

Median Income	Verbal Level	Fuzzy Set Membership Score	Number
Greater than $52,000	Fully in set	1	4
$48,000–$52,000	More in set than out of set	0.5-0.999	6
$44,000–$48,000	More out than in set	0.001-0.49	4
Less than $44,000	Out of set	0	18

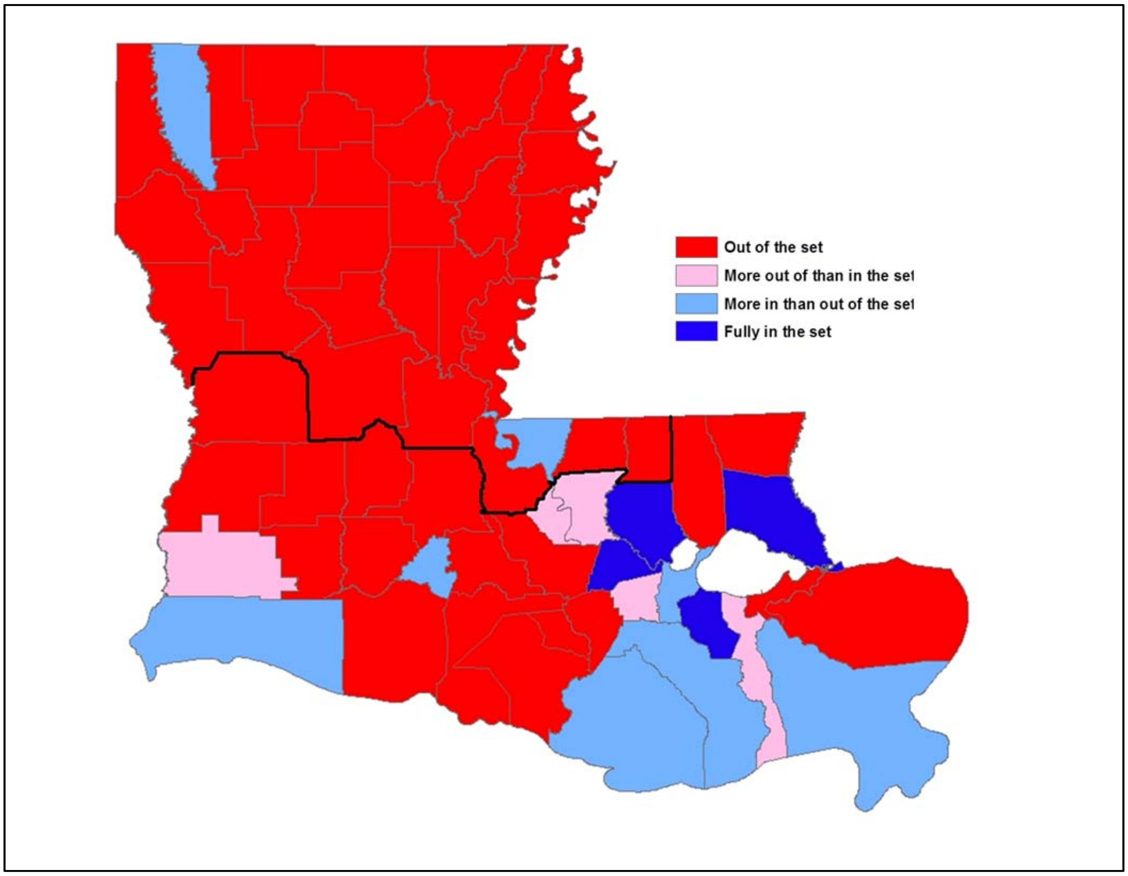

Figure 1.8. Wealthy Population fuzzy set membership.

1.1.3.2. Poor Parish

Definition. We used U.S. Census 2008 estimates of the percent of the total population within a parish below the federally defined poverty line to define poor parishes. For the purpose of this study, any parish with more than 17.8% of the total population fitting the federal definition of poverty was considered to be a poor parish and considered fully within wealthy parish fuzzy set. Those parishes with between the Louisiana average of 17.8% and the national average of 13.5% were considered partially within the fuzzy set to the degree that their respective measures allow. Those parishes with a less than 13.5% of the population fitting the federal poverty definition were not considered to be members of the fuzzy set.

Discussion and Description. In the state of Louisiana, 43 parishes fit the measure to be considered fully within the fuzzy set. Additionally, 17 parishes can be considered partially in the fuzzy set to varying degrees depending on the overall median household income. There are six parishes fully outside of the fuzzy set.

Within the BOEM-defined parishes, 15 parishes have median household income sufficient to be considered fully within the fuzzy set. Fourteen can be considered partially in the fuzzy set. Five parishes are fully outside of the fuzzy set. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.17–1.18 and Figure 1.9.

Table 1.17. Poor Population fuzzy set membership for all Louisiana parishes (2008).

Percent of Population Living Below Federal Poverty Line	Verbal Level	Fuzzy Set Membership Score	Number
Great than 17.8%	Fully in set	1	43
15.65% – 17.8%	More in set than out of set	0.5-0.999	10
13.5% – 15.65%	More out than in set	0.001-0.49	7
Less than 13.5%	Out of set	0	6

Table 1.18. Poor Population fuzzy set membership for BOEM-defined parishes (2008).

Percent of Population Living Below Federal Poverty Line	Verbal Level	Fuzzy Set Membership Score	Number
Great than 17.8%	Fully in set	1	15
15.65% – 17.8%	More in set than out of set	0.5-0.999	8
13.5% – 15.65%	More out than in set	0.001-0.49	6
Less than 13.5%	Out of set	0	5

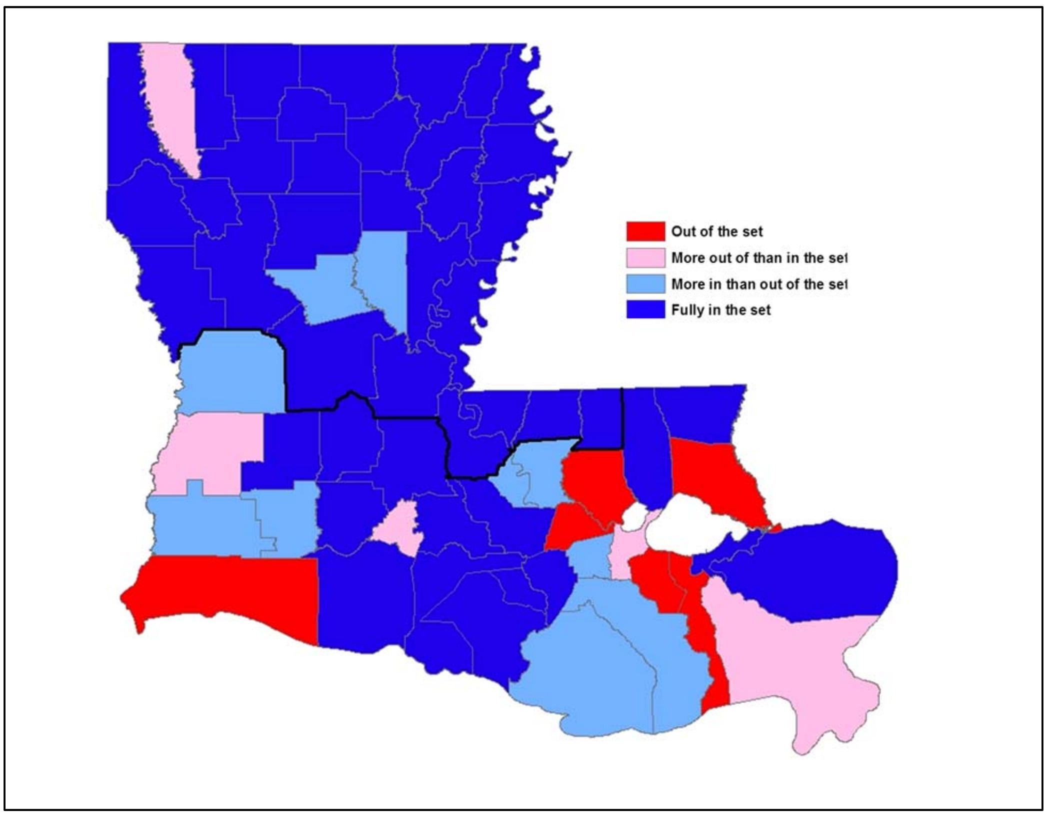

Figure 1.9. Poor Population fuzzy set membership.

1.1.3.3. Parish with High Adult Education Level

Definition. Using U.S. Census 2009 estimates, parishes with high adult education levels were defined using the percent of the total population within a parish with a high school education or above. For the purpose of this study, any parish with more than the national average of 80.3% of the total population with a high school diploma or above is considered fully within the fuzzy set. Those parishes with between the Louisiana average of 75% and the national average of 80.3% were considered partially within the fuzzy set to the degree that their respective measures allow. Those parishes with a less than 75% of the population fitting the federal poverty definition were not considered to be members of the fuzzy set.

Discussion and Description. In the state of Louisiana, four parishes fit the measure to be considered fully within the fuzzy set. Additionally, 13 parishes can be considered partially in the fuzzy set to varying degrees, depending on the overall median household income. There are 49 parishes fully outside of the fuzzy set.

Within the BOEM-defined parishes, two parishes have median household income sufficient to be considered fully within the fuzzy set. Additionally, eight parishes can be considered partially in the fuzzy set. There are 22 parishes fully outside of the fuzzy set.

Table 1.19. Adult Education fuzzy set membership for all Louisiana parishes (2009).

Percent of Adult Population That Graduated from High School	Verbal Level	Fuzzy Set Membership Score	Number
More than 80.3%	Fully in set	1	4
77.65% – 80.3%	More in set than out of set	0.5-0.999	7
75% – 77.65%	More out than in set	0.001-0.49	4
Less than 75%	Out of set	0	49

Table 1.20. Adult Education fuzzy set membership for BOEM-defined parishes (2009).

Percent of Adult Population That Graduated from High School	Verbal Level	Fuzzy Set Membership Score	Number
More than 80.3%	Fully in set	1	2
77.65% – 80.3%	More in set than out of set	0.5-0.999	4
75% – 77.65%	More out than in set	0.001-0.49	4
Less than 75%	Out of set	0	22

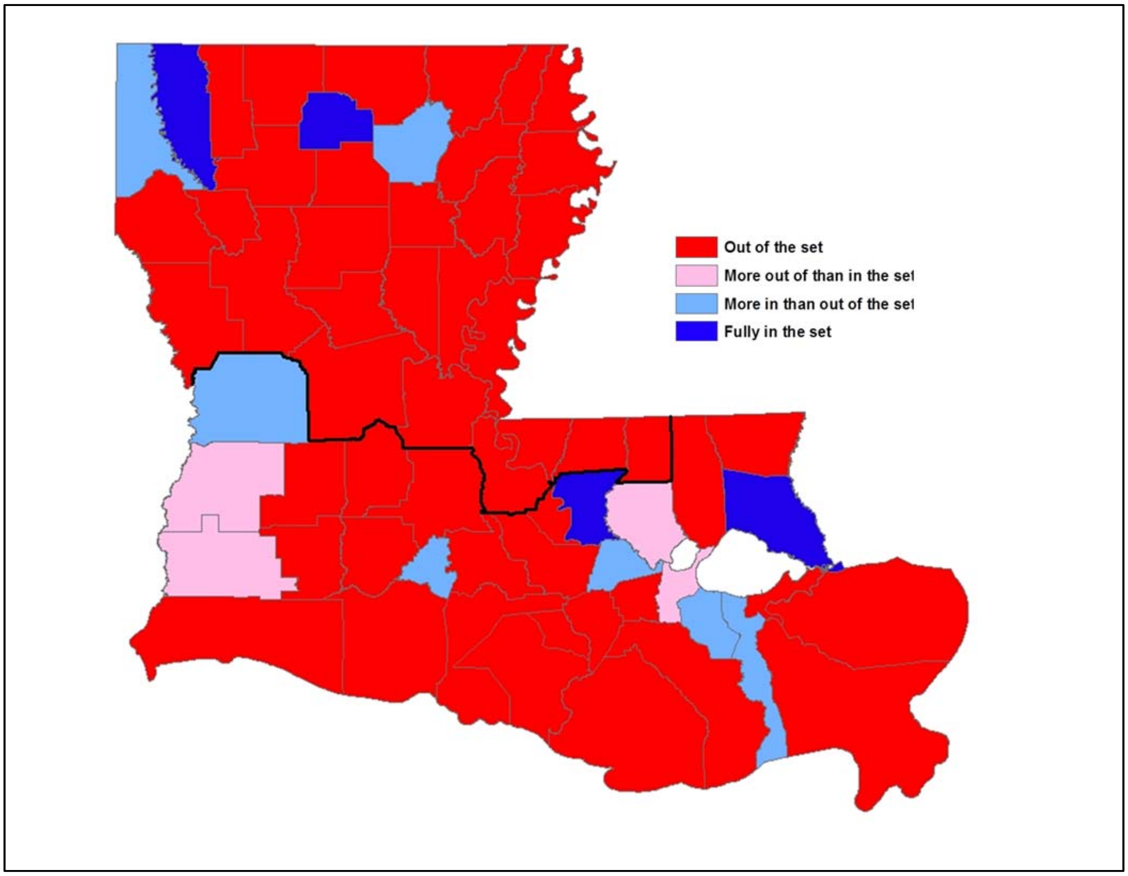

Figure 1.10.Adult Education fuzzy set membership.

1.1.3.4. High-Crime Parish

Definition. To evaluate the county crime rate, we draw upon USA Counties data from 2008. A significant source of variation among counties is non-participation and the use of differing definitions regarding what constitutes violent crime. For the purpose of this report, parishes with more than 1,000 violent crimes are considered fully within the fuzzy set. Parishes with between 500 and 1,000 reported violent crimes are considered partially within the fuzzy set. Parishes with fewer than 500 violent crimes are considered outside of the fuzzy set.

Discussion and Description. In the state of Louisiana, eight parishes can be considered fully within the fuzzy set and considered to have high levels of violent crime. An additional four parishes are considered to be partially within the fuzzy set because they have between 500 and 1000 violent crimes. A full 52 parishes are considered outside of this set.

Within the BOEM-defined parishes, four parishes can be considered to have high levels of violent crime. An additional three parishes are considered partial members of the set to varying degrees based on the number of violent crimes within the parish. A total of 25 parishes can be considered fully outside of the fuzzy set of parishes high violent crime rates. Descriptive statistics as well as the layout of fuzzy set membership are included in Tables 1.21–1.22 and Figure 1.11.

Table 1.21. High Crime fuzzy set membership for all Louisiana parishes (2008).

Number Of Violent Crimes	Verbal Level	Fuzzy Set Membership Score	Number
More than 1000	Fully in set	1	8
Between 750 and 1000	More in set than out of set	0.5-0.999	2
Between 500 and 750	More out than in set	0.001-0.49	2
Fewer than 500	Out of set	0	52

Table 1.22. High Crime fuzzy set membership for BOEM-defined parishes (2008).

Number Of Violent Crimes	Verbal Level	Fuzzy Set Membership Score	Number
More than 1000	Fully in set	1	4
Between 750 and 1000	More in set than out of set	0.5-0.999	1
Between 500 and 750	More out than in set	0.001-0.49	2
Fewer than 500	Out of set	0	25

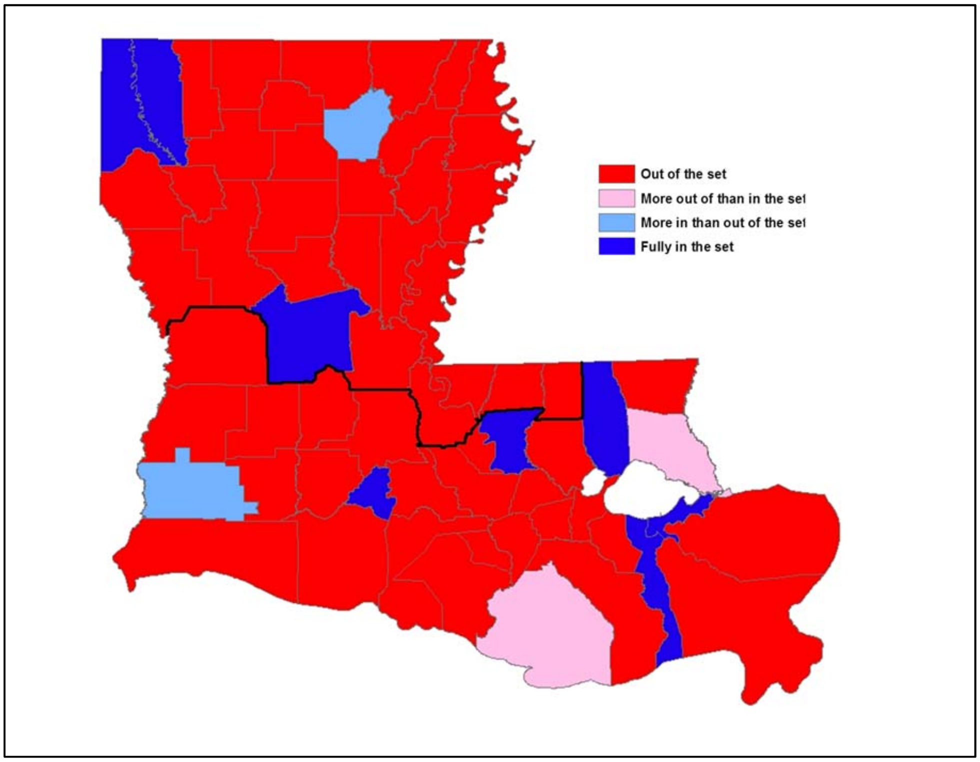

Figure 1.11.High Crime fuzzy set membership.

1.1.4. Parish Location and Geographic Factors

1.1.4.1. Urban and Rural Parishes

Definition. For the purpose of identifying urban and rural parishes, we looked to the U.S. Census Bureau's standard definition of Metropolitan Statistical Areas (MSAs). Any parish within an MSA is defined as urban and any parish outside of a MSA as rural. The U.S. Census Bureau defines a metropolitan statistical area MSA as a geographically defined area which can encompass multiple counties surrounding a metropolitan city. To be considered a part of an MSA, a county or parish needs to have at least one urbanized area with a minimum of 50,000 people which is defined as the central county of the MSA. Outlier counties are defined as counties from which over 25% of employed residents from the outlier county commute to the central county.

Discussion and Description. Louisiana has 29 parishes within metropolitan statistical areas, as defined by the U.S. Census Bureau, and can be considered urban for the purpose of this analysis, and 35 can be considered rural according to the criteria set forth above. Among the coastal parishes, 18 fit the definition of being considered urban for the purpose of this study, and 14 fit the characteristics required to be listed as rural. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.23 and 1.24 and Figure 1.12.

Table 1.23. Urban and Rural Parishes fuzzy set membership (2008).

Parish Designation	Verbal Level	Fuzzy Set Membership Score	Examples
County part of a Census defined MSA	Fully in urban set	1	Orleans Parish (Pop 354,850), Plaquemines (Pop 20,942)
County not part of a Census defined MSA	Fully out of urban set	0	West Carroll (Pop 11,392), St. Mary (pop 50,815)
Counties outside of CBSA or members of a MCA	Fully in rural set	1	Tensas (pop 5,609), Evangeline (Pop 35,330)
Counties outside of CBSA or members of a MCA	Fully out of rural set	0	East Baton Rouge (Pop 434,633)

Table 1.24. Urban and rural parishes.

Urban or Rural Parish	Fuzzy Set Count (Louisiana)	Fuzzy Set Count (BOEM Parishes)
Urban parishes	29	18
Rural parishes	35	14

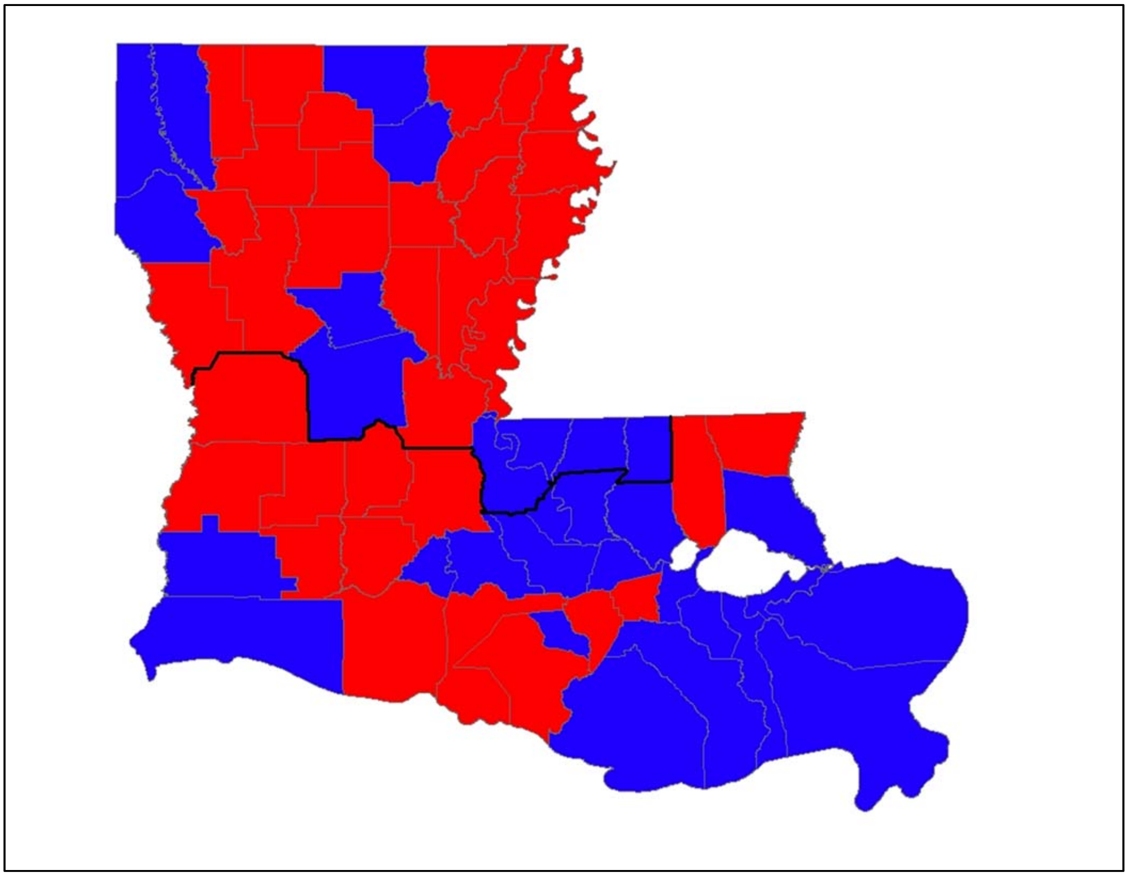

Figure 1.12.Urban and Rural Parish fuzzy set membership.

1.1.4.2. Parish with Noteworthy Natural Amenities

Definition. Natural amenity scores are calculated on a national level based on a method developed by the USDA Economic Research Service and range from 1 to 7, indicating the degree to which a county or parish can be considered a desirable place to live. The scale is constructed using six measures of climate, topography, and water area that reflect environmental qualities that people prefer. Other measures include a warm winter, winter sun, temperate summers, low humidity, topographic variation and water area. Though natural amenity scores for the country ranged from 1 to 7, within the state of Louisiana these scores ranged from 3 to 4, indicating homogeneity within the state in regard to the distribution of natural amenities.

Discussion and Description. In the state of Louisiana, 27 parishes fit the measure to be considered fully within the fuzzy set. Additionally, there are 37 parishes fully outside of the fuzzy set. Within the BOEM-defined parishes, 14 parishes have natural amenity scores of four and are fully in the set. Additionally, there are 18 parishes fully outside of the fuzzy set. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.25-1.26 and Figure 1.13.

Table 1.25. Natural Amenities fuzzy set membership for all Louisiana parishes (2005).

Natural Amenity Score	Verbal Level	Fuzzy Set Membership Score	Number
4	Fully in set	1	27
3	Out of set	0	37

Table 1.26. Natural Amenities fuzzy set membership for BOEM-defined parishes (2005).

Natural Amenity Score	Verbal Level	Fuzzy Set Membership Score	Number
4	Fully in set	1	14
3	Out of set	0	18

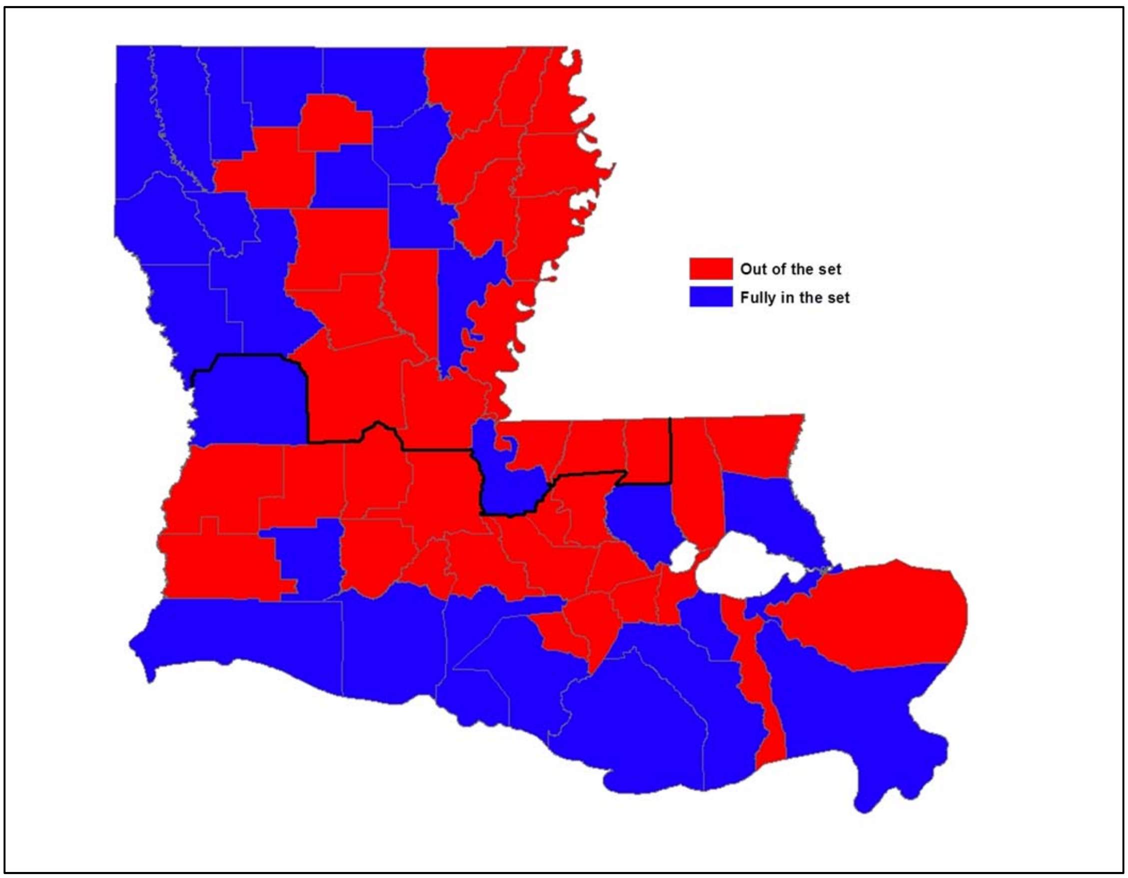

Figure 1.13.Natural Amenities fuzzy set membership.

1.1.4.3. Interstate Highway Parish

Definition. Using maps of interstate highways and parish boundaries, interstate highway parishes were defined based on having a major interstate highway within the parish borders. The interstate parishes examined within Louisiana are: I-10, I-12, I-49, I-20, and I-55. Those parishes with the previously mentioned interstate highways within their borders are considered to be full members of the fuzzy set. Those parishes without an interstate highway within their borders are considered to be outside the fuzzy set.

Discussion and Description. In the state of Louisiana, 30 parishes fit the measure to be considered fully within the fuzzy set. Additionally, 34 parishes can be considered fully outside of the fuzzy set. Within the BOEM-defined parishes, 17 parishes have interstate highways to be considered fully within the fuzzy set. Additionally, there are 15 parishes fully outside of the fuzzy set.

Table 1.27. Interstate Highway fuzzy set membership for all Louisiana parishes (2010).

Interstate Highway Status	Verbal Level	Fuzzy Set Membership Score	Number
Interstate highway runs through parish	Fully in set	1	30
No interstate highway runs through parish	Out of set	0	34

Table 1.28. Interstate Highway fuzzy set membership for BOEM-defined parishes (2010).

Interstate Highway Status	Verbal Level	Fuzzy Set Membership Score	Number
Interstate highway runs through parish	Fully in set	1	17
No interstate highway runs through parish	Out of set	0	15

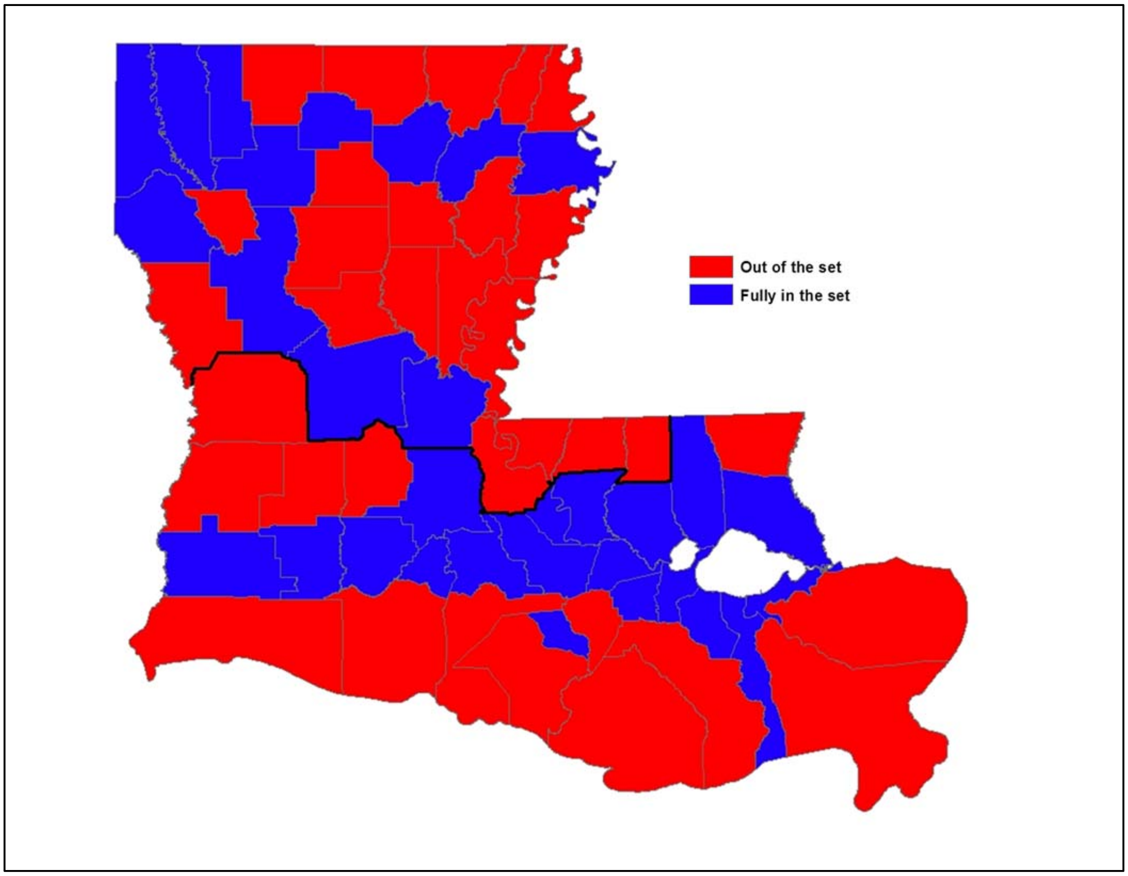

Figure 1.14. Interstate Highway fuzzy set membership.

1.1.4.4. Coastal Parish

Definition. Using maps of coastal and parish boundaries, coastal parishes were defined based on the presence of a border along the Gulf of Mexico or Lake Pontchartrain.

Discussion and Description. In the state of Louisiana, 14 parishes fit the measure to be considered fully within the fuzzy set. Additionally, 50 parishes can be considered fully outside of the fuzzy set. Because all coastal parishes are BOEM-defined parishes, 14 of the parishes are fully in the BOEM-defined set and 18 lie out of the fuzzy set. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.29–1.30 and Figure 1.15.

Table 1.29. Coastal fuzzy set membership for all Louisiana parishes (2010).

Coastal Status	Verbal Level	Fuzzy Set Membership Score	Number
Parish borders Gulf of Mexico or Lake Pontchartrain	Fully in set	1	14
Parish does not border Gulf of Mexico or Lake Pontchartrain	Out of set	0	50

Table 1.30. Coastal fuzzy set membership for BOEM-defined parishes (2010).

Coastal Status	Verbal Level	Fuzzy Set Membership Score	Number
Parish borders Gulf of Mexico or Lake Pontchartrain	Fully in set	1	14
Parish does not border Gulf of Mexico or Lake Pontchartrain	Out of set	0	18

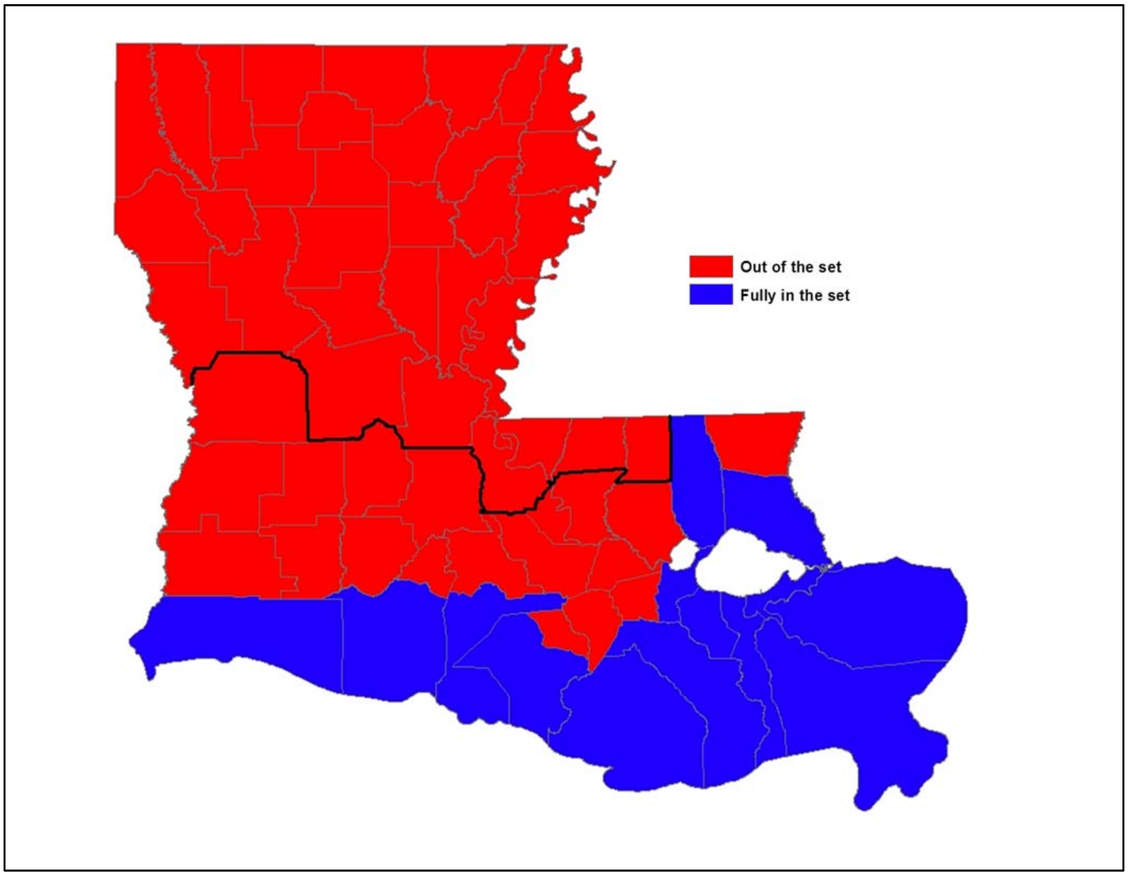

Figure 1.15.Coastal fuzzy set membership.

1.1.4.5. Parish with Port

Definition. Using data from the American Association of Port Authorities Seaports of America Directory, we identified parishes with a sizable cargo port. Many large-scale ports cross parish boundaries and all parishes with a major port within their boundaries are counted as full members of the fuzzy set.

Discussion and Description. In the state of Louisiana, 14 parishes fit the measure to be considered fully within the fuzzy set. Additionally, 50 parishes can be considered fully outside of the fuzzy set. Within the BOEM-defined parishes, 13 parishes lie fully within the fuzzy set of parishes with a major port. Additionally, 19 parishes were fully outside of the fuzzy set. Descriptive statistics the layout of fuzzy set membership are included in Tables 1.3–1.32 and Figure 1.16.

Table 1.31. Major Port fuzzy set membership for all Louisiana parishes (2010).

Major Port Status	Verbal Level	Fuzzy Set Membership Score	Number
Parish has major commercial port	Fully in set	1	14
No major port	Out of set	0	50

Table 1.32. Major Port fuzzy set membership for BOEM-defined parishes (2010).

Port Status	Verbal Level	Fuzzy Set Membership Score	Number
Parish has major commercial port	Fully in set	1	13
No major port	Out of set	0	19

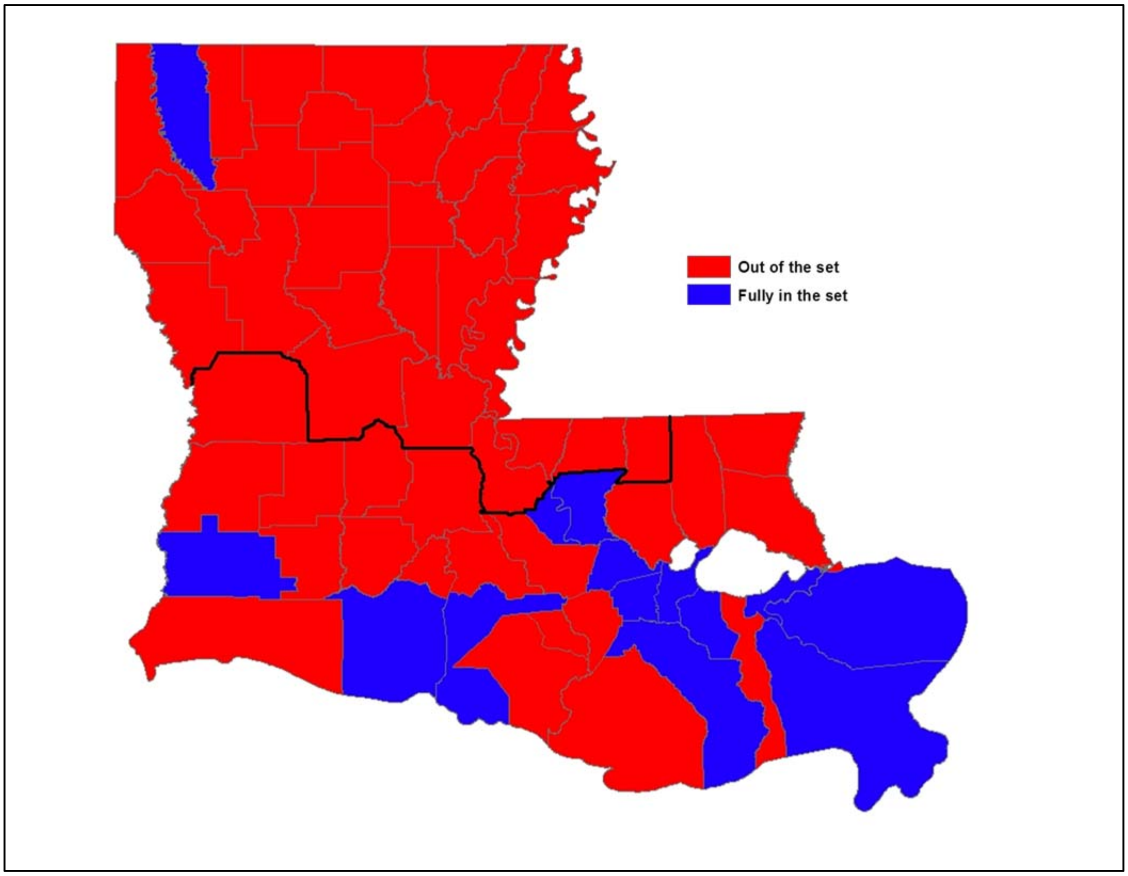

Figure 1.16.Major Port fuzzy set membership.

1.2. Labor Market Profile Overview

This profile uses fuzzy set theory to develop profile elements using available secondary economic and employment data. The fuzzy set approach is generally qualitative and focuses on making meaningful distinctions across sets of units, in this case, parishes in Louisiana and the BOEM-defined impact area. The approach can help to group or organize quantitative data into meaningful categories of set membership. We organize our profile into two sections (see the outline below). Each section contains a range of fuzzy set profile elements. This report focuses on the presentation of the fuzzy set profile elements.

Labor Market Outline

- Labor Market Resources
    - Substantial Mining Employment
    - Small Business Intensive
    - Large Business Presence

- Labor Market Outcomes
  - Low Unemployment
  - Job Growth
  - Competitive per Capita Personal Income

1.2.1. Labor Market Resources

Different levels of availability and access to resources can be an important advantage or disadvantage for parish labor markets. In this section, we developed three fuzzy set elements that focus on these resources and how they contribute to and define each parish's potential for economic functioning or development.

1.2.1.1. Substantial Mining Employment

Definition. Using data from the Bureau of Economic Analysis (BEA) 2006 Regional Economic Information System (REIS), this fuzzy set illustrates the extent to which oil and gas or mining employment is a substantial contribution to the labor market. The REIS data provide information on the level of employment in each industry per parish. This set considers the number of individuals employed in the Mining industry in each parish. To be considered fully in the set of parishes with substantial mining employment, there must be 1,000 people or more employed in this industry. Those parishes that employ fewer than 100 people in this industry are out of the set.

Discussion and Description. Table 1.33 indicates that only 11 Louisiana parishes are fully in the set of those with substantial employment in the Mining industry. Further, only six additional parishes are more in the set than out with 550–999 employees in this category. Eleven parishes are out of the set because they have fewer than 100 employees in this industry. Due to missing data, not all 64 parishes are represented in this table.

Table 1.34 represents the fuzzy set scores for the 32 BOEM-defined parishes. Nine of the original 11 parishes that were fully in the set in Table 1.34 are within the BOEM-defined impact area. The remaining 17 parishes were non-members of the set, only four of which were out of the set with fewer than 100 employees. A breakdown of specific parish membership in this set is presented in Figure 1.17.

Table 1.33. Substantial Mining Employment fuzzy set membership for all Louisiana parishes (2006).

People Employed in Mining	Verbal Label	Fuzzy Set Membership Score	Number (REIS)	Examples
More than 1000	Fully in the set	1.00	11	Lafayette* at 16,385, 1.00 Terrebonne at 5,780, 1.00
550–999	More in than out of the set	0.50 -0.99	6	St. Landry at 623, 0.58 E. Baton Rouge at 849, 0.83
99–550	More out of than in the set	0.01-0.49	16	Iberville at 121, 0.02 St. Martin at 489, 0.43
Fewer than 100	Out of the set	0.00	11	Avoyelles* at 29, 0.00 Vernon at 73, 0.00

*highest and lowest values in range

Table 1.34. Substantial Mining Employment fuzzy set membership for BOEM-defined parishes (2006).

People Employed in Mining	Verbal Label	Fuzzy Set Membership Score	Number (REIS)	Examples
More than 1000	Fully in the set	1.00	9	Lafayette at 16,385, 1.00 Terrebonne at 5,780, 1.00
550–999	More in than out of the set	0.50 -0.99	5	St. Landry at 623, 0.58 E. Baton Rouge at 849, 0.83
99–550	More out of than in the set	0.01-0.49	8	Iberville at 121, 0.02 St. Martin at 489, 0.43
Fewer than 100	Out of the set	0.00	4	Vernon at 73, 0.00 Evangeline at 42, 0.00

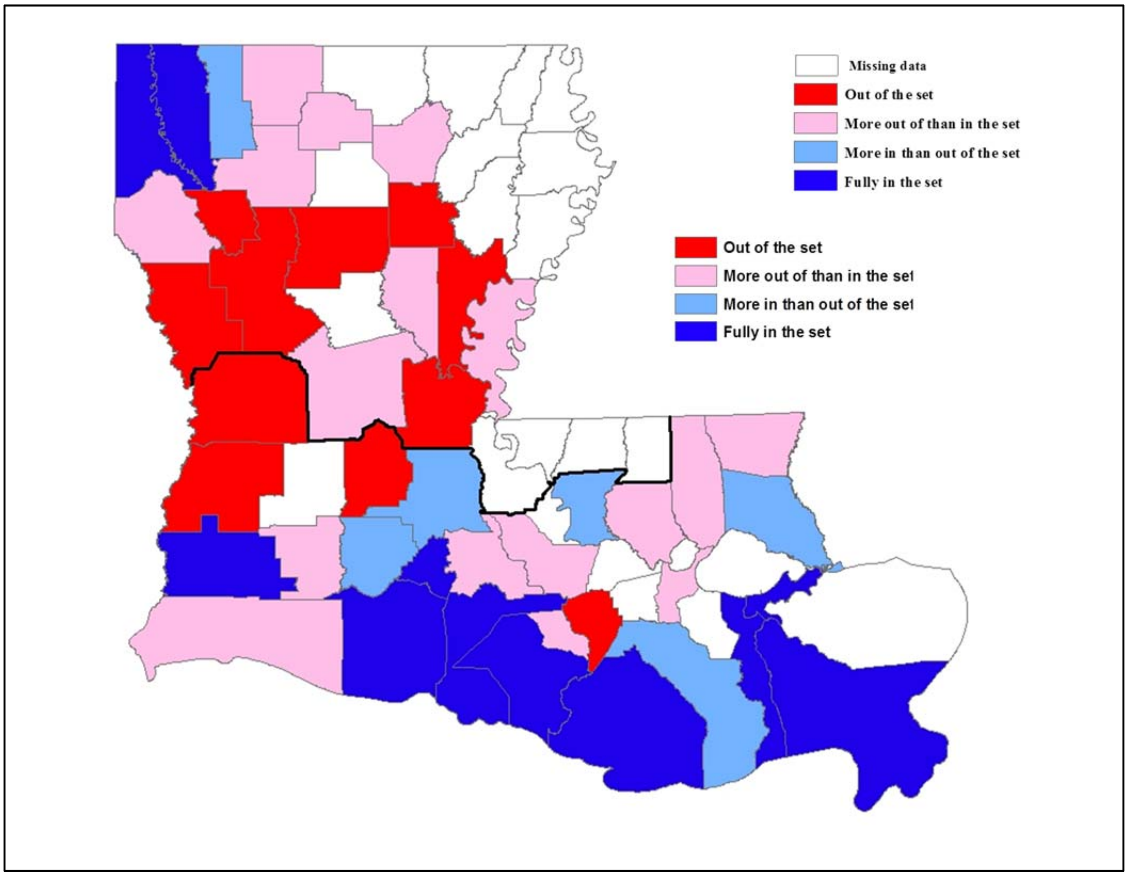

Figure 1.17.Substantial Mining Employment fuzzy set membership.

1.2.1.2. Small Business Intensive

Definition. This table examines parish labor market size based on the percentage of businesses with fewer than 10 employees. If three-fourths or more of a parish's businesses employ fewer than 10 people, it is considered fully in the set of parishes that are Small Business Intensive. Parishes with two-thirds or fewer businesses employing 10 or fewer people are out of the set of small business intensive parishes.

Discussion and Description. Table 1.35 illustrates the many small labor market structures present in Louisiana. A total of 30 parishes are full members of the set with three-fourths or more of their businesses employing fewer than 10 people. By comparison, only two parishes lie fully outside the set. This leaves 32 parishes in Louisiana in the middle categories with partial membership in this set.

Table 1.36 illustrates that, still, only two parishes within the BOEM-defined parishes are out of this set. Ten are fully in the set with three-fourths or more small business, and 20 occupy the middle two categories and are partial members. A breakdown of specific parish membership in this set is presented in Figure 1.18.

Table 1.35. Small Business Intensive fuzzy set membership for all Louisiana parishes (2006).

Percent of Businesses with Fewer than 10 Employees*	Verbal Label	Fuzzy Set Membership Score	Number	Examples
Greater than 75%	Fully in the set	1.00	30	Allen at 80.65%, 1.00 St. Bernard at 82.99%, 1.00
70.83% – 75%	More in than out	0.50-0.99	14	Acadia at 74.93%, 0.99 Jefferson at 71.76%, 0.61
66.67% – 70.83%	More out than in	0.01-0.49	18	Ascension at 68.46%, 0.22 Iberia at 66.86%, 0.02
Less than 66.67%	Out of the set	0.00	2	St. John at 66.25%, 0.00 West Baton Rouge at 61.18%, 0.00

*Note that in almost all parishes the majority of businesses are considered small

Table 1.36. Small Business Intensive fuzzy set membership for BOEM-defined parishes (2006).

Percent of Businesses with Fewer than 10 Employees*	Verbal Label	Fuzzy Set Membership Score	Number	Examples
Greater than 75%	Fully in the set	1.00	10	Allen at 80.65%, 1.00 St. Bernard at 82.99%, 1.00
70.83% – 75%	More in than out	0.50-0.99	9	Acadia at 74.93%, 0.99 Jefferson at 71.76%, 0.61
66.67% – 70.83%	More out than in	0.01-0.49	11	Ascension at 68.46%, 0.22 Iberia at 66.86%, 0.02
Less than 66.67%	Out of the set	0.00	2	St. John at 66.25%, 0.00 West Baton Rouge at 61.18%, 0.00

*Note that in almost all parishes the majority of businesses are considered small

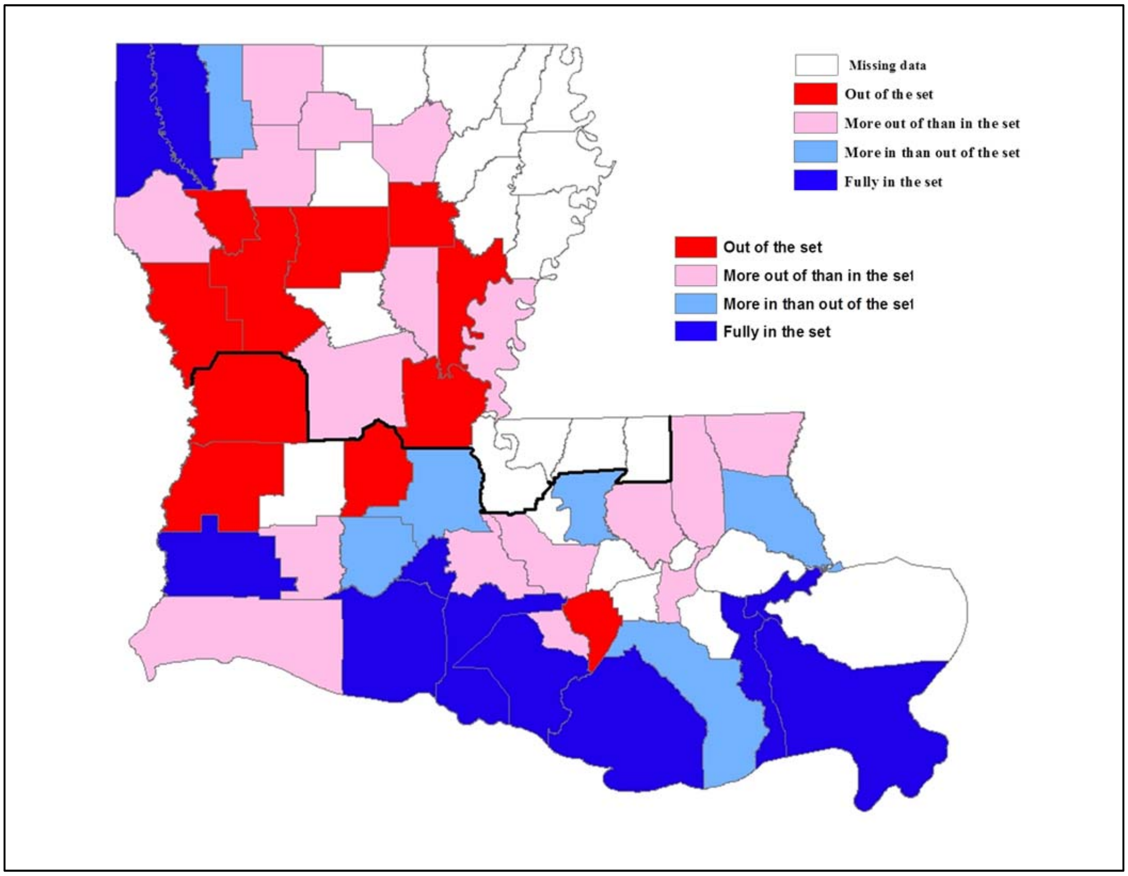

Figure 1.18.Small Business Intensive fuzzy set membership.

1.2.1.3. Large Business Presence

Definition. We define Large Business Presence by drawing on data that indicates the number of employees at each business. In this fuzzy set, it is estimated that 100 or more employees qualifies as a large business. In this table, parishes with 40 or more businesses that employ 100 or more people are considered fully in the set.

Discussion and Description. When the definition business size is altered to measure large parishes, Table 1.37 indicates that 14 parishes in Louisiana are fully in the set of parishes with a large business presence. On the other hand, as in tables in the previous section, almost half of the parishes (33) are in the smaller category, this time defined as 10 or fewer businesses with 100 or more employees. Further, when we add in the 12 parishes that are more out than in this set, it appears that the majority of parish economies in Louisiana (45) are composed mostly of small businesses.

Interestingly, of the 14 parishes with a large business presence from Table 1.37, 10 are BOEM-defined parishes, as seen in 1.38. This time, though, the majority of parishes are not out of the set with 10 or fewer large businesses. The parish economies in the BOEM-defined impact area seem to be reasonably equally dispersed across the categories with the smallest number (four parishes) being in the "more in than out" category of 25–40 businesses with 100 or more employees. A breakdown of specific parish membership in this set is presented in Figure 1.19.

Table 1.37. Large Business Presence fuzzy set membership for all Louisiana parishes (2006).

Number of Businesses with 100 or More Employees	Verbal Label	Fuzzy Set Membership Score	Number	Examples
40 or more	Fully in the set	1.00	14	E Baton Rouge with 363, 1.00 St. Tammany with 80, 1.00
25–40	More in than out	0.50-0.99	5	St. Charles with 35, 0.83 St. Landry with 28, 0.60
10–25	More out than in	0.01-0.49	12	Vernon with 12, 0.07 St. John with 19, 0.30
10 or fewer	Out of the set	0.00	33	Vermillion with 8, 0.00 Cameron with 1, 0.00

Table 1.38. Large Business Presence fuzzy set membership for BOEM-defined parishes (2006).

Number of Businesses with 100 or More Employees	Verbal Label	Fuzzy Set Membership Score	Number	Examples
40 or more	Fully in the set	1.00	10	East Baton Rouge with 363, 1.00 St. Tammany with 80, 1.00
25–40	More in than out	0.50-0.99	4	St. Charles with 35, 0.83 St. Landry with 28, 0.60
10–25	More out than in	0.01-0.49	10	Vernon with 12, 0.07 St. John with 19, 0.30
10 or fewer	Out of the set	0.00	8	Vermillion with 8, 0.00 Cameron with 1, 0.00

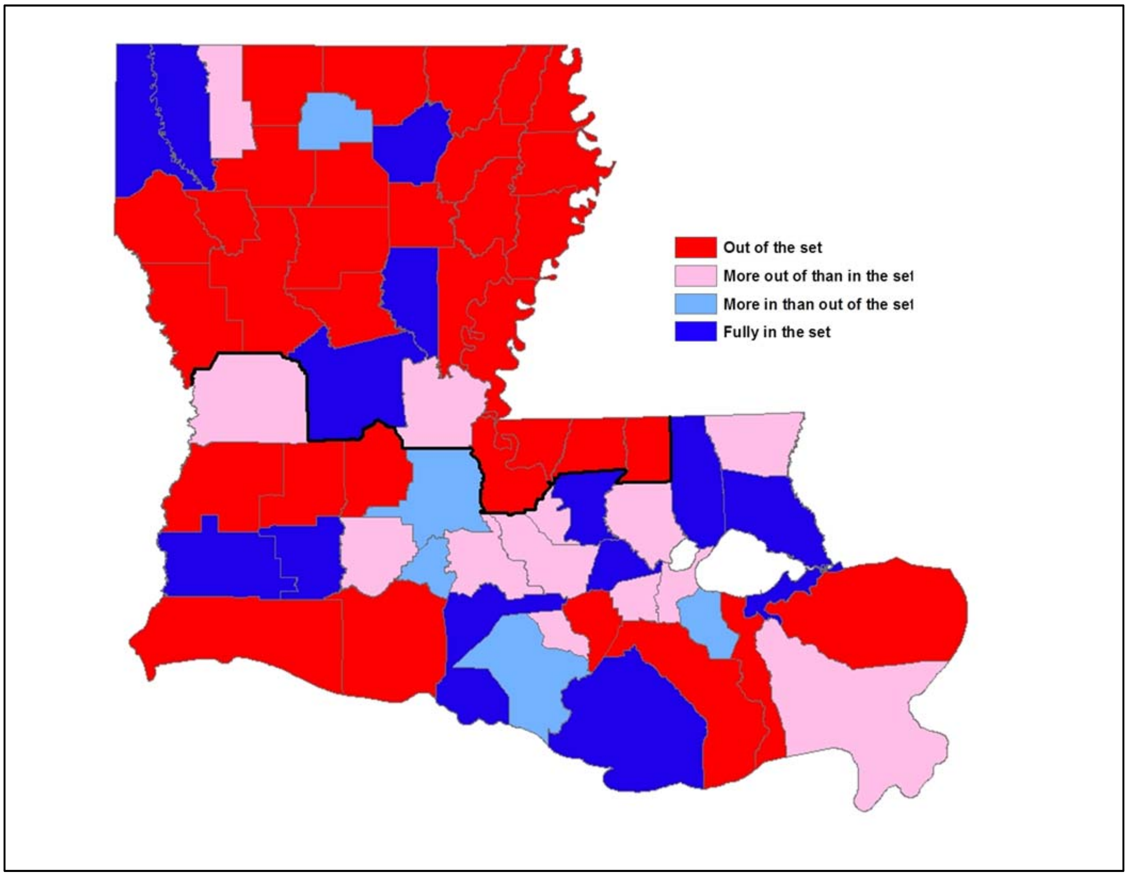

Figure 1.19.Large Business Presence fuzzy set membership.

1.2.2. Outcomes

1.2.2.1. High Unemployment

Definition. To define High Unemployment parishes, we draw upon annual estimates of employment data from the 2010 Bureau of Economic Analysis, Regional Economic Information System. High unemployment is defined as being higher than 9%; parishes that experience unemployment at or above the 9% level are considered fully within the high unemployment fuzzy set. Full employment is considered an unemployment rate below 6%, parishes with 6% or lower unemployment are considered outside the fuzzy set. Those parishes with between 6% and 9% unemployment rates are considered partially within the fuzzy set to the degree that their respective unemployment rates warrant.

Discussion and Description. In the state of Louisiana, 19 parishes can be considered fully within the high unemployment fuzzy set because they exhibit a high unemployment rate. An additional 39 parishes within Louisiana have experienced unemployment between 6% and 9% and are considered partially within the fuzzy set. Only seven parishes within Louisiana have less than a 6% unemployment rate.

Within the BOEM-defined parishes, eight had unemployment rates sufficient to classify them as fully within the high unemployment fuzzy set. There were an additional 20 parishes partially within the set to varying degrees based on their level of unemployment. Five parishes are considered outside of the high unemployment fuzzy set because they have low levels of relative unemployment. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.39–1.40 and Figure 1.20.

Table 1.39. High Unemployment fuzzy set membership for all Louisiana parishes (2010).

Unemployment Rate	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 9%	Fully in set	1	19
7.5% – 9%	More in set than out of set	0.5-0.999	21
6% – 7.5%	More out than in set	0.001-0.49	18
Lsss than 6%	Out of set	0	7

Table 1.40. High Unemployment fuzzy set membership for BOEM-defined parishes (2010).

Unemployment Rate	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 9%	Fully in set	1	8
7.5% – 9%	More in set than out of set	0.5-0.999	6
6% – 7.5%	More out than in set	0.001-0.49	14
Less than 6%	Out of set	0	5

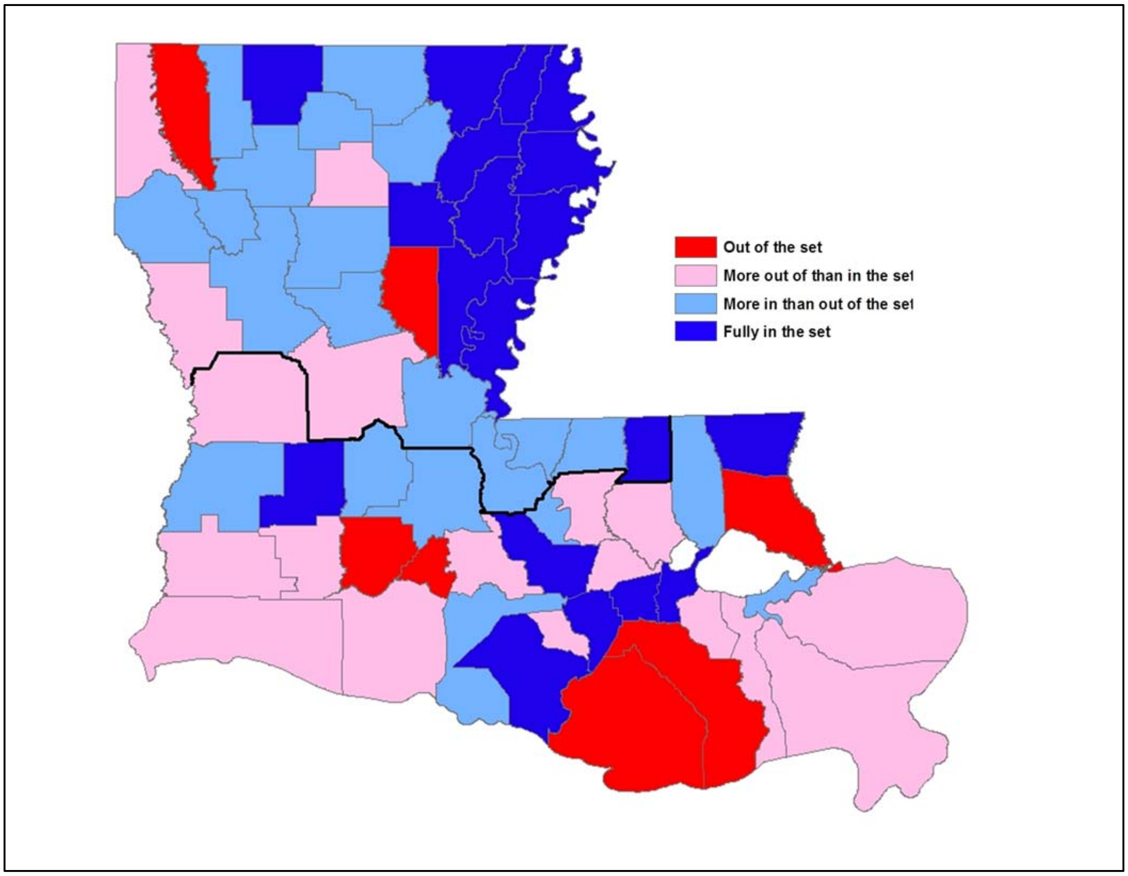

Figure 1.20.High Unemployment fuzzy set membership.

1.2.2.2. Job Growth

Definition. A measure of job growth was created using unemployment and job creation data from 2009 and 2010. The number of new jobs created between 2009 and 2010 is represented as a proportion of the total jobs in the parish in 2010. For the purpose of this fuzzy set, parishes with a job growth rate x above 2.0 are considered fully within the job growth fuzzy set. Parishes that have lost jobs or not created any jobs and as such score 0 or below are considered outside of the fuzzy set. Parishes with index scores between 0 and 2 are considered partially within the set.

Discussion and Description. In the state of Louisiana, nine parishes can be considered fully within the job growth fuzzy set by exhibiting a large amount of job growth. An additional 24 parishes within Louisiana have experienced some job growth and are considered partially within the fuzzy set. There are 27 parishes within Louisiana that had no job growth or lost jobs between 2009 and 2010.

Within the BOEM-defined parishes, three had job growth proportions sufficient to classify them as fully within the job growth fuzzy set. An additional 12 parishes were partially within the set to varying degrees based on their level of job growth. A full 17 parishes are considered outside of the job growth fuzzy set because they experienced no job growth or lost jobs over the past year.

Table 1.41. Job Growth fuzzy set membership for all Louisiana parishes (2009–2010).

Job Creation Rate	**Verbal Level**	**Fuzzy Set Membership Score**	**Number**
Greater than 2.0	Fully in set	1	9
1.0 – 2.0	More in set than out of set	0.5-0.999	3
0.0 – 1.0	More out than in set	0.001-0.49	21
No Job Creation Or Net Job Loss	Out of set	0	27

Table 1.42. Job Growth fuzzy set membership for BOEM-defined parishes (2009–2010).

Job Creation Rate	**Verbal Level**	**Fuzzy Set Membership Score**	**Number**
Greater than 2.0	Fully in set	1	3
1.0 – 2.0	More in set than out of set	0.5-0.999	1
0.0 – 1.0	More out than in set	0.001-0.49	11
No Job Creation Or Net Job Loss	Out of set	0	17

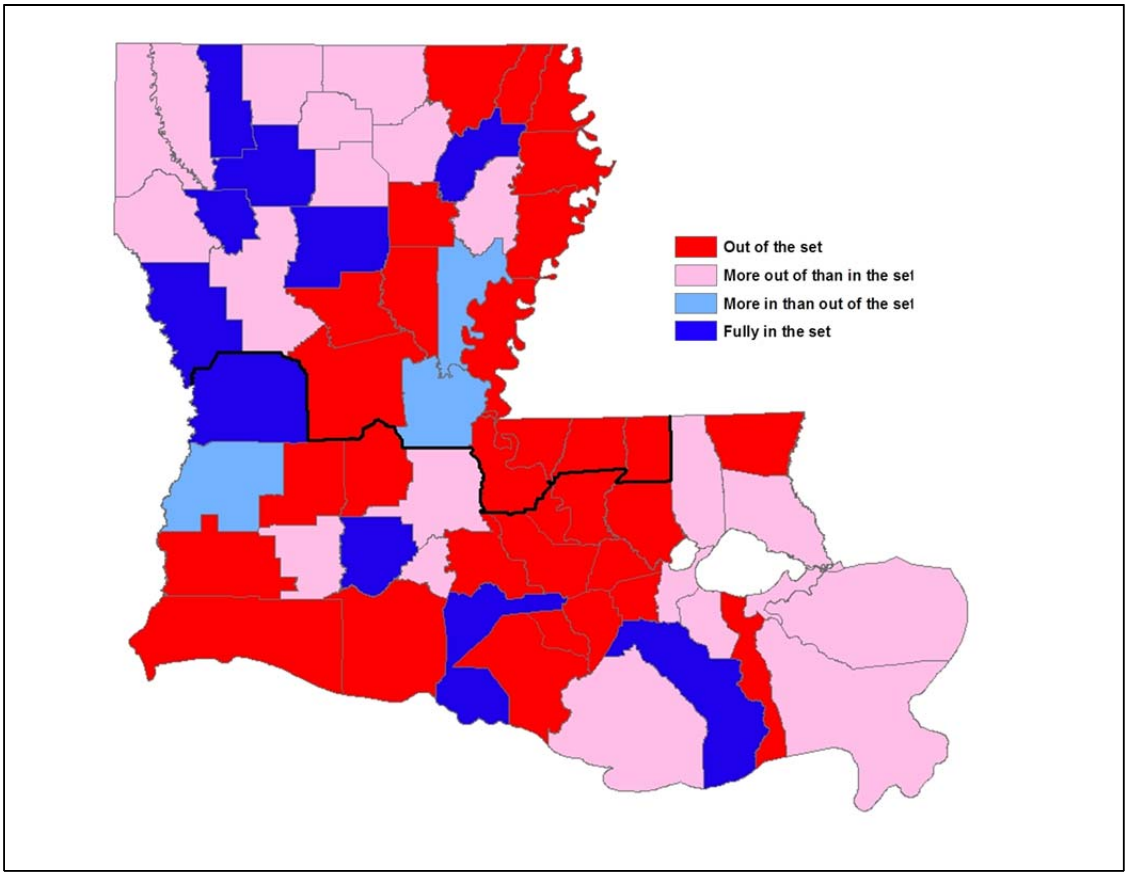

Figure 1.21.Job Growth fuzzy set membership.

1.2.2.3. Competitive Per Capita Income

Definition. Tables 1.43 and 1.44 present fuzzy sets of parishes that offer competitive per capita personal income according to 2006 REIS data. Table 1.43 presents the fuzzy set for all parishes in Louisiana, while Table 1.44 presents the fuzzy set for the 32 parishes in the BOEM-defined impact region.

The fuzzy set compares the per capita personal income in each parish to the per capita income for Louisiana. We defined Louisiana parishes as fully in the set of parishes offering a competitive income (FS=1) if the parish's per capita income is at or above that of Louisiana. We defined the Louisiana parishes as being fully out of the set (FS=0) if the personal income of the parish is below the average per capita personal income of the bottom quartile of parishes.

Discussion and Description. Table 1.43 shows that only 12 Louisiana parishes are fully in the set, meaning they offer competitive per capita personal income as compared to that of the Louisiana average ($38,821). Conversely, six Louisiana parishes are out of the set of parishes offering this competitive income, because theirs fall below the average of the bottom quartile ($22,054). A majority of the parishes, 46, are partial members of the set offering competitive incomes. A total of 13 of these are more in than out because their averages are closer to the Louisiana average than to the bottom quartile average, and 33 are more out then in because their average per capita incomes are closer to the bottom quartile average.

Table 1.44 shows that of the original 12 parishes that are full members of this set, all but two are within the BOEM-defined impact area. Another eight are more in than out of the set, and only two of the impact area parishes are fully out of the set.

Table 1.43. Per Capita Income fuzzy set membership for all Louisiana parishes (2006).

Per Capita Income	**Verbal Label**	**Fuzzy Set Membership Score**	**Number (REIS)**	**Examples**
Greater than or equal to per capita income for LA ($31,821)	Fully in the set	1.00	12	St. Tammany at $34,760, 1.00 St. Bernard* at $61,201, 1.00
$26,938–$31,820	More in than out of the set	0.50 -0.99	13	Calcasieu at $30,488, 0.86 St. John the Baptist at $27,257, 0.53
$26,937-$22,053	More out of than in the set	0.01-0.49	33	St. Landry at $24,731, 0.27 Vermillion at $23,358, 0.13
Less than average per capita income of bottom quartile in US ($22,054)	Out of the set	0.00	6	Evangeline at $20,216, 0.00 Allen* at $19,386, 0.00

*largest and smallest values in the range

Table 1.44. Per Capita Income fuzzy set membership for BOEM-defined parishes (2006).

Per Capita Income	**Verbal Label**	**Fuzzy Set Membership Score**	**Number (REIS)**	**Examples**
Greater than or equal to per capita income for LA ($31,821)	Fully in the set	1.00	10	St. Tammany at $34,760, 1.00 St. Bernard* at $61,201, 1.00
$26,938–$31,820	More in than out of the set	0.50 -0.99	8	Calcasieu at $30,488, 0.86 St. John the Baptist at $27,257, 0.53
$26,937-$22,053	More out of than in the set	0.01-0.49	12	St. Landry at $24,731, 0.27 Vermillion at $23,358, 0.13
Less than average per capita income of bottom quartile in US ($22,054)	Out of the set	0.00	2	Evangeline at $20,216, 0.00 Allen* at $19,386, 0.00

*largest and smallest values in the range

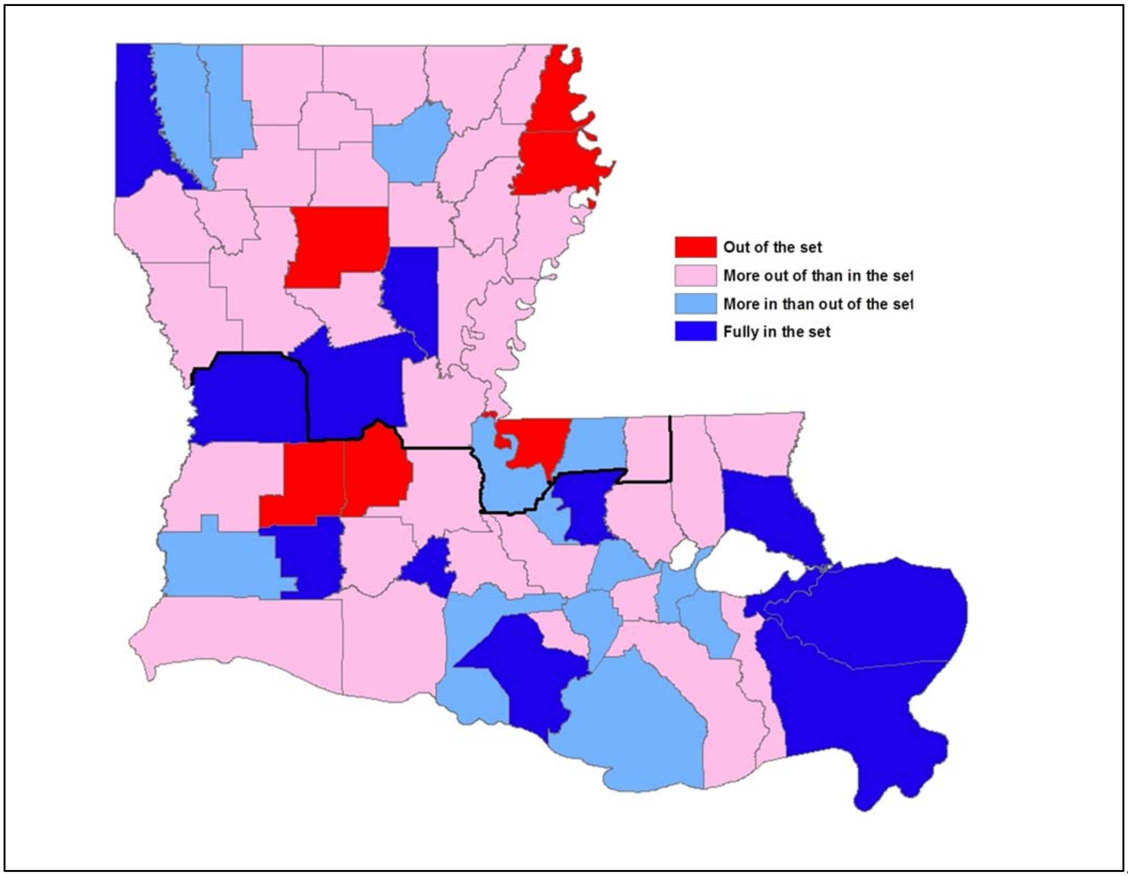

Figure 1.22. Per Capita Income fuzzy set membership.

1.3. EDUCATION PROFILE OVERVIEW

The Education Profile provides a way of grouping similar parishes together on the basis of education indicators. We organize our profile into four sections, each containing a range of fuzzy set profile elements. The four sections—Resources, Outcomes, Student Characteristics, and District Process—allow us to compare and contrast parish/school districts across a range of educational indicators.

Education Profile Outline

- Education Resources
    - Competitive teacher salary
    - Substantial local capacity
    - Onshore oil and gas industry influence
    - Focus on instruction

- Education Outcomes
    - Adequate school performance
    - Few low-performing schools
    - District improvement
    - First-time freshmen
- Student Characteristics
    - Districts with high percentage of at-risk students (free/reduced lunch)
    - Districts with high percentage of African American students
- District Processes
    - District with high drop-out rate
    - Many disciplinary cases
    - Student retention (grade repeat)
    - Small district
    - Large district
    - Large non-public school enrollment

1.3.1. Education Resources

Education resources enable comparisons of school district capacity to hire qualified teaching staff, to spur local investment in schools, to secure resources from the oil and gas industry for education, and to channel resources toward instruction. Therefore, we developed four fuzzy set elements that focus on the capacity of local school districts to obtain and use the necessary resources for maintaining high quality schools.

1.3.1.1. Competitive Teacher Salary

Definition. Tables 1.45 and 1.46 present fuzzy sets of school districts offering competitive teacher salaries for the 2007–2008 school year. Table 1.45 presents the fuzzy set for all school districts in Louisiana, and Table 1.46 presents the fuzzy set for all school districts within the 32-parish BOEM-defined impact region.

The fuzzy set compares the average teacher's salary in the school district with the Southern Regional Educational Board (SREB) average salary. The SREB consists of 16 states in the southern part of the United States. We defined Louisiana school districts as fully in the set of districts offering a competitive teacher's salary (FS=1) if the parish's average teacher salary matches or exceeds the SREB average. We defined the Louisiana school districts as being fully out of the set (FS=0) if the average salary of the parish is less than the average of the four SREB states in the bottom quartile of teacher salaries.

Discussion and Description. Table 1.45 shows that 36 Louisiana school districts are fully in the set, meaning they clearly offer competitive teacher salaries higher than the SREB average ($45,662 in 2007–2008). Conversely, 15 Louisiana school districts are out of the set of districts offering competitive teacher salaries, because their average salaries fall below the average of the bottom quartile average ($34,227 in 2007–2008). A total of 18 districts are partial members of the set of districts offering competitive teacher salaries. Further, 10 of these are more in than out because their average teacher salaries are closer to the overall SREB average than to the bottom quartile SREB average, and eight are more out then in because their average salaries are closer to the bottom quartile average.

Table 1.46 shows that 19 of the 32 school districts in the BOEM-defined impact areas have full membership in the set of those offering competitive teacher salaries, and another seven partial members are more in than out of the set. Only four of the 15 nonmembers of the set of districts offering competitive teacher salaries are in the BOEM-defined impact area.

Figure 1.23 shows that most of the parishes that do not offer a competitive teacher salary are clustered in the Northeast region of Louisiana with a few exceptions. The six parishes in the BOEM-defined region not in the set of those offering competitive salaries are rural parishes with small populations.

Table 1.45. Competitive Teacher Salaries fuzzy set membership for all Louisiana parishes (2007–2008).

Teacher Salary	Verbal Label	Fuzzy Set Membership Score	Number (LDE 2007-08)	Examples
Greater than or equal to SREB average ($45,662)	Fully in the set	1.00	36	Natchitoches** at $52,389, 1.00 Calcasieu at $46,630, 1.00
$44,445–$45,661	More in than out of the set	0.50 -0.99	10	Vermillion at $45,445, 0.91 Terrebonne at $44,717, 0.61
$43,228–$44,444	More out of than in the set	0.01-0.49	8	Lafourche at $43,453, 0.09 Washington at $43,373, 0.06
Less than average of SREB's lowest quartile* ($43,227)	Out of the set	0.00	15	Cameron at $40,579, 0.00 St. Helena** at $34,670, 0.00

*Arkansas, Mississippi, Oklahoma, West Virginia
**lowest and highest values in the range

Table 1.46. Competitive Teacher Salaries fuzzy set membership for BOEM-defined parishes (2007–2008).

Teacher Salary	Verbal Label	Fuzzy Set Membership Score	Number (LDE 2007-08)	Examples
Greater than or equal to SREB average ($45,662)	Fully in the set	1.00	19	Calcasieu at $46,630, 1.00 Vernon at $45,933, 1.00
$44,445–$45,661	More in than out of the set	0.50 -0.99	7	Vermillion at $45,445, 0.91 Terrebonne at $44,717, 0.61
$43,228–$44,444	More out of than in the set	0.01-0.49	2	Lafourche at $43,453, 0.09 Washington at $43,373, 0.06
Less than average of SREB's lowest quartile* ($43,227)	Out of the set	0.00	4	Cameron at $40,579, 0.00 Assumption at $42,959, 0.00

*Arkansas, Mississippi, Oklahoma, West Virginia

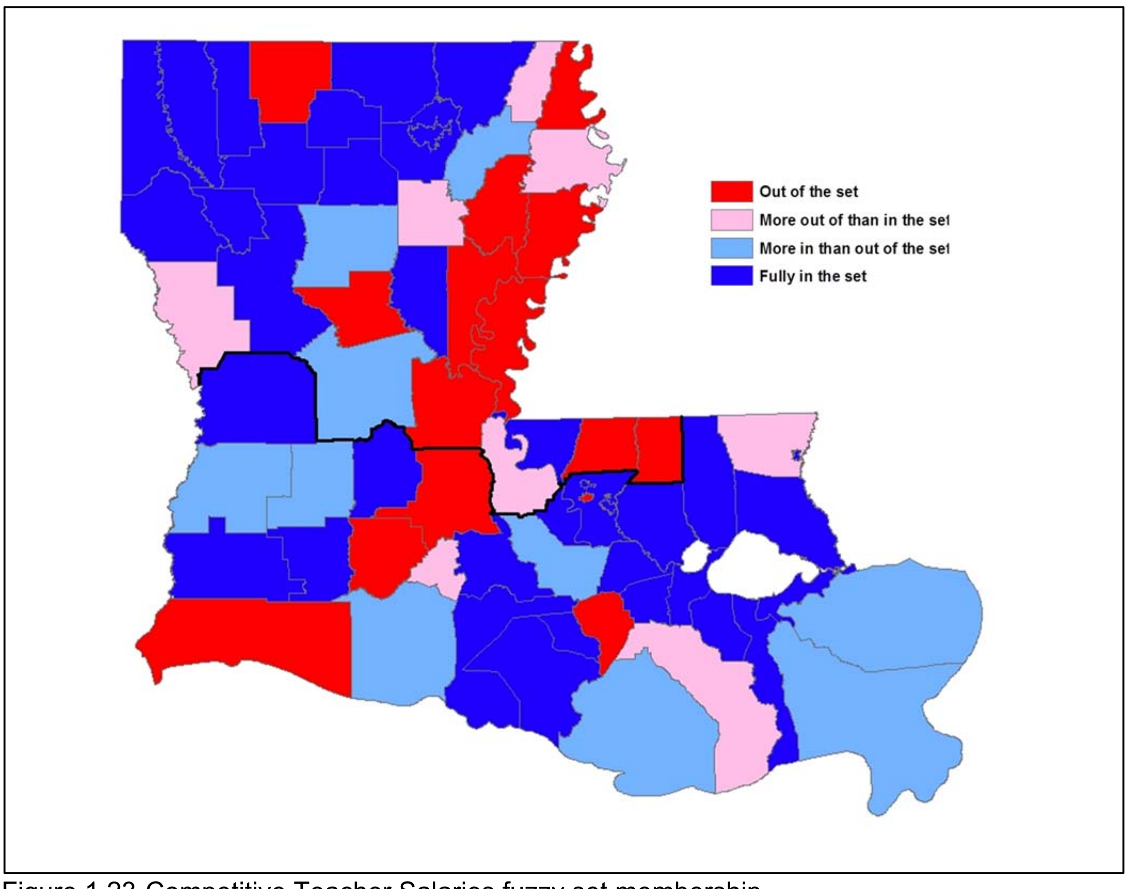

Figure 1.23.Competitive Teacher Salaries fuzzy set membership.

1.3.1.2. Substantial Local Capacity

Definition. Resources for public schooling come primarily from state and local sources of funding. Louisiana has put in place a system that balances the redistribution of state dollars for education to low income areas with an incentive structure to encourage local communities to contribute to public schooling. The Minimum Foundation Program (MFP) collects data on the amount of local revenue collected and details on the percentage of local revenue contributed to schooling.

Using Louisiana's Minimum Foundation Program formula, in this table we compare actual local contribution to spending on education as compared to the amount of revenue the parish produces that is eligible for contribution. If the parish is contributing 75% or more of its eligible revenues toward their share of school spending, it is fully in the set of parishes with a substantial local capacity for supporting the school system. If it uses less than 35%, however, it is fully out of that set.

Discussion and Description. Table 1.47 shows that 15 Louisiana school districts are fully in the set, meaning they are able to substantially contribute to their share of school spending. Conversely, 21 Louisiana school districts are out of the set because they contributed only 35% or less of their eligible revenue toward school spending. A total of 35 districts are partial members of this set. Further, 23 are more in than out because their percent of eligible revenues that went toward school spending was closer to the full membership goal of 75% than to the minimum of 35%, and 12 are more out then in because the percentage of their contributions falls closer to 35%.

Table 1.48 shows that 11 of the 32 school districts in the BOEM-defined impact areas have full membership in the set of those contributing 75% or more of eligible revenues toward education, while eight are more in than out of the set. Only six districts of the 32 BOEM-defined impact area parishes are out of the set of parishes that are substantially able to contribute to education spending.

Figure 1.24 shows that most of the parishes that are not in the set of parishes that substantially contribute to their share of spending on education are clustered in the Northeast region of Louisiana. It is also apparent that several of the southern members of the 32 BOEM-defined impact areas are either full or partial members of the set.

Table 1.47. Substantial Local Capacity fuzzy set membership for all Louisiana parishes (2008–2009).

Use of Local Revenues for Education	Verbal Label	Fuzzy Set Membership Score	Number (MFP 2008-09)	Examples
Used great than 75% of eligible revenues	Fully in the set	1.00	15	Plaquemines* at 129%, 1.00 Cameron at 82.90%, 1.00
Used 55–75% of eligible revenues	More in than out of the set	0.50 -0.99	23	Vermilion at 55.28%, 0.50 Calcasieu at 66.49%, 0.78
Used 35–55% of eligible revenues	More out of than in the set	0.01-0.49	12	Jefferson-Davis at 35.93%, 0.02 Natchitoches at 46.31%, 0.28
Used less than 35% of eligible revenues	Out of the set	0.00	21	Grant* at 18.83%, 0.00 Livingston at 24.80%, 0.00

*****Highest and lowest values in the range

Table 1.48. Substantial Local Capacity fuzzy set membership for BOEM-defined parishes (2008–2009).

Use of Local Revenues for Education	Verbal Label	Fuzzy Set Membership Score	Number (MFP 2008-09)	Examples
Used great than 75% of eligible revenues	Fully in the set	1.00	11	Plaquemines at 129%, 1.00 Cameron at 82.90%, 1.00
Used 55–75% of eligible revenues	More in than out of the set	0.50 -0.99	8	Vermilion at 55.28%, 0.50 Calcasieu at 66.49%, 0.78
Used 35–55% of eligible revenues	More out of than in the set	0.01-0.49	7	Jefferson-Davis at 35.93%, 0.02 Iberia at 45.99%, 0.27
Used less than 35% of eligible revenues	Out of the set	0.00	6	Livingston at 24.80%, 0.00 Assumption at 31.44%, 0.00

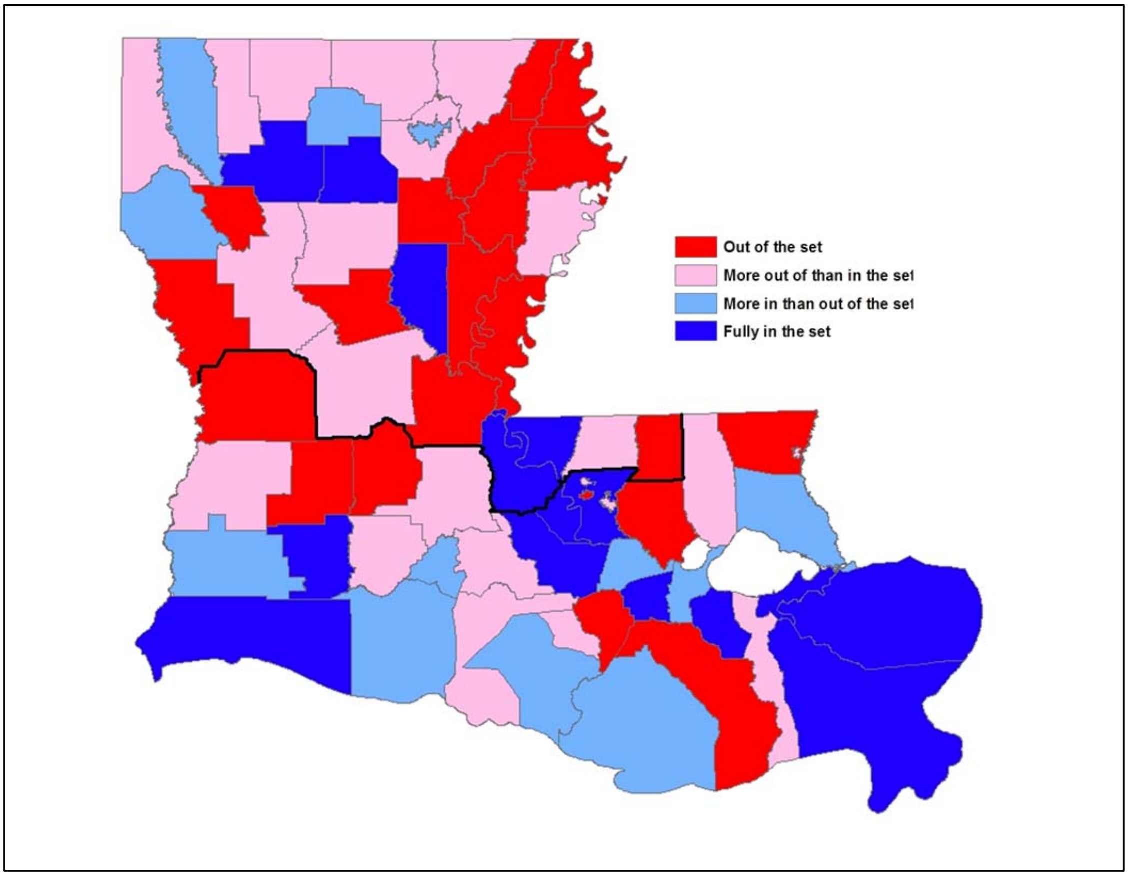

Figure 1.24. Substantial Local Capacity fuzzy set membership.

1.3.1.3. Onshore Oil and Gas Revenue Influence

Definition. The Minimum Foundation Program also provides data on the sources of revenue for each parish. In the "Other" category, revenues that come from oil and gas royalties and forestry are represented. Though many parishes receive oil and gas revenues, only some allocate substantial percentages of those revenues toward education. To be considered fully in the set of districts with an oil and gas influence on education, the Other revenue category must comprise 5% or more of the total revenue for that parish. Those with Other revenues below 2% of the total are out of the set.

Discussion and Description. Table 1.49 indicates that only five Louisiana schools districts are fully in the set of those that exhibit an oil and gas revenue influence. Further, only one district is more in the set than out, because, at 3.92%, East Feliciana is closer to being above 5% than to the minimum of below 2%. The vast majority, 63 districts, are either out of the set or more out than in, and 43 districts out of the set of parishes with an oil and gas influence and 20 with percentages closer to the low of 2% and therefore more out than in.

Table 1.50 represents the fuzzy set scores for the 32 BOEM-defined impact areas. Only two districts had Other revenues above 5%, Cameron and Vermillion Parishes, and none of the BOEM impact districts were more in than out of the set. The remaining 30 districts were non-members of the set. Further, 24 districts received less than 2% revenues that were classified in the Other category and so are out of the set of districts considered to have oil and gas influence. The remaining six districts had between 3.5% and the 2% minimum and so are more out of the set than in.

Figure 1.25 maps the fuzzy set scores of all the LA parishes and the percent in their Other category. As only six parishes are full or partial members of the set, most of the map is colored red or pink to indicate the districts that are out of the set or more out than in. Many of the districts that are out of the set are clustered around Southeast and North- and Southwest regions of the state.

Table 1.49. Oil and Gas Revenue Reliance fuzzy set membership for all Louisiana parishes (2008–2009).

Percent 'Other' Revenue	Verbal Label	Fuzzy Set Membership Score	Number (MFP 2008-09)	Examples
Greater than 5%	Fully in the set	1.00	5	Cameron at 10.65%, 1.00 Vermilion at 11.91%, 1.00
3.5% – 5%	More in than out	0.50-0.99	1	East Feliciana at 3.92%, 0.64
2% – 3.5%	More out than in	0.01-0.49	20	Natchitoches at 3.36%, 0.45 Terrebonne at 2.90%, 0.30
Less than 2%	Out of the set	0.00	43	Ascension* at 0.25%, 0.00 Plaquemines at 0.69%, 0.00

*Lowest value in range

Table 1.50. Oil and Gas Revenue Reliance fuzzy set membership for BOEM-defined parishes (2008–2009).

Percent 'Other' Revenue	Verbal Label	Fuzzy Set Membership Score	Number (MFP 2008-09)	Examples
Greater than 5%	Fully in the set	1.00	2	Cameron at 10.65%, 1.00 Vermilion at 11.91%, 1.00
3.5% – 5%	More in than out	0.50-0.99	0	None
2% – 3.5%	More out than in	0.01-0.49	6	Terrebonne at 2.90%, 0.30 St. Landry at 2.08%, 0.03
Less than 2%	Out of the set	0.00	24	Ascension* at 0.25%, 0.00 Plaquemines at 0.69%, 0.00

*Lowest value in range

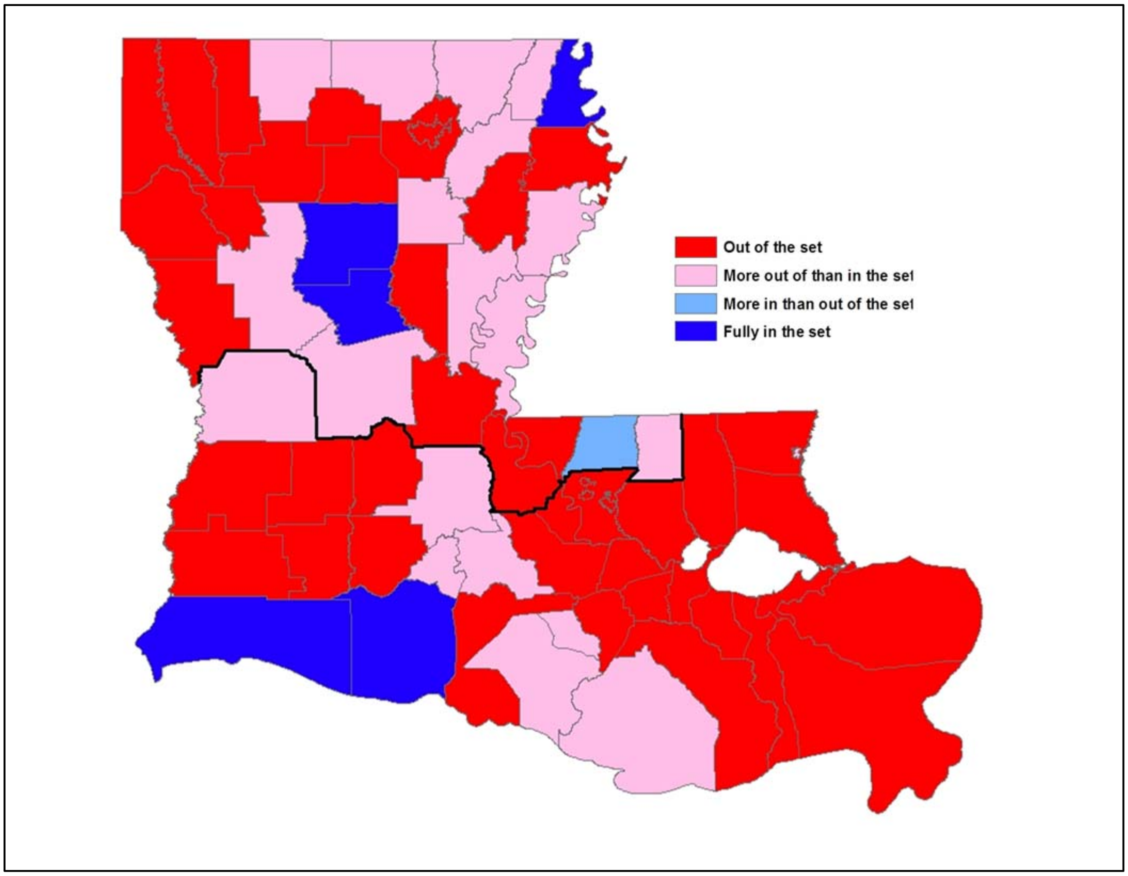

Figure 1.25. Oil and Gas Revenue Reliance fuzzy set membership.

1.3.1.4. Focus on Instruction

Definition. The Louisiana Department of Education recommends that districts devote a minimum of 70% of education expenditures to instruction. The Minimum Foundation Program outlines what percentage of spending is devoted to instruction in each district, and these tables examine which districts do and do not meet these expectations, along with which exceed the 70% minimum.

Compare percent of expenditures on instruction for each district to the overall goal of 70%. To be fully in the set of parishes that exceeded this goal, the percent of expenditures that went toward instruction had to be 5% or more above the 70% minimum according to the 2005–2006 Minimum Foundation Program report. Conversely, districts that were not even able to meet the 70% minimum requirement on instructional spending were out of the set.

Discussion and Description. Table 1.51 illustrates the number of school districts that did or did not meet the 70% minimum requirement for instructional spending, and those that exceeded this expectation. Seven districts are fully in the set of those that exceeded the 70% requirement by 5% or more, with the highest spending on instruction being Rapides Parish at 77.5%. Fifteen districts were unable to meet the minimum spending and therefore out of the set, leaving 46 parishes with partial membership. Of these 46, 13 districts exceeded the minimum by 2.5–5% and therefore are considered more in the set than out. The remaining 33 districts made up the group that only barely met the minimum with percentages at 2.5% or less above 70, and these districts are subsequently labeled more out of the set than in.

Table 1.52 represents the same data, but for the BOEM-defined impact area. In this table, only four districts exceeded the 70% minimum by 5% or more and were fully in the set. Also, however, only six BOEM districts were unable to meet this goal. Similar to above, a majority of the districts comprised the two partial membership categories. A breakdown of specific district membership in this set is presented in Figure 1.26.

Table 1.51. Instruction Expenditures fuzzy set membership for all Louisiana parishes (2005–2006).

Spending on instruction	Verbal Label	Fuzzy Set Membership Score	Number (MFP 2005-06)	Examples
Greater than 75%	Fully in the set	1.00	7	Rapides* at 77.50%, 1.00 Tangipahoa at 75.69%, 1.00
72.5–75%	More in than out	0.50-0.99	13	Washington at 72.70%, 0.54 Terrebonne at 74.99%, 0.99
70–72.5%	More out than in	0.01-0.49	33	Vermilion at 72.03%, 0.40 Acadia at 70.83%, 0.16
Less than 70%	Out of the set	0.00	15	Plaquemines* at 60.22%, 0.00 Cameron at 68.91%, 0.00

*highest and lowest values in range

Table 1.52. Instruction Expenditures fuzzy set membership for BOEM-defined parishes (2005–2006).

Spending on instruction	Verbal Label	Fuzzy Set Membership Score	Number (LDE 2006-07)	Examples
Greater than 75%	Fully in the set	1.00	4	St. James at 76.32%, 1.00 Tangipahoa at 75.69%, 1.00
72.5–75%	More in than out	0.50-0.99	9	Washington at 72.70%, 0.54 Terrebonne at 74.99%, 0.99
70–72.5%	More out than in	0.01-0.49	13	Vermilion at 72.03%, 0.40 Acadia at 70.83%, 0.16
Less than 70%	Out of the set	0.00	6	Plaquemines* at 60.22%, 0.00 Cameron at 68.91%, 0.00

*lowest value in range

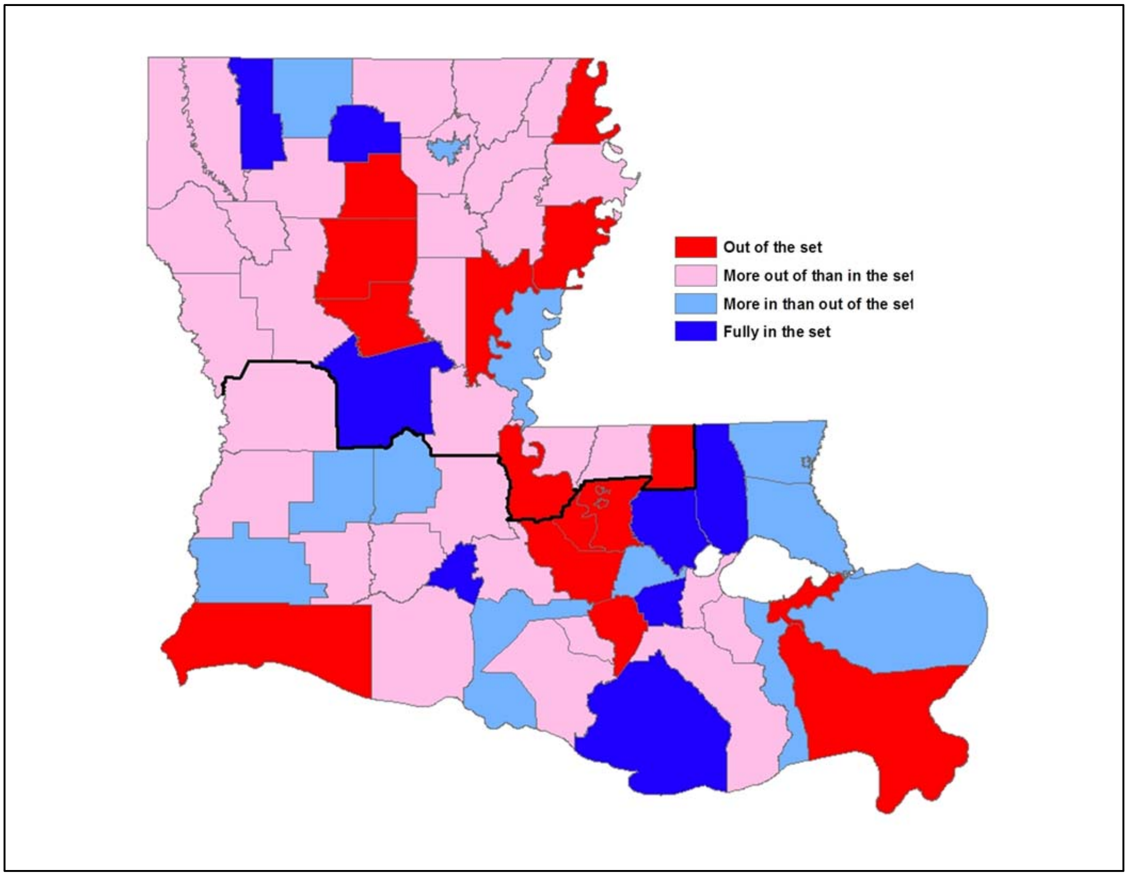

Figure 1.26. Instruction Expenditures fuzzy set membership.

1.3.2. Educational Outcomes

1.3.2.1. Adequate School District Performance

Definition. These tables are based on the Department of Education's goal that by the year 2010, each district's performance score is to reach or exceed 100. In these tables, we consider a score of 95 or above to be fully in the set of parishes that are on their way to exhibiting this level of performance by that deadline, and so their performances can be considered adequate.

We use the Fall 2008 District Performance Scores from the Louisiana Department of Education to determine whether or not each parish exhibits adequate school district performance. If the performance score for that district is at or above 95, it is fully in the set of parishes with adequate school district performance. A score of 85 or below signifies inadequate performance and that parish or district is therefore out of the set.

Discussion and Description. In Table 1.53, 17 districts have been given a performance score of 95 or above and so are full members of the set. A large number of the districts, 32, received scores of 85 or below and are therefore considered out of the set of districts with adequate school performance. The other 20 districts were partial members with nine being more in than out at scores of 90–95, and 11 were more out than in with scores between our 85 minimum and 90.

Table 1.54 again repeats this information only for districts in the BOEM-defined parishes. In this table, 12 of the 32 districts are full members of the set of those with adequate school district performance. Almost the same number, however, are out of the set with scores of 85 or below, and eight more are more out of the set than in.

Figure 1.27 contains a map of these scores for all the Louisiana parishes. There seems to be a small cluster of parishes in the Southeast of the state that are full members of the set, and another cluster in North Louisiana that are out of the set. However, there are still some exceptions and overall the map seems reasonably diversified.

Table 1.53. Adequate School District Performance fuzzy set membership for all Louisiana parishes (2008).

District Performance Score	Verbal Label	Fuzzy Set Membership Score	Number (LDE Fall 2008)	Examples
Greater than 95	Fully in the set	1.00	17	Jefferson Davis at 102.9, 1.00 Beauregard at 100.5, 1.00
90–95	More in than out	0.50 -0.99	9	Rapides at 92.8, 0.78 Lafayette at 91.5, 0.65
85–90	More out than in	0.01-0.49	11	Cameron at 87.4, 0.24 Sabine at 89.8, 0.48
Less than 85	Out of the set	0.00	32	Terrebonne at 84.4, 0.00 Evangeline at 80.9, 0.00

Table 1.54. Adequate School District Performance fuzzy set membership for BOEM-defined parishes (2008).

District Performance Score	Verbal Label	Fuzzy Set Membership Score	Number (LDE Fall 2008)	Examples
Greater than 95	Fully in the set	1.00	12	Jefferson Davis at 102.9, 1.00 Beauregard at 100.5, 1.00
90–95	More in than out	0.50 -0.99	2	Lafayette at 91.5, 0.65 St. James at 91.9, 0.69
85–90	More out than in	0.01-0.49	8	Cameron at 87.4, 0.24 St. Mary at 86.4, 0.14
Less than 85	Out of the set	0.00	10	Terrebonne at 84.4, 0.00 Evangeline at 80.9, 0.00

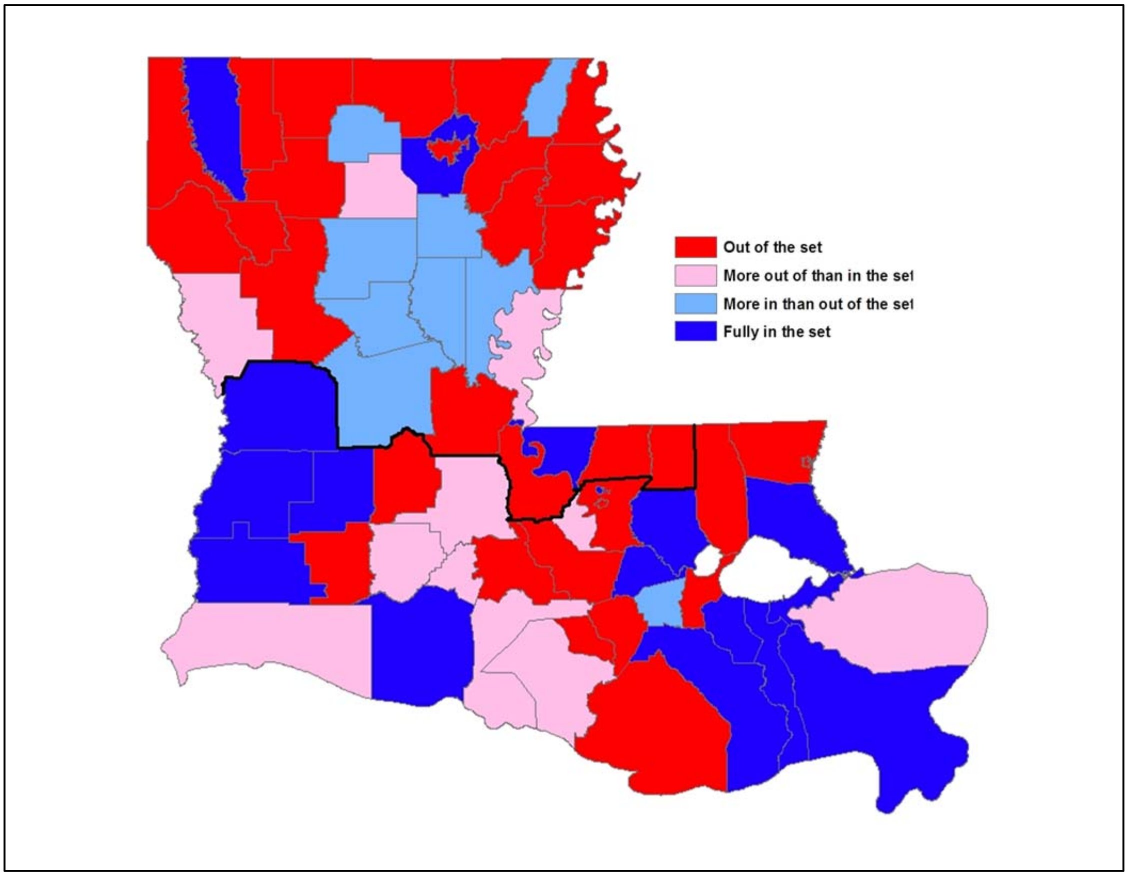

Figure 1.27.Adequate School District Performance fuzzy set membership.

1.3.2.2. Few Low-Performing Schools

Definition. If a school district has many low-performing schools, this may indicate unequal allocation of resources within the school district. Table 1.55 examines the range of school performance within districts based on the percentage of schools in that district that received a performance score of 1 star or lower out of a possible five stars. Schools with less than one star are those labeled Academically Unacceptable by the Department of Education.

Using the School Performance Scores from the 2008 Louisiana Department of Education website, these tables illustrate what percentage of schools in each district is low-performing; the goal is less than 25%. A district with 25% or fewer of its schools receiving a score of one star or fewer (out of five stars) is considered fully in this set. Those with 50% or more low-performing schools are out of the set.

Discussion and Description. In Table 1.55, we see that 24 school districts are fully in the set with 25% or fewer of their schools receiving a score of one star or fewer. Likewise, however, 21 districts had half or more than half of their schools rated with only one star or Academically Unacceptable, which means they are out of the set of districts with few low-performing schools.

Table 1.56 indicates that 15 BOEM districts are fully in the set, with fewer than 25% of their schools exhibiting low performance scores. Further, 11 more districts are more in than out of the set, with percentages of low-performing schools between only 37.5% and 25%. This leaves only five districts with 37.5% or more of their schools deemed low-performing.

This is also indicated by Figure 1.28, which illustrates that much of South Louisiana is made up of districts that are either in the set or more in than out, with only a few exceptions. It also appears from the map that many of the districts that are out of the set and have 50% or more of their schools not performing well are clustered in North Louisiana.

Table 1.55. Few Low-Performing Schools fuzzy set membership for all Louisiana parishes (2008).

Percent of Schools with One Star or Fewer	Verbal Label	Fuzzy Set Membership Score	Number (LDE 2008)	Examples
25% or fewer	Fully in the set	1.00	24	St. Bernard at 0.00%, 1.00 Vermillion at 11.11%, 1.00
37.5–25%	More in than out	0.50 -0.99	14	Plaquemines at 28.57%, 0.86 Orleans at 35.29%,0.59
50– 37.5%	More out than in	0.01-0.49	6	Concordia at 40%, 0.40 St. Martin at 43.75%, 0.25
Greater than 50%	Out of the set	0.00	22	East Baton Rouge at 70.51%, 0.00 St. Helena at 100%, 0.00

Table 1.56. Few Low-Performing Schools fuzzy set membership for BOEM-defined parishes (2008).

Percent of Schools with One Star or Fewer	Verbal Label	Fuzzy Set Membership Score	Number (LDE 2008)	Examples
25% or fewer	Fully in the set	1.00	15	St. Bernard at 0.00%, 1.00 Vermillion at 11.11%, 1.00
37.5–25%	More in than out	0.50 -0.99	11	Plaquemines at 28.57%, 0.86 Orleans at 35.29%,0.59
50– 37.5%	More out than in	0.01-0.49	1	St. Martin at 43.75%, 0.25
Greater than 50%	Out of the set	0.00	4	East Baton Rouge at 70.51%, 0.00 Tangipahoa at 51.52%, 0.00

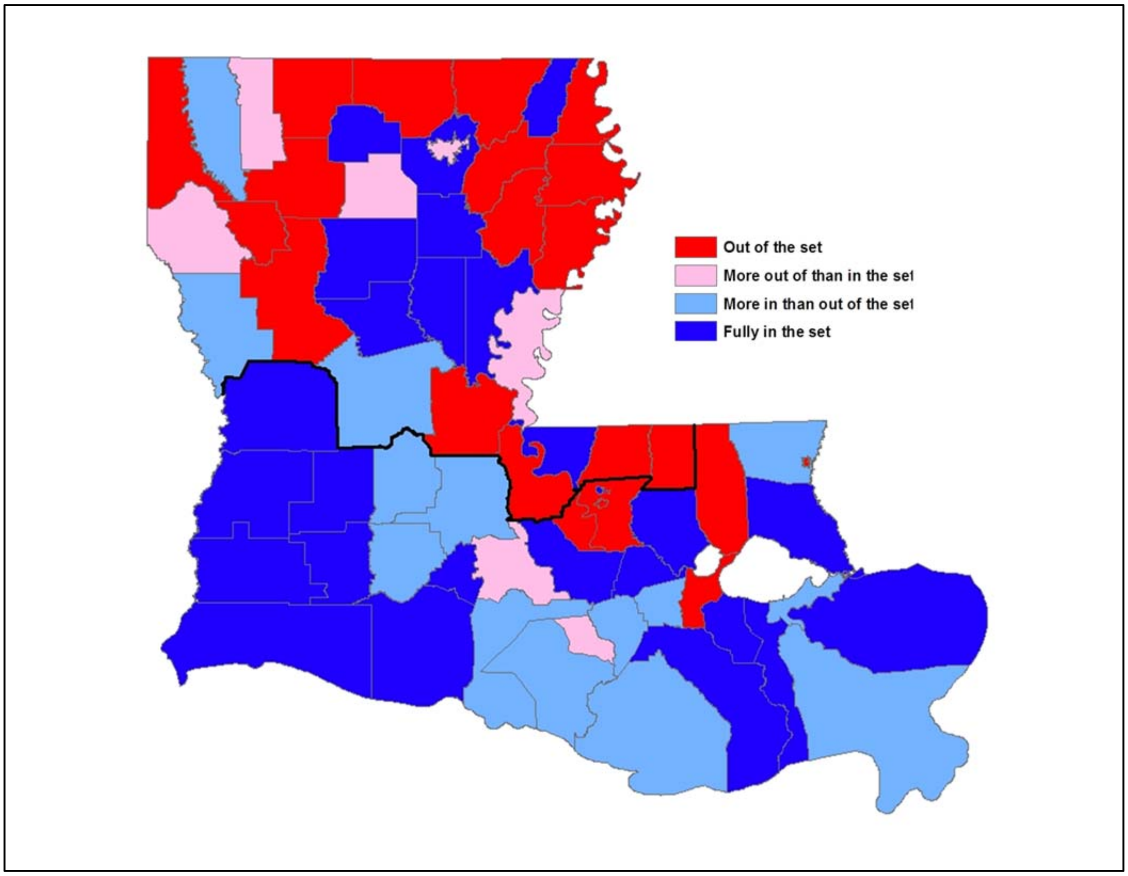

Figure 1.28. Few Low-Performing Schools fuzzy set membership.

1.3.2.3. District Performance

Definition. District performance was measured at the parish level by examining the percentage of schools that were performing as 3, 4, or 5 star schools out of a possible 5 stars. Districts where more than 50% of the schools are performing at the 3-, 4-, or 5-star levels can be considered to be performing adequately and can be considered fully within the fuzzy set. Districts with less than 20% of their schools performing at the 3-, 4-, or 5-star levels were considered fully outside of the fuzzy set. Those districts with between 20% and 50% of their districts performing at the 3-, 4-, or 5-star level were considered partially within the fuzzy set to the extent that the proportion of their performance warrants.

Discussion and Description. The state of Louisiana has 13 districts in which more than 50% of the schools within the district are meeting adequate measures of district improvement and have been ranked as 3, 4, or 5 star schools and as such can be considered fully within the fuzzy set. There are 36 districts with less than 20% of their schools ranked at the 3, 4, or 5 star levels and as such considered fully outside the fuzzy set. There are 20 districts that have between 20% and 50% of their schools ranked at the 3, 4, or 5 star level; these schools are considered partially within to fuzzy set to varying extents.

Within the BOEM-defined parishes, nine can be considered fully within the district performance fuzzy set, an additional 11 can be considered partially within the set, to varying degrees. A total of 12 BOEM-defined parishes can be considered fully outside the adequate district performance fuzzy set. Descriptive statistics and the layout of fuzzy set membership are included in Tables 1.57–1.58 and Figure 1.29.

Table 1.57. District Improvement fuzzy set membership for all Louisiana parishes (2009).

District Improvement	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 50% of schools performing at 3-, 4-, or 5-star level	Fully in set	1	13
35–50% of schools at 3-, 4-, or 5-star level	More in set than out of set	0.5-0.999	8
20–35% of schools at 3-, 4-, or 5-star level	More out than in set	0.001-0.49	12
Less than 20% of schools performing at 3-, 4-, or 5-star level	Out of set	0	36

Table 1.58. District Improvement fuzzy set membership for BOEM-defined parishes (2009).

District Improvement	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 50% of schools performing at 3-, 4-, or 5-star level	Fully in set	1	9
35–50% of schools at 3-, 4-, or 5-star level	More in set than out of set	0.5-0.999	5
20–35% of schools at 3-, 4-, or 5-star level	More out than in set	0.001-0.49	6
Less than 20% of schools performing at 3-, 4-, or 5-star level	Out of set	0	12

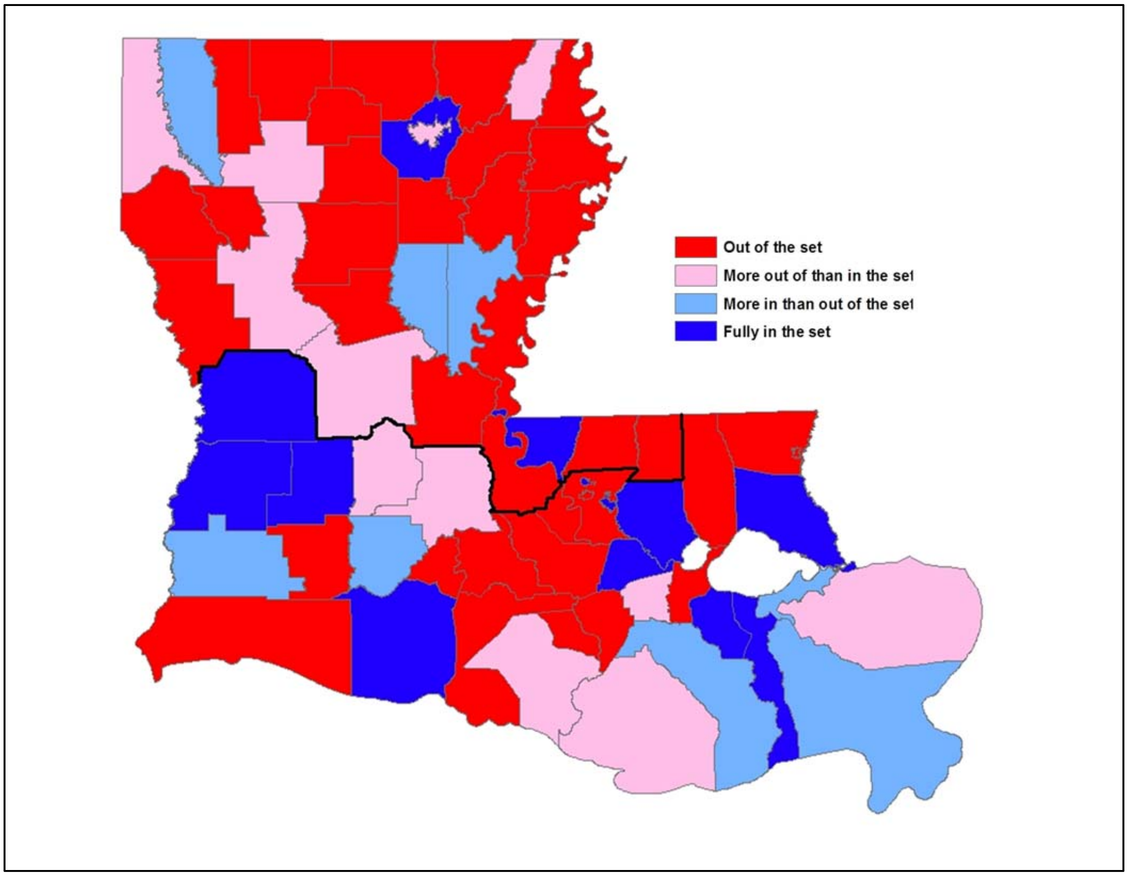

Figure 1.29. District Improvement fuzzy set membership.

1.3.2.4. High College Attendance

Definition. Districts that sent more than 50% of their high school graduates on to become first time freshman at Louisiana colleges and universities were considered to be fully within the fuzzy set and to fit the definition of having a large proportion of first time freshman. Ideally, this measure would include those who enroll as first time freshman in out of state colleges and universities, but data is lacking on out of state enrollments. Districts that send less than 35% of their graduating seniors to a Louisiana college or university were considered to be fully outside of the fuzzy set. Districts that send between 50% and 35% of their graduating seniors to a Louisiana college or university are considered partially within the set to various levels.

Discussion and Description. In the state of Louisiana, in 18 districts more than 50% of the students that graduate go on to become first time freshmen at Louisiana colleges and universities and can be considered fully within the high college attendance fuzzy set. There are 44 districts with between 35% and 50% of the student population going on to attend a Louisiana college or university; these districts can be considered partially in the fuzzy set proportionally based on their proportions. There are eight districts where less than 35% of the population attending public schools go on to attend a Louisiana college or university; these districts are considered fully outside the fuzzy set.

Within the BOEM-defined area, only six can be considered fully within the high percent of first time freshmen fuzzy set; an additional 25 can be considered partially within the set to varying degrees. Only two can be considered fully outside the high percent of first time freshmen fuzzy set. Descriptive statistics as well as the layout of fuzzy set membership are included in Tables 1.59–1.60 and Figure 1.30 below.

Table 1.59. First-time Freshmen fuzzy set membership for all Louisiana parishes (2009).

Percent of High School Graduates Enrolling in College or University	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 50%	Fully in set	1	18
42.5–50%	More in set than out of set	0.5-0.999	23
35–42.5%	More out than in set	0.001-0.49	21
Less than 35%	Out of set	0	8

Table 1.60. First-time Freshmen fuzzy set membership for BOEM-defined parishes (2009).

Percent of High School Graduates Enrolling in College or University	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 50%	Fully in set	1	6
42.5–50%	More in set than out of set	0.5-0.999	14
35–42.5%	More out than in set	0.001-0.49	11
Less than 35%	Out of set	0	2

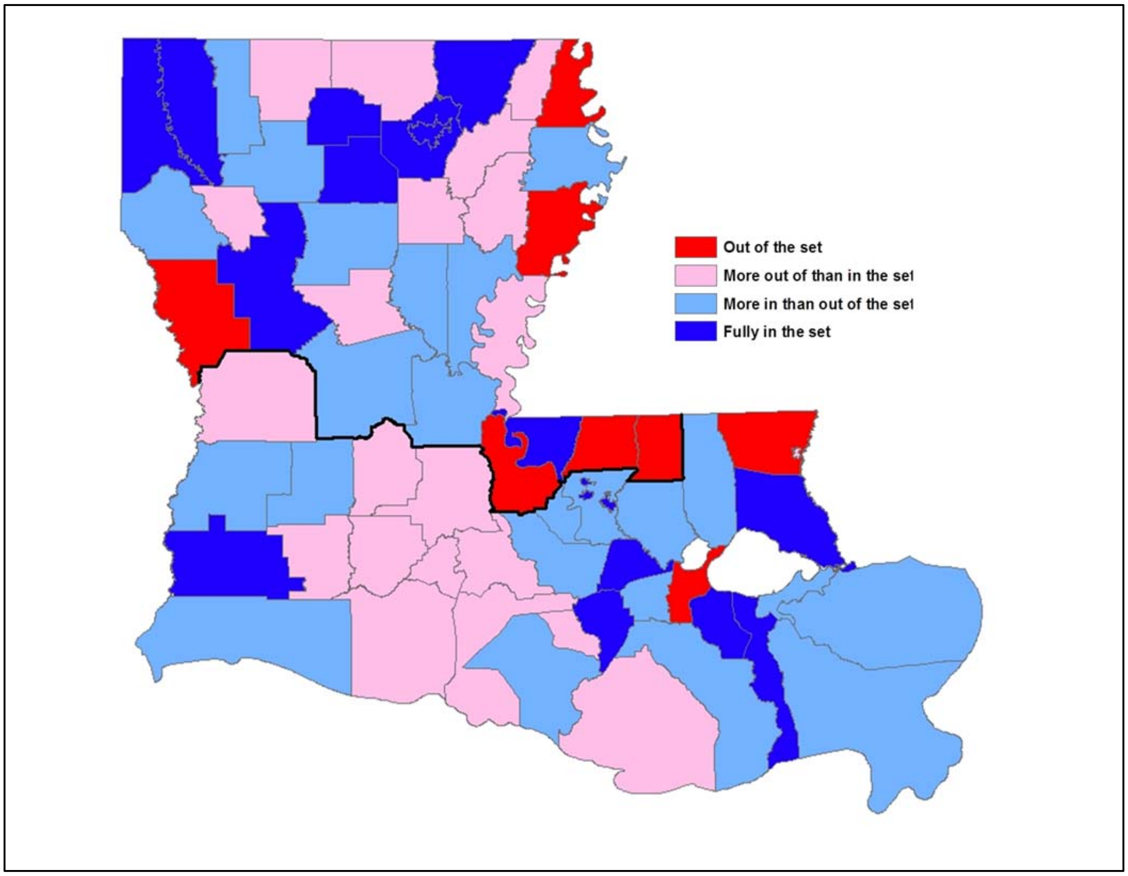

Figure 1.30. First-time Freshmen fuzzy set membership.

1.3.3. Student Characteristics

1.3.3.1. High Percent of Students on Free or Reduced Lunch

Definition. Districts that have more than 65% of their student population receiving a federally subsidized free or reduced lunch are considered to be fully within the fuzzy set. Districts that have less than 50% of their students receiving free or reduced lunch are considered fully outside of the fuzzy set. Districts with between 50% and 65% of their students are considered partially within the set to the extent that the proportion warrants.

Discussion and Description. In the state of Louisiana, in 42 districts more than 65% of the student population attending public schools receive free or reduced lunch; these districts are considered fully within the at risk student fuzzy set. There are 19 districts with between 50% and 65% of the student population reported as receiving a free or reduced lunch; these districts can be considered partially in the fuzzy set proportionally based on the percentage for each category. There are eight districts where less than 50% of the population attending public schools receive a free or reduced lunch and are considered fully outside the fuzzy set.

Within the BOEM-defined parishes, 17 districts can be considered fully within the many at risk students fuzzy set, an additional 12 can be considered partially within the set to varying degrees. A total of three can be considered fully outside the fuzzy set. Descriptive statistics as well as the layout of fuzzy set membership are included in Tables 1.61–1.62 and Figure 1.31.

Table 1.61. At-risk Students Receiving Free or Reduced Lunch fuzzy set membership for all Louisiana parishes (2009).

Percent of Students Receiving Free or Reduced Lunch	**Verbal Level**	**Fuzzy Set Membership Score**	**Number**
Greater than 65%	Fully in set	1	42
57.5–65%	More in set than out of set	0.5-0.999	14
50–57.5%	More out than in set	0.001-0.49	5
Less than 50%	Out of set	0	8

Table 1.62. At-risk Students Receiving Free or Reduced Lunch fuzzy set membership for BOEM-defined parishes (2009).

Percent of Students Receiving Free or Reduced Lunch	**Verbal Level**	**Fuzzy Set Membership Score**	**Number**
Greater than 65%	Fully in set	1	17
57.5–65%	More in set than out of set	0.5-0.999	8
50–57.5%	More out than in set	0.001-0.49	4
Less than 50%	Out of set	0	3

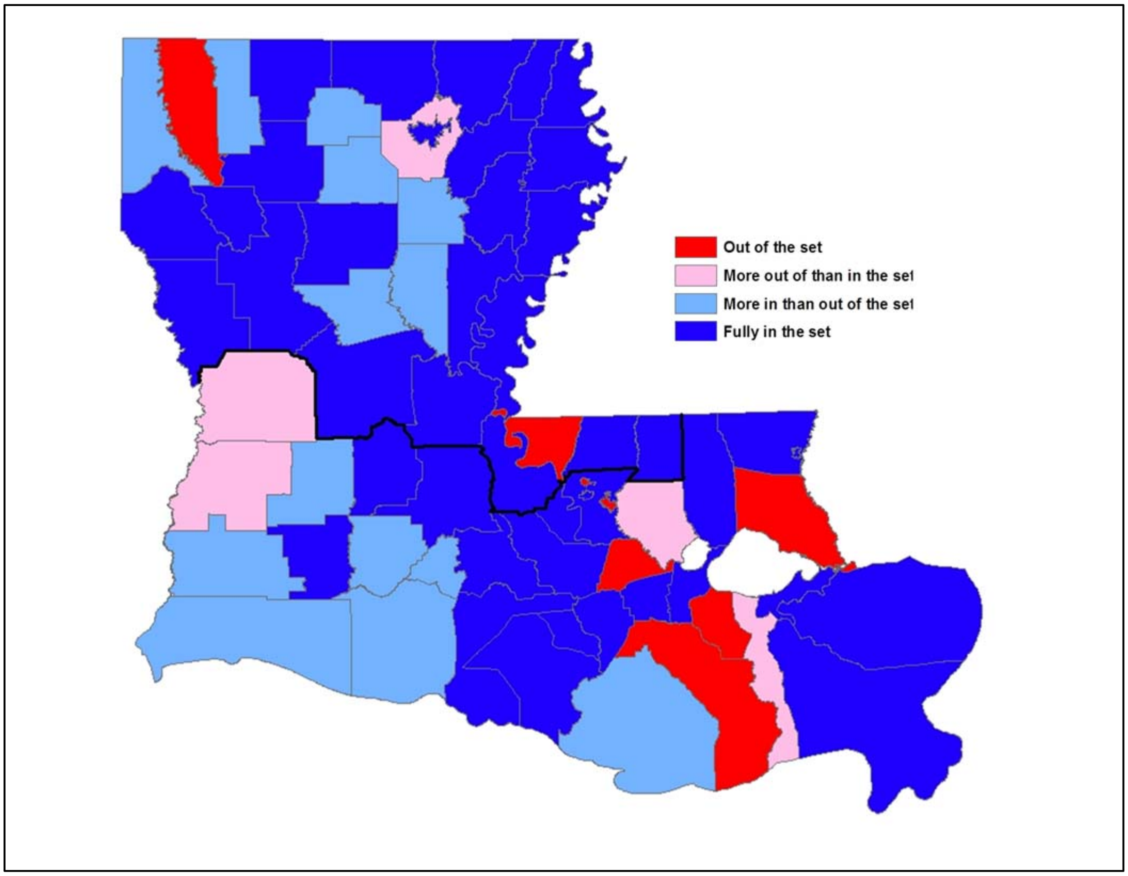

Figure 1.31. At-risk Students Receiving Free or Reduced Lunch fuzzy set membership.

1.3.3.2. Many African American Students

Definition. A school district was defined as having many African American students if greater than 70% of the pupils attending within the district are African American. A district was considered fully outside the fuzzy set if less than 30% of the pupils within the district are African American. Those districts with between 30% and 70% of their pupils classified as African American were deemed to be partially within the fuzzy set.

Discussion and Description. In the state of Louisiana, in 11 districts more than 70% of the student population attending public schools are reported as being African American; these districts are considered fully within the high proportion of African American students fuzzy set. There are 39 districts with between 30% and 70% of the student population reported as being African American; these districts can be considered partially in the fuzzy set proportionally based on their proportions. There are 19 districts where less than 30% of the population attending public schools is reported as being African American; these districts are considered fully outside the fuzzy set.

Within the BOEM-defined parishes, only four districts can be considered fully within the large proportion of African American students fuzzy set; an additional 16 can be considered partially within the set to varying degrees. A total of 12 can be considered fully outside the large proportion of African American students fuzzy set.

Table 1.63. High Percent of African American Students fuzzy set membership for all Louisiana parishes (2009).

Percent of Students Who Are African American	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 70%	Fully in set	1	11
50–70%	More in set than out of set	0.5-0.999	15
30–50%	More out than in set	0.001-0.49	24
Less than 30%	Out of set	0	19

Table 1.64. High Percent of African American Students fuzzy set membership for BOEM-defined parishes (2009).

Percent of Students Who Are African American	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 70%	Fully in set	1	4
50–70%	More in set than out of set	0.5-0.999	3
30–50%	More out than in set	0.001-0.49	13
Less than 30%	Out of set	0	12

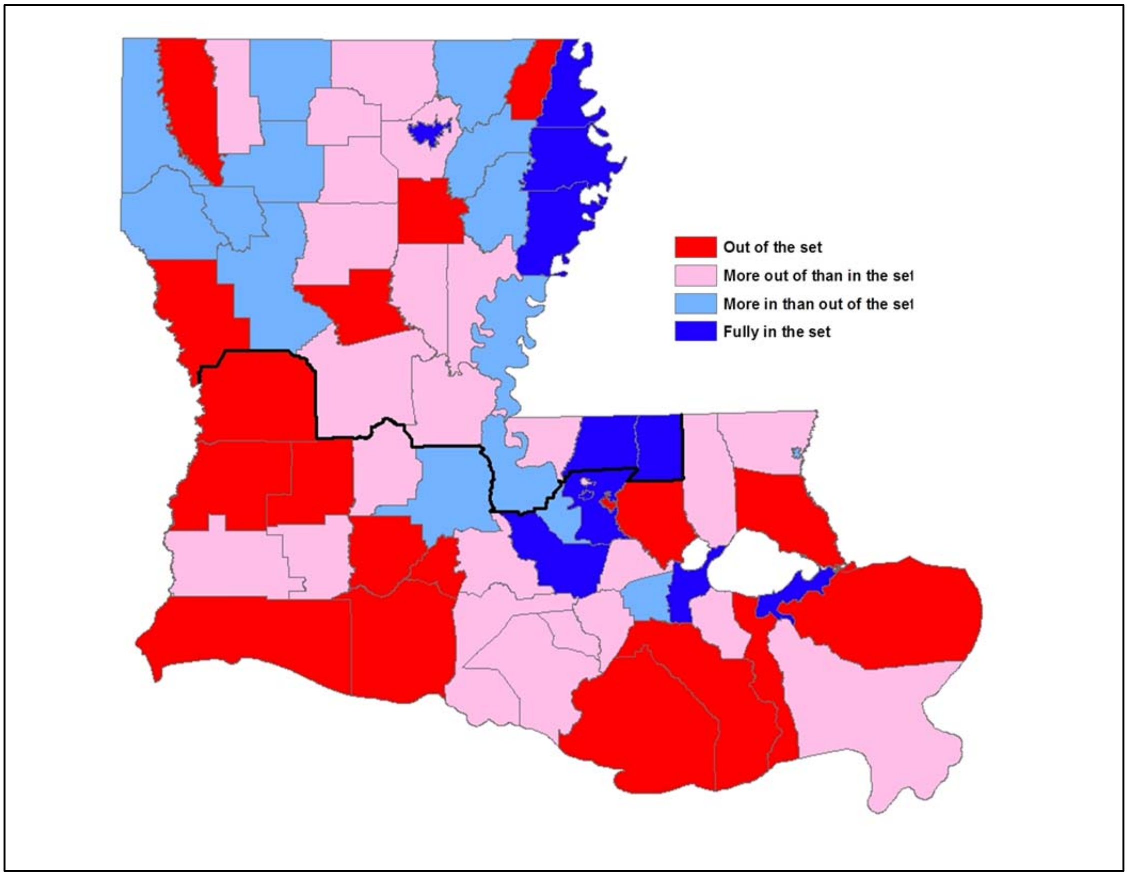

Figure 1.32.High Percent of African American Students fuzzy set membership.

1.3.3.3. High Student Drop Outs Between Grades 8 and 12

Definition. Districts that have more than 10% of the students drop out between the grades 8 and 12 are considered fully within the high student drop out fuzzy set. Districts that have less than 5% of their students drop out between grades 8 and 12 are considered fully outside the fuzzy set. Districts that have between 5% and 10% of their students drop out between grades 8 and 12 are considered to be partially within the fuzzy set.

Discussion and Description. The state of Louisiana has school districts where more than 10% of the student population attending grades 8–12 dropped out within the 2008/2009 school year and are considered fully within the high percent of student drop outs fuzzy set. There are 34 districts with between 5% and 10% of the student population between grades 8 and 12 dropping out; these districts can be considered partially in the fuzzy set proportionally based on their proportions. There are 30 districts where less than 5% of the population attending public schools dropped out over the 2008/2009 school year.

Within the BOEM-defined parishes, only one can be considered fully within the high percent of student dropouts fuzzy set; an additional 15 can be considered partially within the set to varying degrees. A total of 16 districts can be considered fully outside fuzzy set. Descriptive statistics as well as the layout of fuzzy set membership are included in Tables 1.65-1.66 and Figure 1.33.

Table 1.65. High Student Dropout Rate fuzzy set membership for all Louisiana parishes (2007–2008; grades 8–12).

Dropout Rate, Grades 8–12	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 10%	Fully in set	1	5
7.5–10%	More in set than out of set	0.5-0.999	12
5–7.5%	More out than in set	0.001-0.49	22
Less than 5%	Out of set	0	30

Table 1.66. High Student Drop-out Rate fuzzy set membership for BOEM-defined parishes (2007–2008; grades 8–12).

Dropout Rate, Grades 8–12	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 10%	Fully in set	1	1
7.5–10%	More in set than out of set	0.5-0.999	4
5–7.5%	More out than in set	0.001-0.49	11
Less than 5%	Out of set	0	16

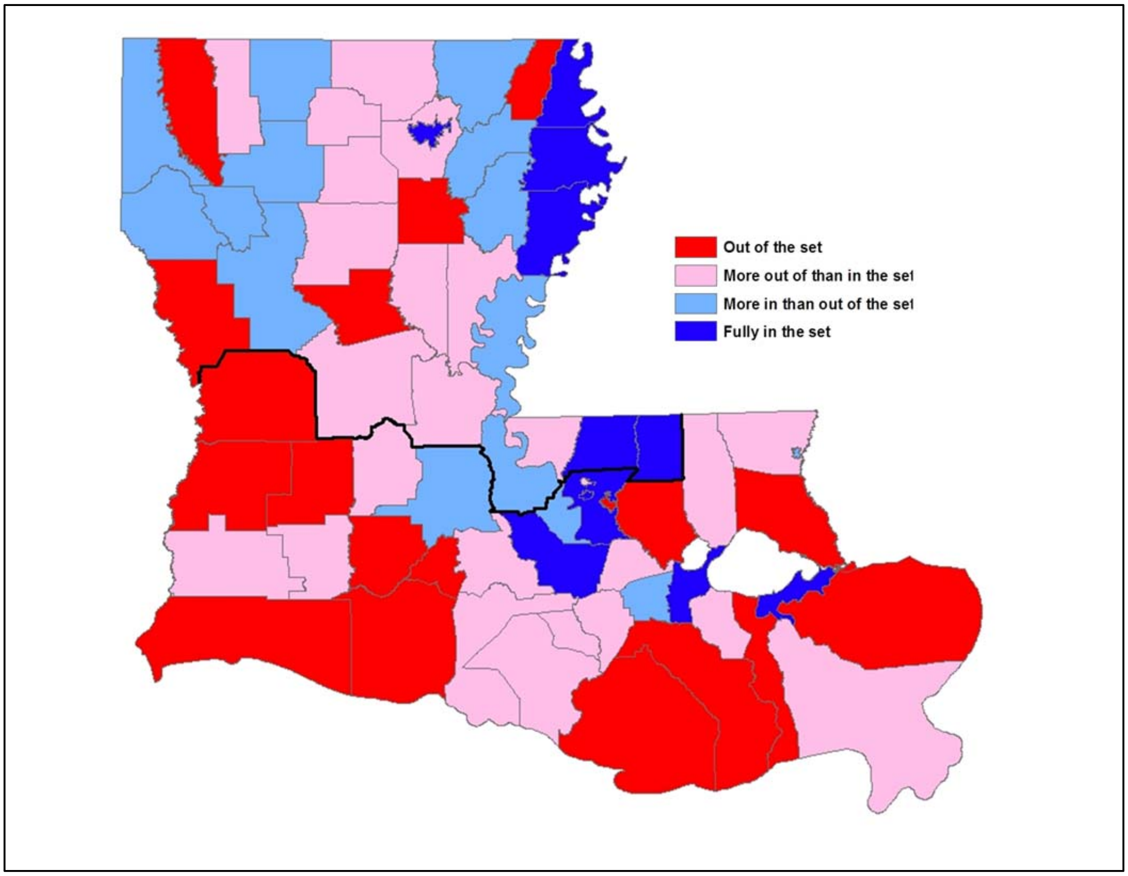

Figure 1.33.High Student Drop-out Rate fuzzy set membership.

1.3.3.4. High Disciplinary Suspension Rate

Definition. Districts with more than 10% of the student body receiving an out of school suspension in the 2008-2009 school year are considered to be fully within the high out of school suspension fuzzy set. Districts that suspended less than 2% of the student body over the 2008/2009 school year are considered fully outside the fuzzy set. Districts that have suspended between 2% and 10% of the student body are considered to be partially within the fuzzy set to various degrees.

Discussion and Description. The state of Louisiana has 34 districts where more than 10% of the student population has received an out of school suspension during the 2008/2009 school year; these districts are considered fully within the high disciplinary action fuzzy set. There are 24 districts with between 2% and 100% of the student population reported having been suspended outside of school; these districts can be considered partially in the fuzzy set proportionally based on their respective data. In 11 districts, less than 2% of the population attending public schools is reported as having been suspended during the 2008/2009 school year; these districts are considered fully outside the fuzzy set.

Within the BOEM-defined parishes, 16 districts can be considered fully within the high disciplinary suspension rate fuzzy set, an additional 11 districts can be considered partially within the set to varying degrees. A total of five districts can be considered fully outside the fuzzy set. Descriptive statistics as well as the layout of fuzzy set membership are included in Tables 1.67–1.68 and Figure 1.34.

Table 1.67. High Disciplinary Suspensions fuzzy set membership for all Louisiana parishes (2008–2009).

Percent of Students Receiving Out-of-School Suspensions	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 10%	Fully in set	1	34
6–10%	More in set than out of set	0.5-0.999	19
2–6%	More out than in set	0.001-0.49	5
Less than 2%	Out of set	0	11

Table 1.68. High Disciplinary Suspensions fuzzy set membership for BOEM-defined parishes (2008–2009).

Percent of Students Receiving Out-of-School Suspensions	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 10%	Fully in set	1	16
6–10%	More in set than out of set	0.5-0.999	10
2–6%	More out than in set	0.001-0.49	1
Less than 2%	Out of set	0	5

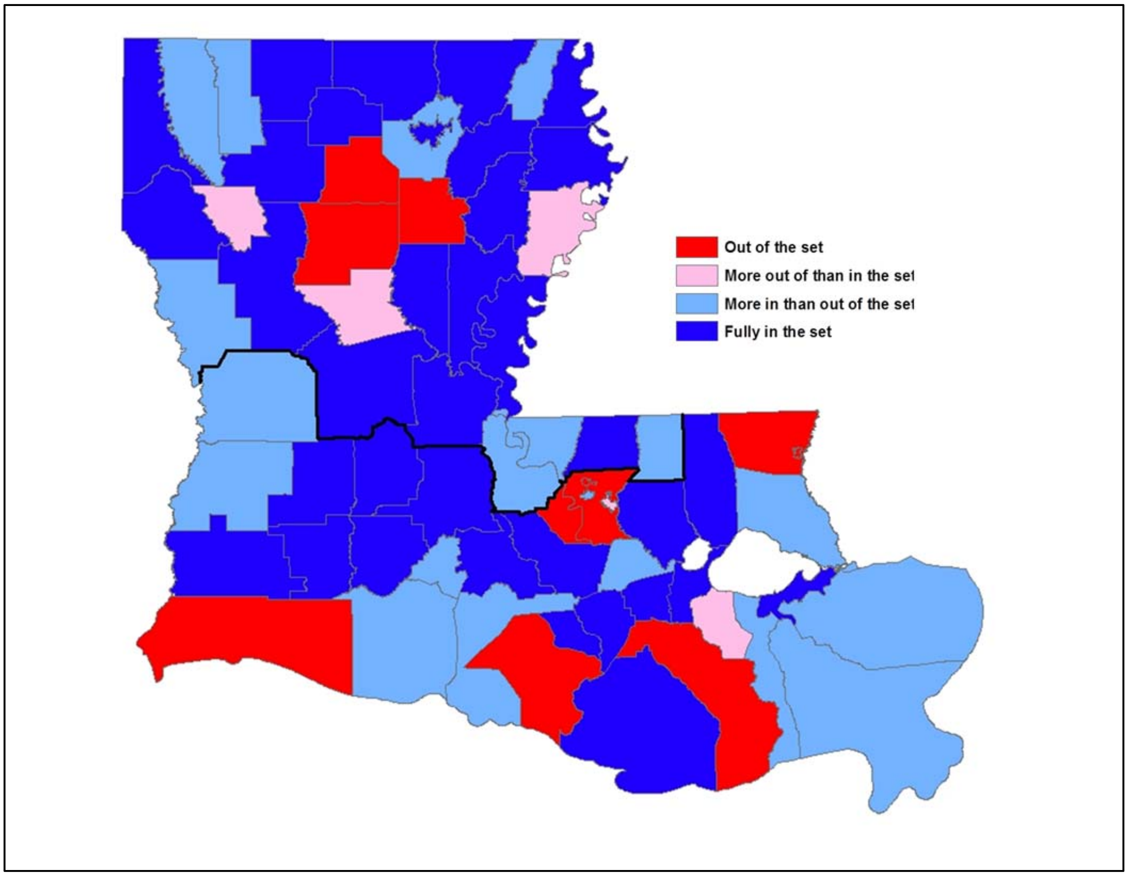

Figure 1.34. High Disciplinary Suspensions fuzzy set membership.

1.3.3.5. High Student Grade Repeat

Definition. Districts where more than 9% of students are asked to repeat a grade are considered to be fully within the fuzzy set. Districts where less than 3% of the students were held back a grade are considered to be fully outside the fuzzy set. Districts where between 3% and 9% of the students are held back are considered to be partially within the fuzzy set to varying degrees.

Discussion and Description. The state of Louisiana has 15 districts where more than 9% of the student population attending public schools are retained or ask to repeat a grade within school; these districts are considered fully within the high student retention fuzzy set. There are 42 districts with between 3% and 9% of the student population reported as being retained; these districts can be considered partially in the fuzzy set proportionally based on their relative scores. There are two districts where less than 3% of the population attending public schools are reported as being retained, these districts are considered fully outside the fuzzy set.

Within the BOEM-defined parishes, only six districts can be considered fully within the high percent of students retained fuzzy set; an additional 25 can be considered partially within the set to varying degrees. Only one district can be considered fully outside the large percent of students retained. Descriptive statistics as well as the layout of fuzzy set membership are included in Tables 1.69–1.70 and Figure 1.35.

Table 1.69. High Percent of Students Retained fuzzy set membership for all Louisiana parishes (2008–2009).

Percent of Students Retained to Repeat a Grade	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 9%	Fully in set	1	15
6–9%	More in set than out of set	0.5-0.999	27
3–6%	More out than in set	0.001-0.49	25
Less than 3%	Out of set	0	2

Table 1.70. High Percent of Students Retained fuzzy set membership for BOEM-defined parishes (2008–2009).

Percent of Students Retained to Repeat a Grade	Verbal Level	Fuzzy Set Membership Score	Number
Greater than 9%	Fully in set	1	6
6–9%	More in set than out of set	0.5-0.999	13
3–6%	More out than in set	0.001-0.49	12
Less than 3%	Out of set	0	1

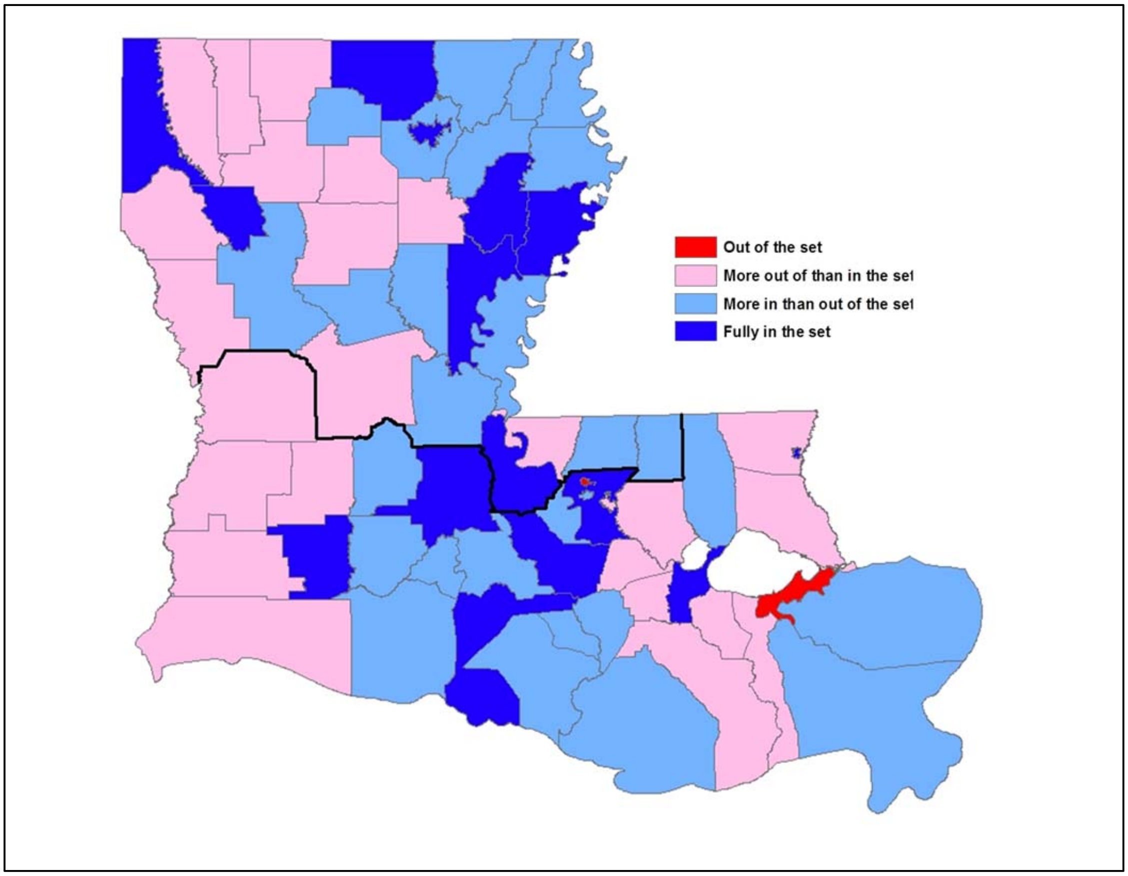

Figure 1.35.High Percent of Students Retained fuzzy set membership.

1.3.4. District Structure

1.3.4.1. Small School District

Definition. Table 1.71 shows district size based on the number of schools in each district, with a range of two schools in St. Bernard Parish to 80 schools in East Baton Rouge Parish. Fifteen or fewer schools are considered fully in the set of small districts, and districts with 25 or more schools are out of the set of small school districts.

Discussion and Description. Table 1.71 illustrates the many small school districts present in Louisiana. A total of 43 school districts are full members of the set, and have only 15 or fewer schools. By comparison, only 17 districts are members of the bottom category, and have 25 or more schools, and are out of the set. This leaves just eight districts in Louisiana with partial membership in this group. Seven districts have between 16 and 20 schools and are more in than out, and only one district has 21–24 schools making it more out than in.

Table 1.72 illustrates that an equal number of districts are in compared to out of the set of small school districts in the BOEM-defined impact area. A total of 13 districts make up both the fully in and fully out categories and only six parishes exhibit partial membership (Note: this includes the Orleans Parish School District because only 17 schools remained under the authority of this school district by 2008. All the others were under control of the state or charters). Fuzzy set membership for each parish is defined in Figure 1.36.

Table 1.71. Small School District fuzzy set membership for all Louisiana parishes (2008).

Number of Schools in Parish	**Verbal Label**	**Fuzzy Set Membership Score**	**Number (LDE Fall 2008)**	**Examples**
15 or fewer schools	Fully in the set	1.00	43	St. Bernard* at 2, 1.00 Cameron at 4, 1.00
16–20 schools	More in than out	0.50 -0.99	7	Orleans at 17, 0.80 Vermilion at 18, 0.70
21–24 schools	More out than in	0.01-0.49	1	Ascension at 21, 0.40
25 or more schools	Out of the set	0.00	17	E. Baton Rouge* at 80, 0.00 Jefferson at 77, 0.00

*Highest and lowest values in range

Table 1.72. Small School District fuzzy set membership for BOEM-defined parishes (2008).

Number of Schools in Parish	**Verbal Label**	**Fuzzy Set Membership Score**	**Number (LDE Fall 2008)**	**Examples**
15 or fewer schools	Fully in the set	1.00	13	St. Bernard* at 2, 1.00 Cameron at 4, 1.00
16–20 schools	More in than out	0.50 -0.99	5	Orleans at 17, 0.80 Vermilion at 18, 0.70
21–24 schools	More out than in	0.01-0.49	1	Ascension at 21, 0.40
25 or more schools	Out of the set	0.00	13	E. Baton Rouge* at 80, 0.00 Jefferson at 77, 0.00

*Highest and lowest values in range

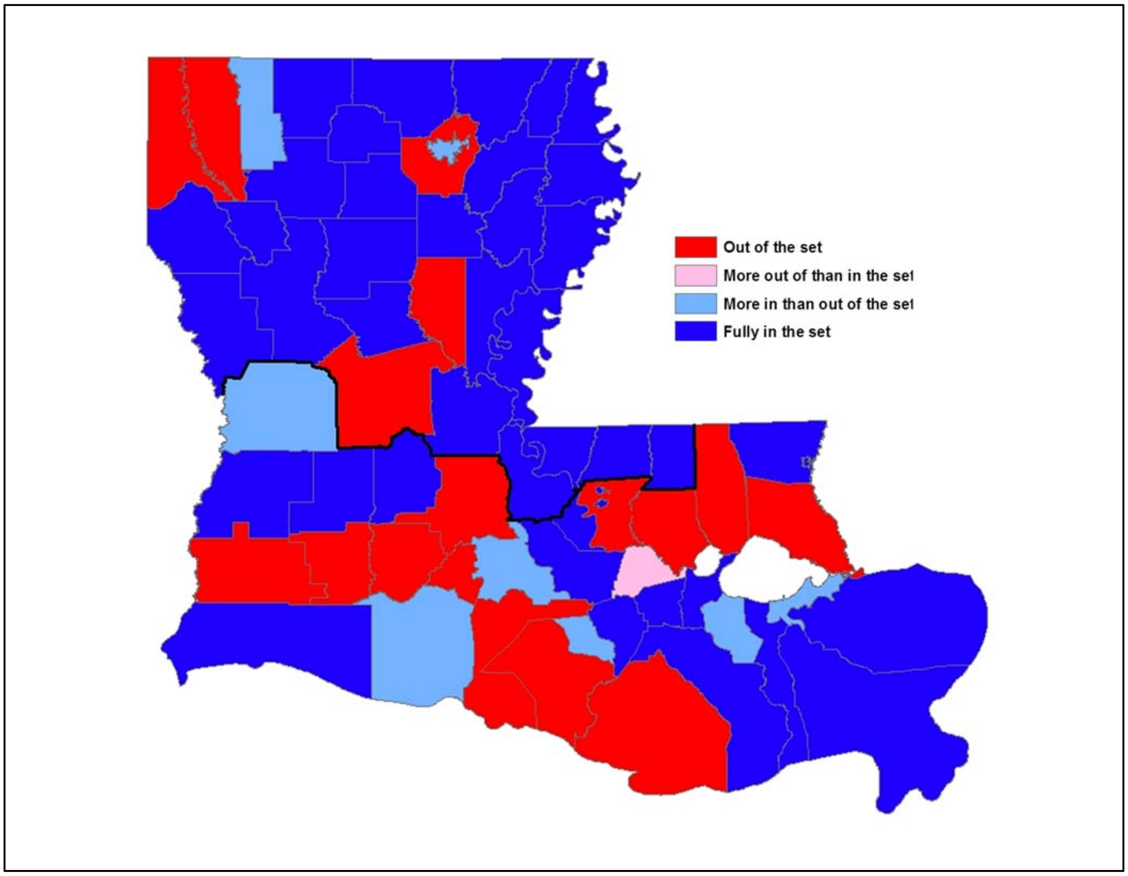

Figure 1.36.Small School District fuzzy set membership.

1.3.4.2. Large School District

Definition. This table also examines district size based on the number of schools in each district, but from the perspective of large school districts. In this table, fully in the set are districts with 50 or more schools and those with fewer than 30 are out of the set.

Discussion and Description. When the definition of district size was altered to favor large school districts, Table 1.73 indicates that only four parishes in Louisiana are fully in the set of large districts with 50 or more schools. On the other hand, a majority of the districts are in the smaller category; this time with fewer than 30 schools and out of the set.

Interestingly, of the four large districts from Table 1.73, three are BOEM districts, as seen in Table 1.74. Only one BOEM district is in the 18–24 schools range and therefore more in than out of the set. Again, a majority of the districts are small, with 23 districts out of the set at 10 or fewer schools and 5 districts more out of the set than in. The layout of fuzzy set membership by parish is included in Figure 1.37 below.

Table 1.73. Large School District fuzzy set membership for all Louisiana parishes (2008).

Number of Schools in Parish	Verbal Label	Fuzzy Set Membership Score	Number (LDE Fall 2008)	Examples
50 or more schools	Fully in the set	1.00	4	E. Baton Rouge* at 80, 1.00 Jefferson at 77, 1.00
40–49 schools	More in than out	0.50 -0.99	2	Rapides at 48, 0.90 St. Tammany at 49, 0.95
30–39 schools	More out than in	0.01-0.49	7	Lafayette at 38, 0.40 Tangipahoa at 33, 0.15
Fewer than 30 schools	Out of the set	0.00	55	Vermilion at 18, 0.00 St. Bernard* at 2, 0.00

*Highest and lowest values in range

Table 1.74. Large School District fuzzy set membership for BOEM-defined parishes (2008).

Number of Schools in Parish	Verbal Label	Fuzzy Set Membership Score	Number (LDE Fall 2008)	Examples
50 or more schools	Fully in the set	1.00	3	E. Baton Rouge* at 80, 1.00 Jefferson at 77, 1.00
40–49 schools	More in than out	0.50 -0.99	1	St. Tammany at 49, 0.95
30–39 schools	More out than in	0.01-0.49	5	Lafayette at 38, 0.40 Tangipahoa at 33, 0.15
Fewer than 30 schools	Out of the set	0.00	23	Vermilion at 18, 0.00 St. Bernard* at 2, 0.00

*Highest and lowest values in range

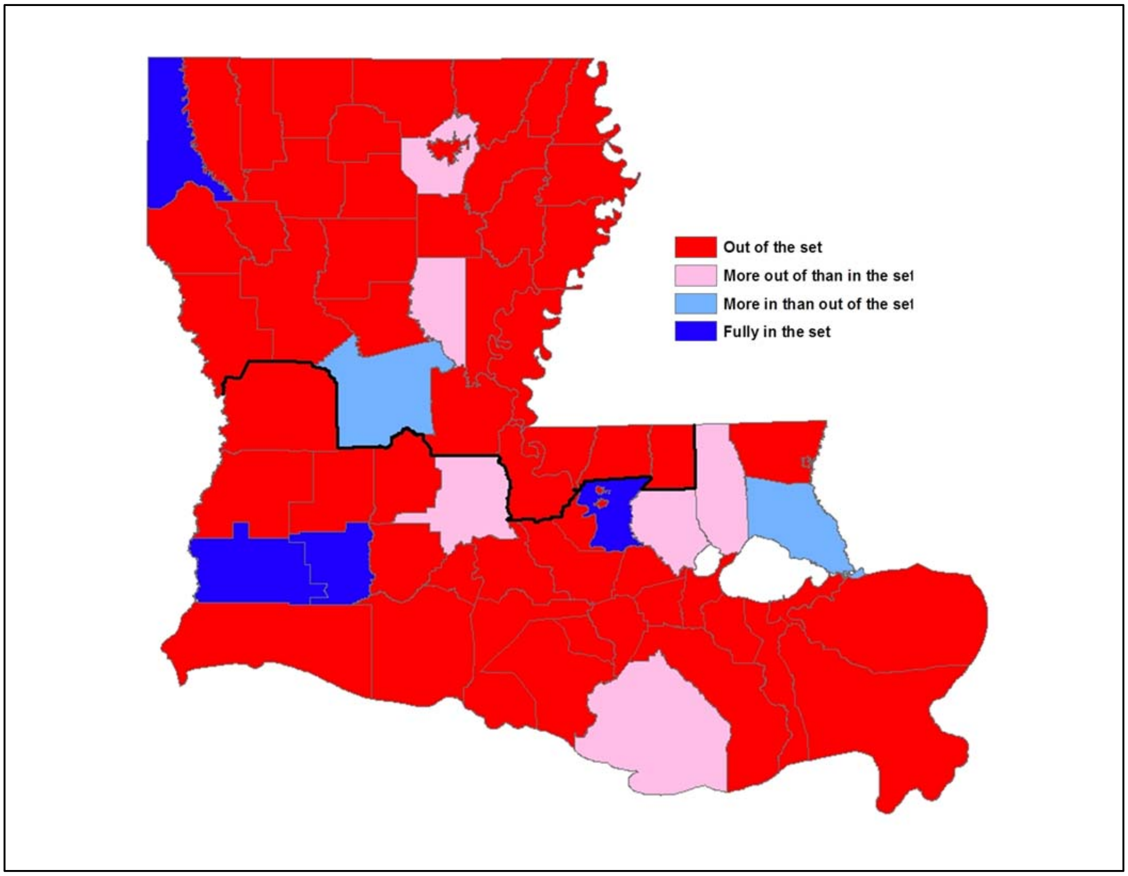

Figure 1.37.Large School District fuzzy set membership.

1.3.4.3. Many Students Enrolled in Private Schools

Definition. Districts that have more than 2,000 students enrolled in private institutions are considered fully within the high private institution enrollment fuzzy set. Districts with no enrollment in private institutions are considered fully outside of the fuzzy set. Districts with some enrollment within private institutions but less than 2,000 students enrolled are considered partially within the fuzzy set to varying degrees.

Discussion and Description. In the state of Louisiana, in15 districts more than 2,000 students within the district are attending private schools; these districts are considered fully within the many students enrolled in private schools fuzzy set. There are 41 districts with between 1 and 2,000 students reported as attending private schools; these districts can be considered partially in the fuzzy set proportionally based on their overall numbers. There are 13 districts where there is no enrollment in private schools; these districts are considered fully outside the fuzzy set.

Within the BOEM-defined impact area, 13 parishes can be considered inside the high non-public school enrollment fuzzy set. A further 17 parishes can be considered partially within the set as they have some level of non-public school enrollment. Only two parishes in the BOEM-defined set have no private school enrollment. Descriptive statistics as well as the layout of fuzzy set membership are included in Tables 1.75–1.76 and Figure 1.38.

Table 1.75. Private School Enrollments fuzzy set membership for all Louisiana parishes (2009–2010).

Students Enrolled in Non-Public Schools	**Verbal Level**	**Fuzzy Set Membership Score**	**Number**
More than 2,000	Fully in set	1	15
1,000–2,000	More in set than out of set	0.5-0.999	7
1–1,000	More out than in set	0.001-0.49	34
No private school enrollment	Out of set	0	13

Table 1.76. Private School Enrollments fuzzy set membership for BOEM-defined parishes (2009–2010).

Students Enrolled in Non-Public Schools	**Verbal Level**	**Fuzzy Set Membership Score**	**Number**
More than 2,000	Fully in set	1	13
1,000–2,000	More in set than out of set	0.5-0.999	3
1–1,000	More out than in set	0.001-0.49	14
No private school enrollment	Out of set	0	2

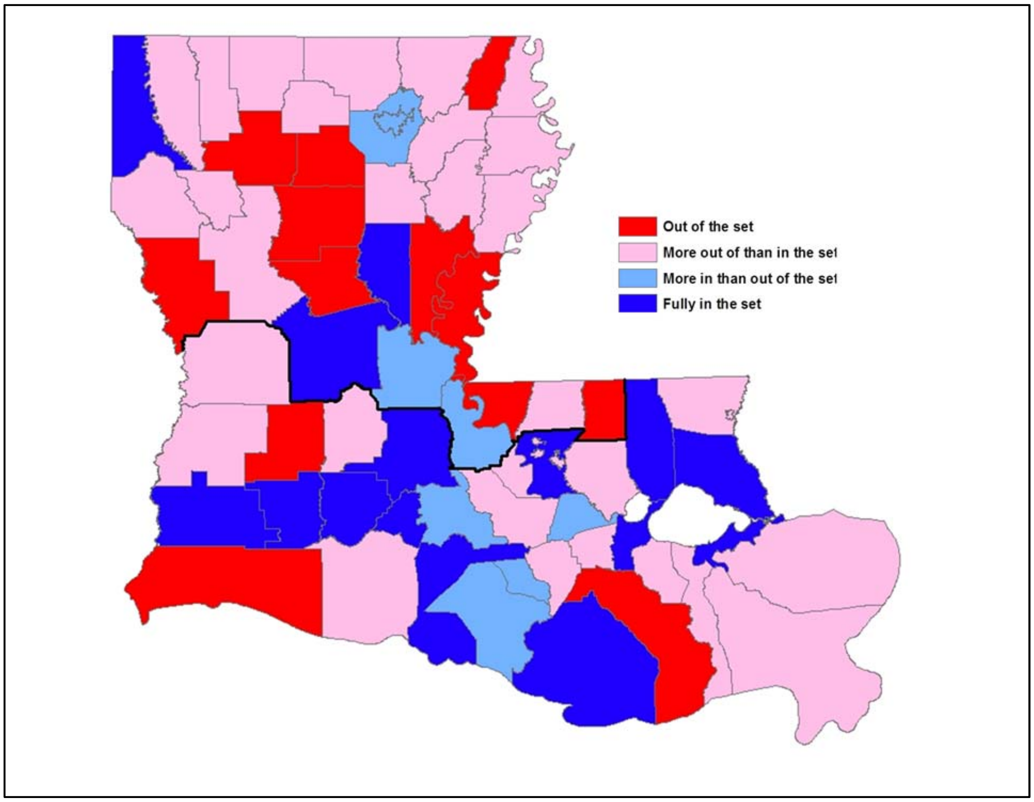

Figure 1.38.Private School Enrollments fuzzy set membership.

CHAPTER 2. DISTINGUISHING REGIONAL COMPARED TO LOCAL COMPARATIVE ADVANTAGE THROUGH SHIFT SHARE ANALYSIS

2.1. Introduction

In the previous chapter, we attempted to generate a socio-economic baseline across general, labor market, and education categories. The overall strategy was to identify key variables that would identify socio-economic condition so that future change could be analyzed. Though some of the data presented in these profiles represented secondary data from sources that are updated annually, others may only be updated once every ten years (such as the decennial U.S. Census) or on an ad hoc basis from other federal and state administrative data sources.[1]

In this chapter, we narrow the focus of our socio-economic analysis to focus strictly on the employment variable in the BOEM-defined region of Louisiana. In particular, we focus on comparing changes in a period before Hurricanes Katrina and Rita and a period from just before to just after these two storms.

Local governments formulate new policies and adjust the old ones for any fiscal year depending on the growth pattern of a region. Any exogenous shock, for example, natural disasters- hurricanes, floods, could affect employment levels of any given industry in a region and consequently create volatility in functioning of local governments. Further, changes in the local community may also be affected by changes in neighboring/contiguous regions. Unfortunately, in many cases, in their research and policy implementation, policymakers and regional scientists fail to take into account the concept of spatial interaction.[2] In most cases, policies set by local governments for resiliency after any natural disasters are meant to be applied uniformly across all regions. However, in the aftermath of such disasters, some regions are more severely affected than others.

In the past, researchers have used shift share analysis to decompose a region's sectoral growth within a given period of time. The classical shift share analysis at its core is a simple variance decomposition technique and many regional scientists over several decades have applied the technique to analyze growth in a region and/or county for a specific industry. However, the classical shift share analysis has several shortcomings. For example, the classical shift share analysis does not take into account the spatial interaction or the neighboring region's growth when evaluating a region's growth. Similarly, any externality (positive or negative) that is present during the study period is not accounted for. In this study, we propose to use spatial shift share analysis to address these shortcomings. The spatial shift share analysis attempts to overcome some of the potential shortcomings of classical shift share analysis; for example, the classical shift share analysis does not delineate the effects of growth in the neighboring region's industry growth. Further, our results suggest that the spatial shift share model does provide a

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1 This manuscript is the authors' accepted version of Adhikari, Arun, J. Matthew Fannin, and Ashok K. Mishra. "Decomposing Changes in Employment Rate after Natural Disasters." *Journal of Policy Modeling*. (Forthcoming).
2 Policymakers are often interested in "one-size-fits-all" policies.

more “distinct” effect between the neighboring region and local effects than the uniqueness between the industry mix and competitive effects in the classical shift share model.

The purpose of this chapter is to identify the interpretable distinctiveness of spatial shift share through an application of employment change in the mining sector following natural disasters like hurricanes. We address this issue by incorporating neighboring region effects through a spatial weight matrix to the classical shift share analysis. Further, we show that by using the spatial shift share approach, additional information could be provided for the policymakers, such as growth decompositions in any industry, by comparing neighboring regional industry effects to sub-regional local effects.

The remainder addresses how these spatial shift share techniques can be applied to understanding these differing employment patterns over time and how they provide a more precise identification of comparative advantage from trade theory. We first present an alternative regionalized decomposition approach using spatial weight matrices as presented by Nazara and Hewings (2004). We then conclude with an empirical analysis of these novel shift share techniques to local employment data from parishes (counties) impacted by Hurricanes Katrina and Rita to test the distinctness of the regionalized effect.

2.2. SPATIAL SHIFT SHARE ANALYSIS

The economic growth of any spatial unit is not independent of the growth of its neighboring units. Any spatial unit may be affected (positively or negatively) by the spatial spillovers transmitted from its neighboring regions (Isard 1960). Based on this idea, Nazara and Hewings (2004) incorporated a spatial structure within shift share analysis and developed an extensive taxonomy of regional growth decompositions. The general formula for their model replaces G_i with $\vec{g}_i$, which is a spatial lag variable that denotes the growth rate of sector i in the neighborhood regions.

(E2.1) $(\text{growth})_i = G + (\vec{g}_i - G) + (g_i - \vec{g}_i)$ (Spatial shift share)

The spatial lag variable, $\vec{g}_i$ is a weighted average of neighboring regions, and is acquired by multiplying a square spatial weight matrix (R X R)[3], denoted as W, times the conformable column vector of neighboring values. W is therefore a spatial weight matrix whose elements w_{jk} describe the level of interdependence between spatial units j and k (Evans, 2008). The first part of the right hand side (G) refers to overall national growth. The second part ($\vec{g}_i$ – G) refers to the difference between the growth rate of i^{th} sector in the neighboring region and overall national growth. This effect due to the growth in a neighboring region for any particular sector is termed as the neighboring region effect. A positive number reflects the growth of i^{th} sector in the neighboring region grows faster than the total national growth. The third part (g_i - $\vec{g}_i$) is the difference in the growth of the i^{th} sector in any specific local area and its neighboring region.

3 R is the number of regions (parishes) in the system

This effect is termed as the local effect and the positive number implies that the growth of i^{th} sector in any specific region is faster than the growth of the same sector in its neighboring region.

Nazara and Hewings (2004) calculated the all sector employment growth rate for the contiguous region k of a particular region j, denoted by $\vec{g}$. Mathematically, the formula is written as

(E2.2) $$\vec{g} = \frac{(\sum_{k=1}^{J} \tilde{w}_{jk} e_k^{t+1} - \sum_{k=1}^{J} \tilde{w}_{jk} e_k^{t})}{\sum_{k=1}^{J} \tilde{w}_{jk} e_k^{t}}$$

where $\tilde{w}_{jk} =$ element of a square spatial row standardized weight matrix indicating the intensity of j's interaction with region k. Similarly, the formula can be modified slightly to obtain the growth rate for region k's neighbor for a specific sector i.

(E2.3) $$\vec{g}_i = \frac{(\sum_{k=1}^{J} \tilde{w}_{jk} e_{ik}^{t+1} - \sum_{k=1}^{J} \tilde{w}_{jk} e_{ik}^{t})}{\sum_{k=1}^{J} \tilde{w}_{jk} e_{ik}^{t}}$$

e_{ik}^{t+1} = total employment in region k for sector i for time period t+1

e_{ik}^{t} = total employment in region k for sector i for time period t

In addition to the spatial augmentation of the classical shift share analysis, Nazara and Hewings (2004) present alternative shift share decompositions:

(E2.4) Growth (g_i) = $G_i + (\vec{g}_i - G_i) + (g_i - \vec{g}_i)$ (Augmented spatial shift share).

In Equation E2.4, we see an approach to augmenting the spatial shift share decomposition. In the spatial shift share version of Equation E2.4, the decomposition creates a neighboring region/industry effect that compares the difference between the overall national growth of an industry against the neighboring region employment growth in that industry ($\vec{g}_i - G_i$). Hence, this neighboring-region effect is unique to each region and represents how much faster or slower a neighboring region's employment in a given industry contributes relative to the employment growth of the industry nationally. It creates a third "industry-based effect" and thereby better distinguishes where potential comparative advantage is geographically focused (nation/state, larger neighboring region, or localized area).

Since the original formulation by Nazara and Hewings (2004), there have been a number of applications. Applications have been numerous for many geographic regions, including China (Chunyun et al. 2007), Australia (Mitchell, Myers, and Juniper 2005), Spain (Marquez, Ramajo, and Hewings 2009), Greece (Fotopoulas, Kallioras, and Petrakos 2009), and Texas (Tu and Sui 2010). However, Nazara and Hewings' (NH; 2004) approach has been criticized for the potential in creating neighboring regions that are not sufficiently large to take into account sectors driven by larger geographic region effects (Fotopoulas, Kallioras, and Petrakos 2009); it has been used to evaluate tradeoffs between sectoral and regional classification (Marques, Ramajo, and Hewings 2009). The NH approach has been modified to include an exponential distance function for the spatial weight matrix (Mitchell, Myers, and Juniper 2005) and extensions of the NH approach to incorporate homothetic effects in the tradition of the Esteban-Marquillas (EM) approach (Pautelli et al. 2006).

Unfortunately, to our knowledge, no study has attempted to test whether the spatial shift share model improves on the distinctiveness of localized effect. Loveridge and Selting (1998) tested a number of variations of classical shift share model and found that augmented models used in EM approach eliminate the proposed problem that the traditional competitive effect was actually measuring part of the industry mix effect. Loveridge and Selting used a correlation analysis to show that the EM family of models did reduce the correlation of the industry mix and competitive effect from the classical shift share model, but the solution, the breakup of the competitive effect into a traditional competitive effect component and homothetic (industry proportion) competitive effect component, resulted in almost perfect correlation of these components rendering their separate interpretative value meaningless.

Because many of the aforementioned applications of the spatial shift share approach assume that the neighboring region effect is truly differentiable from the localized effect, their interpretations of these results would be invalid if the neighboring region effect created by the spatial weight matrix was not truly distinct. Further, the practical interpretative value of the neighboring region effect suggests that validation of its distinctness is important before the approach is extended from the academic realm to the economic development practitioner.

2.3. ECONOMIC CHANGE FOLLOWING THE 2005 HURRICANE SEASON

Katrina and Rita, two of the most deadly hurricanes in the history of the United Sates, made a landfall less than a month apart in 2005. The U.S. Department of Commerce (2006) reported that Hurricane Katrina was the costliest hurricane in the history of the U.S., and responsible for $81.2 billion[4] in damages. Hurricane Rita was recorded as the ninth costliest storm in U.S. history and responsible for approximately $10 billion in damages (Knabb, Brown, and Rhome 2007). These hurricanes had a strong impact on economies and employment in the affected areas. There were many incidences of mass layoffs and increase in unemployment rates after these hurricanes (Kosanovich 2006). Beside the decline in population and employment in many of the hurricane affected areas, significant changes in expenditure, revenues, assets and liabilities of local governments were observed in its aftermath. These changes can be examined by shift share analysis by decomposing the changes into various effects.

With natural disasters, such as Hurricanes Katrina and Rita, the comparative advantage a region has over another region may vary due to a number of factors. For example, one of the key

4 The amount is specified in 2005 U.S. dollars.

industry sectors in New Orleans, the Food Services sector, is driven by a combination of local demand from local residents and export demand from tourists. One would expect the timing of growth in this industry to lag, given the slow re-population of the historical population base necessary to support minimum efficient scale of restaurants in the region. Further, its support establishments–those inter-connected sectors both upstream and downstream–are also highly dependent on the export base of tourist population. Hence, we might expect, in a worst case scenario, the loss of market share because of an exogenous natural disaster to be significant enough to move the regional economy beyond a "sustain point" as described by Fujita et al. (1998), such that the previous agglomeration effects in the tourism industry are no longer attainable. At best, we might see local establishments in the Food Services sector temporarily move to other neighboring regions where the local population base has relocated, until that population relocates back to the urban core; the population base reaches a level to sustain food service establishments at a historically viable scale.

On the other hand, the oil and gas extraction sector's economic base comes from a combination of a historically large supply and low cost to extract petroleum and natural gas minerals along the Gulf Coast with a support of infrastructure of suppliers and transportation networks (ships, barges, pipelines, ports) to move these raw minerals from their extraction source to further processing (e.g., petroleum refineries) and eventually to end consumers. Further, the skilled labor involved in the industry is accustomed to the mobile nature of the industry. Both onshore and offshore drilling and related activities change geographic locations regularly, which lead to measurable dichotomies in place of work and place of residence. Hence, a worst case scenario might be that low producing oil or gas wells are simply shut and removed from production after natural disasters like hurricanes. At best, the loss and damage to infrastructure in the industry are quickly repaired, given that the labor force supporting the industry is geographically spread over a much greater area.

The importance of deepwater drilling and production as a proportion of total oil production in the U.S. increased during this period. After the year 2000, average daily deepwater offshore oil production exceeded shallow water oil production in the U.S.[5] (Nixon et al. 2009). Louisiana's total offshore oil production is dominated by federal outer-continental shelf production (mostly deepwater), with 48 million barrels extracted annually, compared to only 6.3 million barrels in shallow-water. Further, the majority of the servicing of deepwater rigs occurs in Louisiana, particularly in Port Fourchon, in Lafourche Parish. Approximately 90% of all deepwater rigs in the entire Gulf of Mexico are serviced in this area (Scott and Associates 2008).

5 Deepwater drilling is considered drilling of wells with a water depth of at least 1,000 ft. Ultra-deepwater drilling is defined as drilling of wells with a water depth of at least 5,000 ft.

2.4. DATA AND METHODOLOGY

The mining industry in Louisiana is a good case for this analysis in that two conditions hold for its measurement. The first is that many of the physical inputs in mining, particularly Oil and Gas Extraction, are bulky making it cost prohibitive to transport the inputs long distances. The second is an artifact of the data. A larger proportion of the major physical and service inputs in the aggregate mining sector from the North American Industrial Classification System (NAICS) also are classified as mining sector industries. Consequently, when mining is decomposed using spatial shift share analysis, the supply chain linkages can be captured. For a sector where a large proportion of its inputs come from an entirely unrelated industry sector altogether, an aggregated industry decomposition using spatial shift share analysis would fail to capture the supply chain linkages.

The analysis is performed on the basis of the classical shift share analysis and the spatial decomposition based on the contiguity of parishes. We focus on the Coastal Louisiana Region (CLR) parishes that are measurably influenced by industries geographically concentrated in this region as well as tropical storms[6]. CLR parish level employment data are drawn from Wholedata (Isserman and Westervelt 2006). Wholedata uses county business patterns (CBP) data that provides detailed employment by up to six digit NAICS sectors; however, because many sectors in small regions have only small numbers of establishments, their employment data are not disclosed to protect confidentiality. Wholedata imputes the undisclosed data so that employment estimates are available for all detailed NAICS sectors for each county. Summed national industry employment is used for the aggregate effect; hence total national employment in the given time t is denoted by E_t. The total employment in the given time t for different sectors in the nation are denoted as E_{it}. Similarly, the overall employment for each CLR parish in time t is denoted by e_t and the employment for each sector of each CLR parish is denoted by $e_{it.}$

The spatial weight matrix is developed based on the contiguity of the parishes. The matrix is then row standardized for further application in shift share analysis. To check the employment changes for every CLR parish, we evaluate a wide range of models enveloped by Nazara and Hewings (2004). The primary basis for spatial decomposition in this paper is the physical contiguity of parishes. Similarly, we can proceed further by creating the weight matrix on the basis of some economic variables and treating the neighboring regions on the basis of the interdependence in those economic variables. The weight matrix as constructed makes the neighboring region and local competitive effects easily interpretable by general practitioners.

Nazara and Hewings (2004) suggest that some of the local competitive effect explained in the classical shift share model is actually explained by neighboring region industry effects. How might this be tested to know if the neighboring region effect is truly a distinct effect from the localized effect? We apply a correlation analysis test used by Loveridge and Selting (1998) to test the distinctiveness of the neighboring region effect. We apply the same correlation analysis by taking the average of annual shift share decomposition effects between 2001 and 2006 and

6 Coastal Louisiana Region includes 32 parishes chosen from U.S. Dept. of the Interior Bureau of Ocean Energy Management (BOEM) definition of parishes influenced by energy industry activities off the outer-continental shelf (Saha, Manik, and Phillips 2005).

evaluating their pair wise correlations. Our hypothesis is that if the spatial neighboring region industry effect is a distinct decomposition effect, we would see the correlation between the neighboring region effect and the new localized effect created from the spatial model weakly correlated suggesting their effects are distinct.

2.5. RESULTS

In Tables 2.1 and 2.2, we compare the classical shift share analysis against the spatial shift share model (Equation E2.1) and the augmented spatial shift share model (Equation E2.4) for two time periods: a three year period (2001–2004) preceding the impacts of Hurricanes Katrina/Rita (Table 2.1) and a two year period[7] (2004–2006) during which Katrina and Rita occurred. For comparison, we report results of the classical shift share analysis. Columns 1-3 in Table 2.1 and 2.2 refer to the classical shift share case in 2001–04 and 2004–06 respectively, columns 4–6 report the spatial shift share model results, and columns 7–9 report the augmented spatial shift share results.

During 2001–04, the overall national employment was essentially flat (Table 2.1, column 1), and contributed to the industry mix effect of -3.2% (Table 2.1, column 2). These results from the classical shift share model suggest that any overall positive employment growth in an individual parish's mining sector was entirely due to localized in-parish positive competitive effects. On the other hand, the spatial shift share model was able to tease out more precise localized effects from the larger regional effects. Take the example of Calcasieu Parish, using the spatial shift share model (Table 2.1, columns 4–6), results show that the new localized effect (26.5%) is much greater than the competitive effect (5.6%) in the classical shift share model. This difference may be due to industry mix in the classical shift share model which treats a portion of a local parish's employment growth in a given industry, as being driven by the overall growth in that industry nationally. However, in the spatial shift share model, that growth in employment is not only driven by the same industry growth, but also in the neighboring contiguous parishes. If one prefers to include both the national industry growth rate and neighboring region effects separately in the shift share decomposition, then using the augmented spatial shift share models is appropriate (columns 7–9, Tables 2.1 and 2.2). While generating the same localized effect as the spatial shift share model, it disentangles any neighboring region effects that may be driven by national industry growth.

In Table 2.2, we see even greater contrasts and interpretation between the classical and the spatial shift share models. In the Calcasieu Parish case, between 2004 and 2006, the classical shift share model shows that 19% of the 37% growth rate in employment in the mining sector was attributable to local competitive effects (Table 2.2, column 3) whereas the spatial shift share model shows that approximately 41% of the same 37% growth rate in employment was due to local effects. The underlying differences are driven by differences between the industry mix and neighboring region effects. In the classical shift share model, national industry growth would have contributed approximately 14% (Table 2.2, column 2) to overall employment growth rate,

7 Only two year period was selected for analysis because of data availability issue.

whereas the neighboring region effect would have reduced growth rates in employment in Calcasieu Parish by 8% (Table 2.2, column 5). In the Calcasieu case, when using the augmented spatial shift share model, the neighboring region effect reduces growth rate in employment by over 21% (Table 2.2, column 8).

To better understand how the spatial shift share model interprets growth in employment, we present a breakdown of growth by sign (+/-) of the neighboring region effects and local effects using the spatial shift share model for mining in Figures 2.1 (2001–2004) and 2.2 (2004–2006).

Table 2.1. Comparing classical and augmented spatial shift share analysis on employment growth in the mining sector 2001–2004.

	Classical Shift Share (01-04)			Spatial Shift Share (01-04)			Augmented Spatial Shift Share (01-04)			
	G	Gi-G	gi-Gi	G	gibar-G	gi-gibar	Gi	gibar-Gi	gi-gibar	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Area name	**Nat. Effect**	**Industry Mix**	**Comp. Effect**	**Nat. Effect**	**Neigh. Region Effect**	**Local Effect**	**Nat. Industry Effect**	**Neigh. Region Effect**	**Local. Effect**	**Total Growth (01-04)**
Acadia	0.0001	-0.032	0.442	0.0001	-0.281	0.691	-0.031	-0.249	0.691	0.410
Allen	0.0001	-0.032	-0.094	0.0001	0.673	-0.798	-0.031	0.705	-0.798	-0.125
Ascension	0.0001	-0.032	-0.382	0.0001	-0.178	-0.235	-0.031	-0.147	-0.235	-0.413
Assumption	0.0001	-0.032	0.240	0.0001	-0.129	0.337	-0.031	-0.097	0.337	0.209
Beauregard	0.0001	-0.032	0.410	0.0001	0.529	-0.150	-0.031	0.560	-0.150	0.378
Calcasieu	0.0001	-0.032	0.056	0.0001	-0.241	0.265	-0.031	-0.209	0.265	0.025
Cameron	0.0001	-0.032	-0.535	0.0001	-0.334	-0.233	-0.031	-0.302	-0.233	-0.566
E. Baton Rouge	0.0001	-0.032	-0.608	0.0001	-0.221	-0.418	-0.031	-0.189	-0.418	-0.639
Evangeline	0.0001	-0.032	0.395	0.0001	-0.227	0.591	-0.031	-0.195	0.591	0.364
Iberia	0.0001	-0.032	0.046	0.0001	-0.101	0.115	-0.031	-0.069	0.115	0.014
Iberville	0.0001	-0.032	-0.149	0.0001	-0.102	-0.079	-0.031	-0.070	-0.079	-0.181
Jefferson	0.0001	-0.032	-0.273	0.0001	-0.202	-0.103	-0.031	-0.171	-0.103	-0.305
Jefferson Davis	0.0001	-0.032	-0.503	0.0001	-0.001	-0.534	-0.031	0.031	-0.534	-0.535
Lafayette	0.0001	-0.032	-0.208	0.0001	-0.126	-0.114	-0.031	-0.094	-0.114	-0.239
Lafourche	0.0001	-0.032	0.107	0.0001	-0.183	0.258	-0.031	-0.152	0.258	0.075
Livingston	0.0001	-0.032	-0.380	0.0001	0.356	-0.768	-0.031	0.387	-0.768	-0.412
Orleans	0.0001	-0.032	-0.227	0.0001	-0.072	-0.187	-0.031	-0.040	-0.187	-0.259
Plaquemines	0.0001	-0.032	0.027	0.0001	-0.156	0.151	-0.031	-0.125	0.151	-0.005
St. Bernard	0.0001	-0.032	0.127	0.0001	-0.132	0.227	-0.031	-0.100	0.227	0.095
St. Charles	0.0001	-0.032	-0.589	0.0001	0.003	-0.624	-0.031	0.035	-0.624	-0.620
St. James	0.0001	-0.032	-0.254	0.0001	0.028	-0.313	-0.031	0.059	-0.313	-0.286
St. John	0.0001	-0.032	0.272	0.0001	0.096	0.144	-0.031	0.128	0.144	0.240
St. Landry	0.0001	-0.032	-0.627	0.0001	0.157	-0.815	-0.031	0.189	-0.815	-0.658
St. Martin	0.0001	-0.032	0.127	0.0001	-0.142	0.238	-0.031	-0.111	0.238	0.095
St. Mary	0.0001	-0.032	0.034	0.0001	-0.005	0.007	-0.031	0.027	0.007	0.002
St. Tammany	0.0001	-0.032	0.100	0.0001	1.464	-1.396	-0.031	1.495	-1.396	0.068
Tangipahoa	0.0001	-0.032	2.267	0.0001	0.147	2.088	-0.031	0.179	2.088	2.235
Terrebonne	0.0001	-0.032	-0.306	0.0001	0.095	-0.433	-0.031	0.127	-0.433	-0.338
Vermilion	0.0001	-0.032	-0.459	0.0001	-0.183	-0.307	-0.031	-0.152	-0.307	-0.490
Vernon	0.0001	-0.032	2.781	0.0001	0.127	2.623	-0.031	0.158	2.623	2.750
Washington	0.0001	-0.032	0.724	0.0001	1.152	-0.459	-0.031	1.183	-0.459	0.692
W. Baton Rouge	0.0001	-0.032	0.154	0.0001	-0.410	0.532	-0.031	-0.378	0.532	0.122
Average	**0.0001**	**-0.032**	**0.085**	**0.0001**	**0.044**	**0.009**	**-0.031**	**0.075**	**0.009**	**0.053**

Table 2.2. Comparing classical and augmented spatial shift share analysis on employment growth in the mining sector 2004–2006.

	Classical Shift Share (04-06)			Spatial Shift Share (04-06)			Augmented Spatial Shift Share (04-06)			
	G	Gi-G	gi-Gi	G	gibar-G	gi-gibar	Gi	gibar-Gi	gi-gibar	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Area name	**Nat. Effect**	**Industry Mix**	**Comp. Effect**	**Nat. Effect**	**Neigh. Region Effect**	**Comp. Effect**	**Nat. Industry Effect**	**Neigh. Region Effect**	**Local. Effect**	**Total Growth (04-06)**
Acadia	0.042	0.137	0.084	0.042	0.009	0.211	0.179	-0.127	0.211	0.263
Allen	0.042	0.137	-0.179	0.042	0.008	-0.050	0.179	-0.129	-0.050	0.000
Ascension	0.042	0.137	1.025	0.042	0.209	0.953	0.179	0.072	0.953	1.204
Assumption	0.042	0.137	-0.223	0.042	0.310	-0.396	0.179	0.173	-0.396	-0.044
Beauregard	0.042	0.137	-0.649	0.042	0.338	-0.850	0.179	0.201	-0.850	-0.471
Calcasieu	0.042	0.137	0.190	0.042	-0.081	0.408	0.179	-0.218	0.408	0.369
Cameron	0.042	0.137	0.024	0.042	0.057	0.104	0.179	-0.080	0.104	0.203
E. Baton Rouge	0.042	0.137	0.521	0.042	0.621	0.036	0.179	0.485	0.036	0.700
Evangeline	0.042	0.137	-0.872	0.042	0.260	-0.996	0.179	0.124	-0.996	-0.693
Iberia	0.042	0.137	-0.494	0.042	0.111	-0.469	0.179	-0.026	-0.469	-0.315
Iberville	0.042	0.137	0.233	0.042	0.317	0.053	0.179	0.181	0.053	0.412
Jefferson	0.042	0.137	-0.162	0.042	0.182	-0.207	0.179	0.045	-0.207	0.017
Jefferson Davis	0.042	0.137	-0.029	0.042	-0.121	0.229	0.179	-0.258	0.229	0.150
Lafayette	0.042	0.137	0.099	0.042	0.125	0.111	0.179	-0.012	0.111	0.278
Lafourche	0.042	0.137	0.043	0.042	0.147	0.033	0.179	0.010	0.033	0.221
Livingston	0.042	0.137	0.561	0.042	0.329	0.369	0.179	0.192	0.369	0.740
Orleans	0.042	0.137	-0.228	0.042	0.053	-0.144	0.179	-0.084	-0.144	-0.049
Plaquemines	0.042	0.137	0.280	0.042	-0.116	0.533	0.179	-0.253	0.533	0.459
St. Bernard	0.042	0.137	-0.370	0.042	0.163	-0.396	0.179	0.026	-0.396	-0.191
St. Charles	0.042	0.137	0.087	0.042	0.070	0.153	0.179	-0.066	0.153	0.265
St. James	0.042	0.137	-0.579	0.042	0.328	-0.770	0.179	0.191	-0.770	-0.400
St. John	0.042	0.137	-0.080	0.042	0.210	-0.153	0.179	0.073	-0.153	0.099
St. Landry	0.042	0.137	0.619	0.042	-0.002	0.757	0.179	-0.139	0.757	0.797
St. Martin	0.042	0.137	0.134	0.042	0.176	0.094	0.179	0.040	0.094	0.313
St. Mary	0.042	0.137	0.005	0.042	0.245	-0.103	0.179	0.108	-0.103	0.184
St. Tammany	0.042	0.137	-0.123	0.042	-0.415	0.428	0.179	-0.551	0.428	0.055
Tangipahoa	0.042	0.137	-0.697	0.042	0.125	-0.685	0.179	-0.012	-0.685	-0.518
Terrebonne	0.042	0.137	1.017	0.042	0.078	1.075	0.179	-0.058	1.075	1.196
Vermilion	0.042	0.137	-0.402	0.042	0.073	-0.339	0.179	-0.063	-0.339	-0.223
Vernon	0.042	0.137	0.821	0.042	-0.277	1.235	0.179	-0.414	1.235	1.000
Washington	0.042	0.137	-0.406	0.042	-0.273	0.004	0.179	-0.410	0.004	-0.227
W. Baton Rouge	0.042	0.137	0.120	0.042	0.514	-0.257	0.179	0.377	-0.257	0.299
Average	**0.042**	**0.137**	**0.012**	**0.042**	**0.118**	**0.030**	**0.179**	**-0.019**	**0.030**	**0.190**

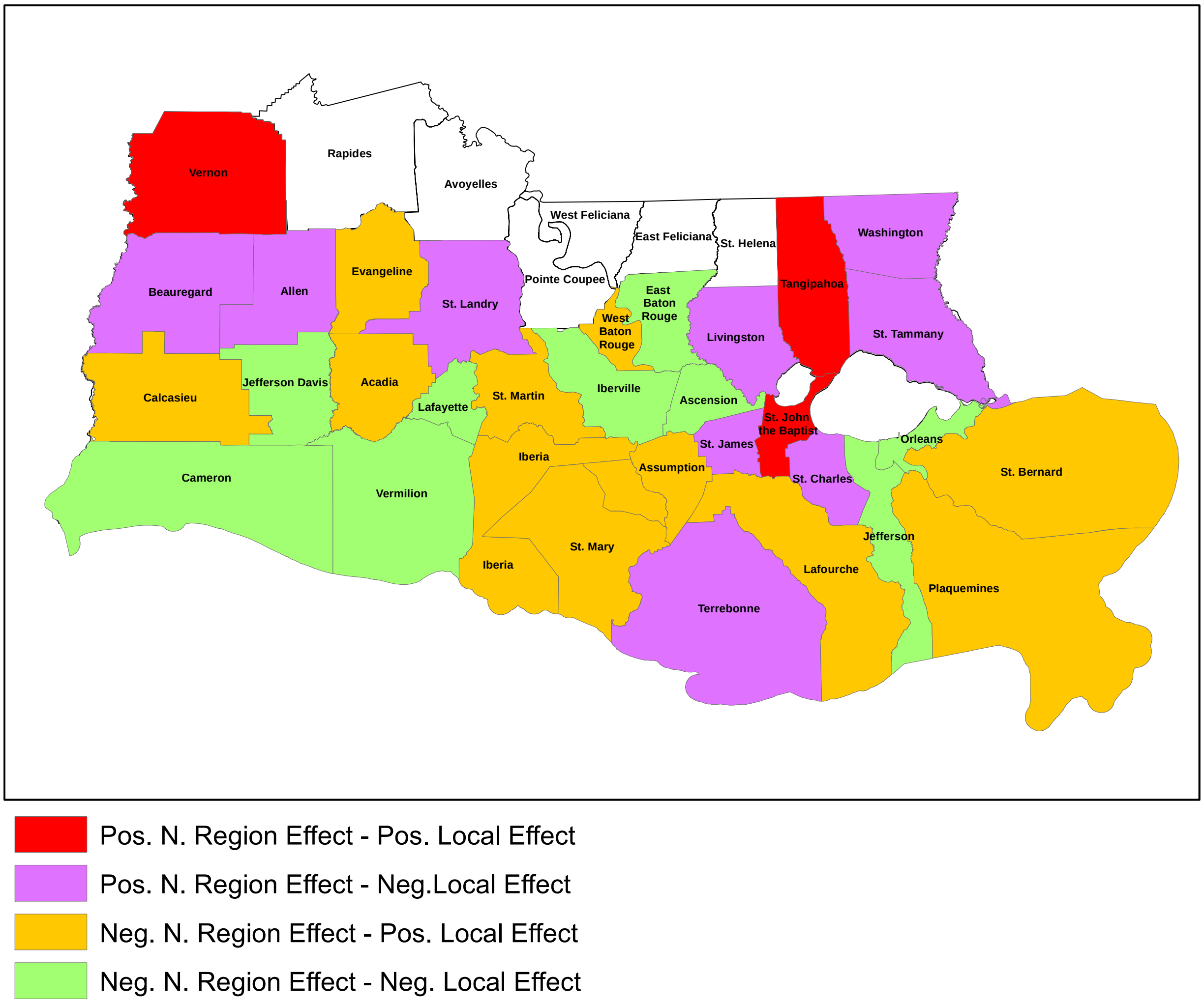

Figure 2.1. Spatial shift share analysis of neighboring region and local effects for mining from 2001–2004.

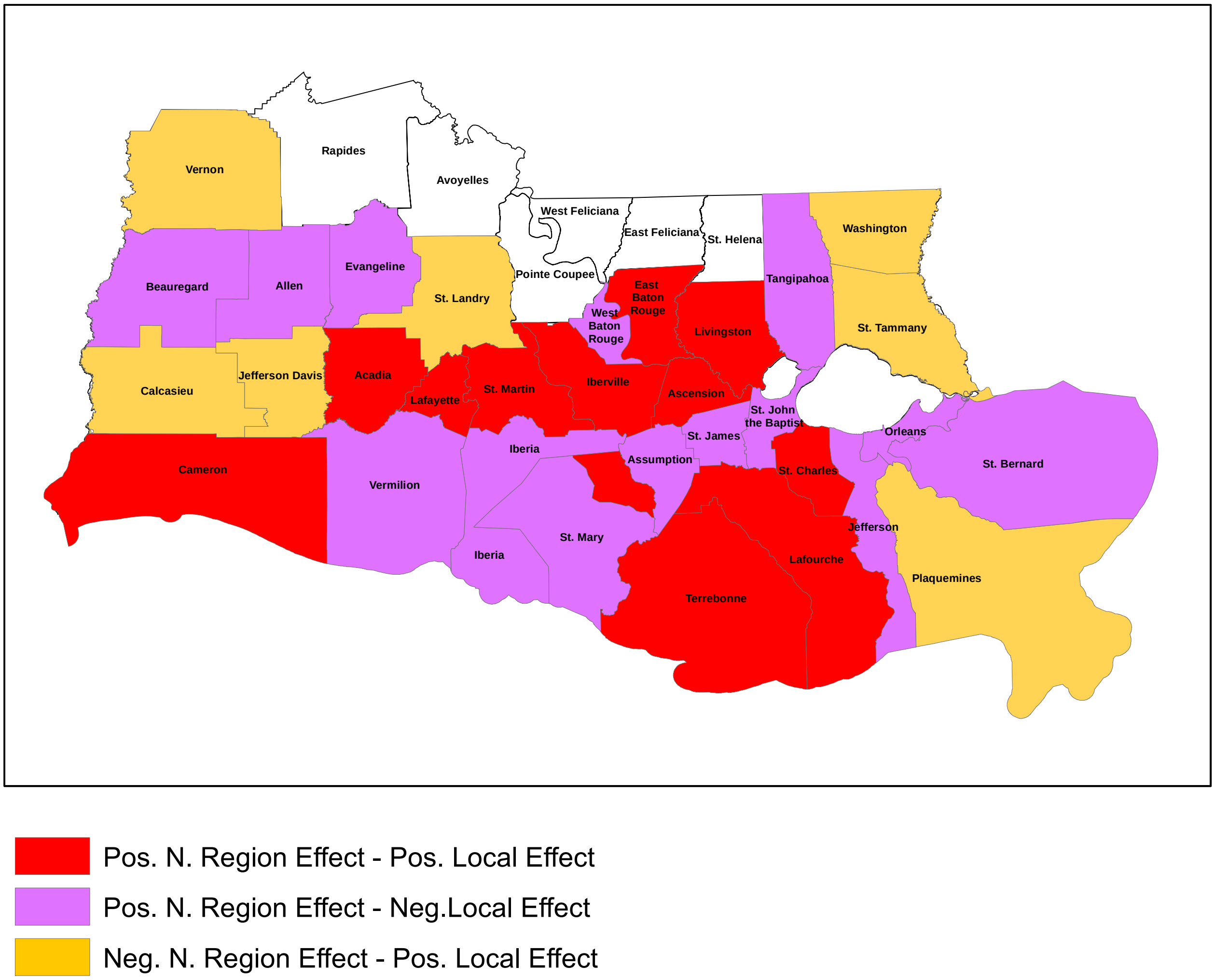

Figure 2.2. Spatial shift share analysis of neighboring region and local effects for mining from 2004–2006.

In Figure 2.1, we identify parishes based on the signs of growth rates of employment from both the neighboring region effect and the local effect from the spatial shift share model for the period 2001–04. As can be seen from the figure, red parishes have both neighboring region effects that are positive as well as localized effects that are positive. These parishes are thriving from both localized and regional effects. Parishes in purple represent those parishes that have positive neighboring region effects, but a negative local effect. These parishes are potentially receiving spillover employment benefits from a larger region and are likely to indicate that the parish may have a weaker comparative advantage in the industry compared to what the competitive effect would suggest in classical shift share analysis. Finally, parishes in orange have negative neighboring region effects but a positive local effect. These parishes are likely to have a strong comparative advantage effect locally and may have a larger region that supports a parish's specific industry. Parishes in green represent poor localized conditions for employment growth and a weak regional environment to maintain existing employment in the mining industry.

During 2001–2004, oil prices stayed in the range of \$20 to \$40 per barrel, which did not economically support re-investment in more mature shallow depth oil fields. Structurally, growth in the oil and gas industry was occurring in the deep waters of the Gulf of Mexico. The major service port for a majority of drilling activity is Port Fourchon, at the southern tip of Lafourche Parish (see Figure 2.1). This parish showed an overall positive employment growth rate (7.5%) during this period, despite its neighboring region effect contributing to approximately 18% reduction in employment growth rate (Table 2.1, column 5). Related to this port, support activity industry establishments for deepwater drilling are spread across multiple parishes along the coast. The positive spillover effect of Lafourche Parish's employment growth rate (driven largely in part by its deepwater port activity) dampened potentially larger reductions in employment growth for support industry in Terrebonne and St. James parishes. Further, Figure 2.1 highlights few spatial spillovers in mining originating from the major metropolitan centers in South Louisiana to surrounding areas. Orleans (New Orleans), East Baton Rouge (Baton Rouge), Lafayette (Lafayette) and Calcasieu (Lake Charles) core metro parishes only had one contiguous parish each that were categorized as having positive neighboring region effects.

However, during 2004–2006, we see a changing spatial spillover landscape. In particular, we see two spatial "corridors" of thriving employment growth: a corridor along the Interstate 10 and Interstate 12 corridor from Livingston Parish in the east to Acadia Parish in the west, and a corridor extending through Terrebonne, Lafourche, and St. Charles Parishes. Sandwiched between these two corridors is a large horizontal corridor of parishes that received positive neighboring spillover benefits driven by neighboring parishes to both the north and the south. During this period, Terrebonne and Lafourche (as well as Cameron parish in Southwest Louisiana) parishes were major ports involved in the repair and restoration of many of the drilling rigs, platforms, and pipeline systems within the Gulf of Mexico. The I-10 and I-12 corridor highlights a region likely benefitting from onshore mining support industries helping in the restoration of the offshore industry infrastructure. Finally, increasing oil prices during this period helped in creating a mild increase in onshore activities, such as work-over rigs and other repair and activities, on existing land-based wells to extract additional hydrocarbons from many older oil producing wells.

Results from the spatial shift share in Table 2.3 suggest that the spatial shift share model, unlike the Esteban-Marquillas (EM) approaches, tends to disentangle neighboring region effects ($\vec{g}_i$-G) from truly localized competitive effects ($\vec{g}_i$ –gi) without creating additional correlation issues, compared to the classical shift share model. For example, in the classical shift share model for the mining industry sector, the correlation between the industry mix, (G_i-G), and competitive effect, (gi-G_i), was significant (-0.297). In the spatial shift share model for mining industry sector, the correlation between the neighboring region effect, ($\vec{g}_i$-G), and the local effect, (gi-$\vec{g}_i$), was negative and insignificant (-0.013). Therefore, these results may suggest that the regional structural influence that was argued for the restructuring of the competitive effect in the EM approach, and argued as unsuccessful by Loveridge and Selting (1998), appears to have been mitigated with the spatial shift share method.

Table 2.3. Correlation analysis testing the distinctness of neighboring region effect for the mining sector.

Decompositions	National (G)	Industry-mix (G_i-G)	Competitive (g_i-G_i)	Neigh. Region ($g_i$bar-G)	Local (g_i-$g_i$bar)
National (G)	1.000				
Business-mix (G_i-G)	0.994*** (0.000)	1.000			
Competitive (g_i-G_i)	-0.324* (0.070)	-0.297* (0.097)	1.000		
Neigh. Region ($g_i$bar-G)	-0.997*** (0.000)	-0.994*** (0.000)	0.325* (0.069)	1.000	
Local (g_i-$g_i$bar)	0.014 (0.937)	0.042 (0.815)	0.940*** (0.000)	-0.013 (0.941)	1.000

Values in parenthesis indicate p-values. *, **, and *** indicate the significance levels of 10%, 5% and 1%, respectively.

2.6. DISCUSSION

The results presented above for the mining industry sector suggest that some parishes may have localized competitive advantages despite having little economic support from neighboring parishes (negative neighboring region effect, positive local effect), whereas other parishes tend to ride the coat-tails of their neighbors economically (positive neighboring region effect, negative local effect). What might be driving these varying patterns? In particular, though the interpretation of the competitive effect of classical shift share analysis holds for interpreting the localized effect in the spatial shift share model, what may be driving the neighboring region effect?

We posit two explanations. The first is that the larger region has multiple establishments producing products that are connected together as part of a larger supply chain. There is increased demand for a product at one point along the supply chain which is located in one parish in the larger region. To the extent that establishments upstream in the supply chain are in neighboring parishes, the backward linkage effects spill over to the neighboring parish.

The second explanation suggests that a common site advantage, such as a harbor or river, may be shared by multiple parishes in a larger region to produce a similar product. Hence, if demand increases for a product that needs to take advantage of a natural site advantage, economies of scale may indicate expansion of an existing facility up to an efficient scale threshold. Beyond that point, increased demand may need to be met by a new establishment. The new establishment may take advantage of the natural site advantages in a neighboring parish possibly resulting in neighboring region spillover effects.

In both explanations, the local effect in the spatial shift share model is strictly dependent on the growth rate of the neighboring region effect. That is, after controlling for the overall national growth of the economy, all of the remaining employment growth in a parish, for a particular industry, is first attributed to the neighboring region growth with the residual being the local effect. The decomposition assumes that a local parish's employment growth is dependent on its neighboring region's growth. Unfortunately, there are some limitations to this assumption. For example, let's assume a local port that supplies the offshore oil and gas industry grows over a period of time and reaches capacity with no possibility for further growth. Industries that use the existing port recognize the economic value of supporting their offshore activities using the canal to move finished products. If a neighboring parish's port along the same canal increases the depth of its access points to supply the larger offshore vessels, it may generate additional employment growth from related industries.

The spatial shift share model with the neighboring region effect in the above example would assume that the first port's growth in employment (the port that reached capacity) was dependent on the employment growth of the neighboring parish's port. However, the example shows that causality cannot be clearly inferred from spatial shift share analysis. In most cases for aggregated industries, the classical shift share decomposition is mostly immune to this shortcoming, because most small regions analyzed with classical shift share model are too small to cause economic growth in the larger region.

The choice between the classical and numerous variants of spatial shift share analysis should not be taken lightly. As mentioned previously, both regional industry structure and data structure should be considered. For industries that are very homogenous in their production process across space or typically have demand effects that evenly spread across geographic space, a classical shift share model with national industry growth may be appropriate. However, for aggregated industry classifications with heterogeneous production processes across space, a spatial shift share model may be a preferable alternative. Finally, industries that have multiple sections of a supply chain in the same industry classification (such as mining) may also benefit because it highlights spatial policy spillovers from supply chain effects.

2.7. CONCLUSION

Shift share analysis has been applied over the decades to provide local policy makers and development officials a better perspective concerning what factors drive their local economic growth. It is a statistical tool that decomposes a region's growth into different effects. Most of the previous studies dealt with classical shift share analysis that decomposes a region's growth into three different effects. In this study, we move further by applying spatial shift share analysis that takes into account a region's growth that is affected by its neighboring region's growth in any specific industry or all industries. There have been debates in earlier studies whether these different effects are truly distinct effects. We apply a correlation analysis test to test the validity of decomposition. Finally, this research identified an alternative decomposition technique that increased distinctiveness between industry and local effects that were not achieved by Esteban-Marquillas shift share formulations.

This research used an augmented spatial shift share model to understand regionalized comparative advantage in core economic sectors of the state of Louisiana and regional economic shifts that occurred after natural disasters like hurricanes Katrina and Rita. Our results indicate that while overall employment declined in the three year period prior to the natural disasters, the spatial shift share model identified regions that witnessed employment growth. Further, the employment growth was broken into individual parishes that had localized comparative advantage. One of the possible explanations for this comparative advantage was a re-focusing of particular parishes to deepwater oil and gas exploration and development. It was argued that neighboring parishes to these parishes showing positive local comparative advantage from deepwater operations also received spatial spillovers in terms of employment growth. The study found that the spatial neighboring region industry effect was a distinct effect from the sub-region localized effect. The results indicate the importance of considering the neighboring region effect when formulating local growth and development policies.

CHAPTER 3. MODELING THE LABOR MARKET AND ESTIMATING THE RELATIVE PERFORMANCE OF ESTIMATORS FOR LOUISIANA LABOR MARKET: A LABOR FORCE MODULE APPROACH

3.1. Introduction and Background Information

In the previous two chapters, we developed a socio-economic baseline for BOEM-defined Louisiana parishes. In particular, we identified key socio-economic variables and through the use of fuzzy set analysis and identified key strengths and weaknesses of these parishes based on the variables presented. Further, we focused on employment change in a key economic sector in the BOEM on shore area region of Louisiana and evaluated how they were impacted by Hurricanes Katrina and Rita.

In the next two chapters, we present the development of a Community Policy Analysis System (COMPAS) model for Louisiana. This model can be applied to measure changes in local government revenues and expenditures from changes in major economic activity, such as deepwater oil and gas operations, among other external economic changes. In this chapter (Chapter 3), we present the development of the labor force module of COMPAS. In Chapter 4, we present the development of the fiscal module of COMPAS. Finally, in Chapter 5, we apply the fully developed COMPAS model to evaluate changes in local government revenues and expenditures for a given BOEM on shore area parish from drilling activity in the Gulf of Mexico.

The Community Policy Analysis System (COMPAS) model is an effective tool to measure the labor and fiscal impacts of different industries in a region. The model exhibits inter-sectoral linkages, since an exogenous shock in any sector of the economy leads to a series of changes in other sectors. Community Policy Models such as the Louisiana Community Impact Model (LCIM) (Fannin et al. 2008; Adhikari and Fannin 2010a) have been helpful in addressing economic impact questions to address the policy issues of a region. Other policy analysis models such as the Virginia Impact Projection (VIP) Model developed by Johnson (1991), the Iowa Economic/Fiscal Impact Modeling System developed by Swenson and Otto (2000), and the Integrated Economic Impact and Simulation Model for Wisconsin Counties (Shields 1998) demonstrate how such a model could be used to aid local decision makers. This paper focuses in extending the results from Adhikari and Fannin (2008) by using panel models and comparing to 3SLS modeling to measure the forecasting performances of estimators.

The COMPAS modeling framework can be applied across the country to address labor market and fiscal impacts from initial changes in economic activity (Johnson, Otto and Deller 2006). At its foundation, COMPAS is an employment driven model. Employment demand is generated by changes in local product demand. The definition of employment demand may vary, but the exogenous shock that appears from the changes in employment demand is the basis of the modeling system in COMPAS based models. In many cases, this product is converted to employment demand through the use of input-output models. The input-output (I/O) model treats final demand as exogenous and the labor market supply as perfectly elastic to meet the labor demands generated by the product demands (Beaumont 1990). In this I/O framework, an exogenous change in demand for the product and services interact with the rest of the economy through linkages of industrial material goods and services in an economy, its local labor market, and ultimately, its fiscal sector. See Figure 3.1 for an example of this structure.

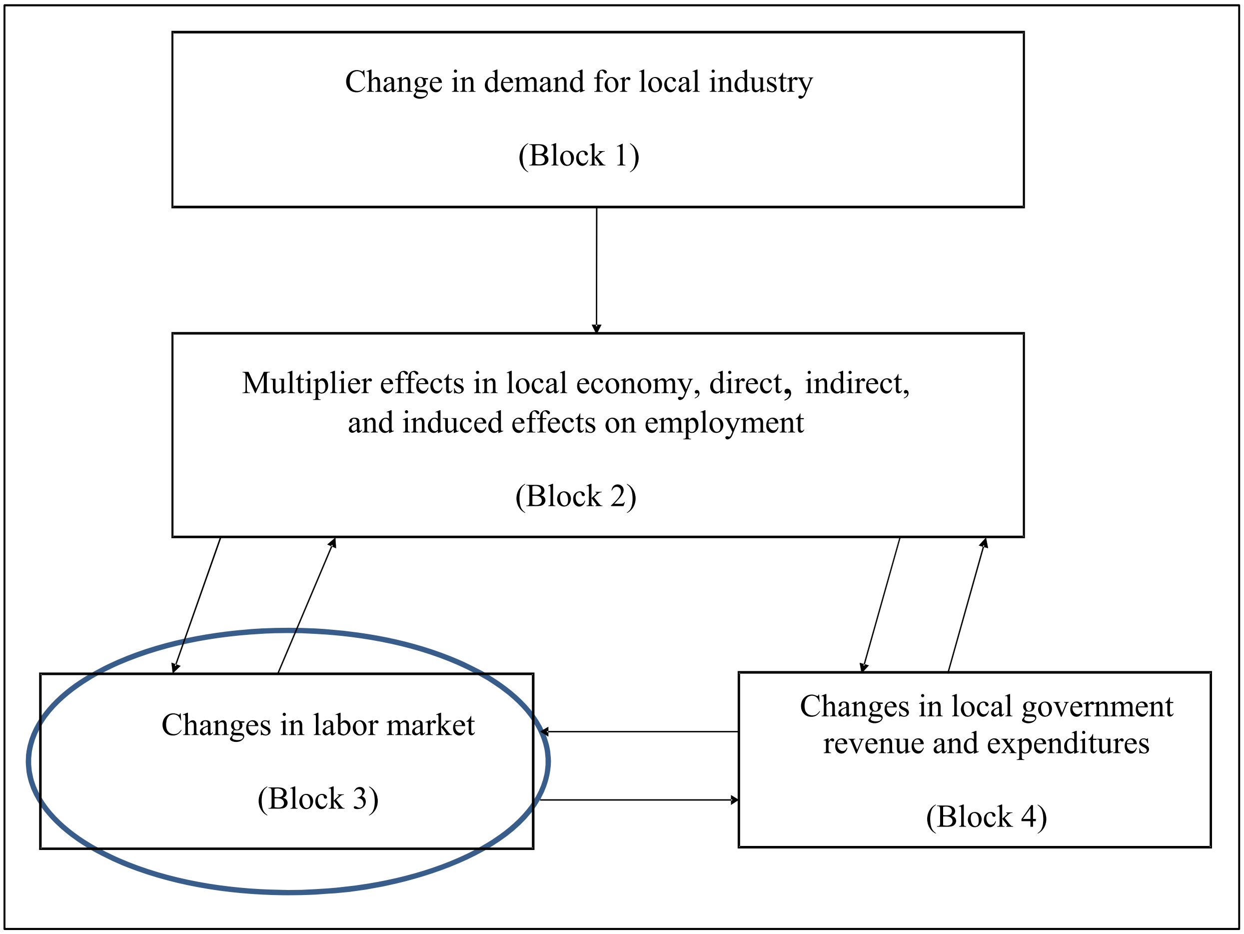

Figure 3.1. Highlighting the labor market in the COMPAS modeling framework

The chapter comprises several sections. The next section is a literature review where we present the major ideas of several scholars who have conducted similar studies and lay out a foundation for the development of the remaining sections of the chapter. Next, we set out a conceptual framework that explains the foundation of the model. This is followed by the objectives of the study, and then by a data and methodology section where we set forth the theoretical and empirical model and describe the data and methods we will be using for accomplishment of the study objectives. These results will then be discussed and compared based on their relative performance of alternative labor market estimators.

3.2. LITERATURE REVIEW

The labor force module is a demand driven framework based on employment demand (Swenson 1996; Johnson, Otto, and Deller 2006; Fannin et al. 2008). The underlying assumption is that economic growth is largely due to the exogenous increase in employment in a region.

A concept of modeling the spatial labor market and a foundation of COMPAS-type models was developed by Johnson (2006); his assumption that economic growth of a community is based on the labor market that distributes jobs between in-commuters, out-commuters, currently unemployed and new entrants to the local labor market (Figure 3.2). Commuting plays a vital role while analyzing the labor market of a specific region. A small region might have a smaller resident labor force, but more commuters because of shorter travelling distance to its neighboring region. Similarly, a large and developed region might have measurable commuters because of more opportunities and job placement in the region. A labor market is conceptualized and presented in the Figure 3.2 below.

The linking of the labor force module with input-output models such as IMPLAN (impact modeling for planning) is highlighted by Swenson and Otto (1998). They constructed an Iowa economic/fiscal impact model (IE/FIM) to generate detailed information for local decision makers about economic, demographic and fiscal variables. The model presents an inter-relationship of the labor force module and a fiscal module in the sense that the changes in employment demand and the population are major factors affecting local tax bases, local revenues and expenditures. Labor force, out-commuters, and in-commuters are the three dependent variables used in the model whereas population is assumed to be a function of labor force and other variables that affect labor force participation rate.

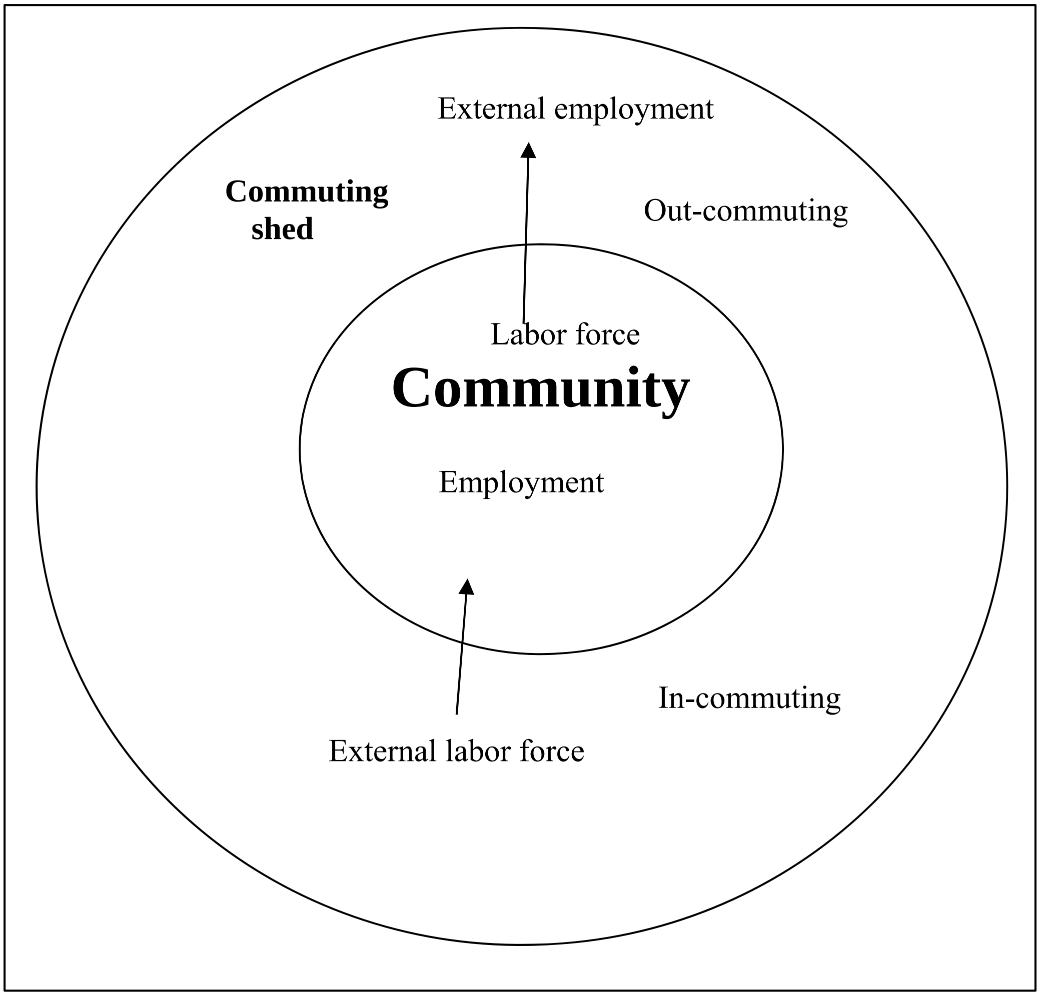

Figure 3.2. A conceptual labor market (Johnson 2006).

A similar study was carried out recently by Fannin et al. (2008) to evaluate the deepwater energy impacts on economic growth and public service provision in Lafourche Parish, Louisiana. The authors created a Louisiana community impact model (LCIM) in a block recursive fashion based on the COMPAS modeling framework to enumerate the linkages among local economic activity and the demand for local government services. A conjoined input-output and econometric model was used to analyze the economic impacts of the region. In this study, we propose modifications from the 2008 study in variables and the estimation procedure by inclusion of a three stage least squares model, and panel regression methods that account for cross-equation correlation and multi-year variation respectively.

An extension of earlier studies was proposed by Evans and Stallmann (2006), where they proposed the Small Area Fiscal Estimation Simulator (SAFESIM) for Texas counties using a two-stage least squares procedure. SAFESIM was constructed as a spreadsheet-based simulator, which consisted of several socio-economic variables with data from county and school districts. Data in the model were obtained from a number of sources, including the U.S. Census Bureau, Woods and Poole Economics, Inc., National Center for Education Statistics' Core of Common

Data, and the Census of Governments. A labor force module and fiscal module were estimated using a 14-equation model. Civilian labor force was defined to be a function of employment status and results showed that that the labor force was positively affected by population and negatively by the level of unemployment. Total population was assumed to be a function of total number of jobs (positive relationship) and net commuting (negative relationship). Similarly, net commuting (In-commuters minus Out-commuters) was defined as a function of the place of work employment and the level of unemployment. Results indicated that there was a positive and significant relationship of place of work employment with net commuting. As the number of jobs in a region increase, the number of in-commuters increase and out-commuters decrease and thus the net commuting is positive. The effect was opposite in case of the increased levels of unemployment.

Many of the earlier studies in other disciplines used different techniques for evaluating forecasting performance. Cicarelli (1982) proposed a new method of evaluating the accuracy of economic forecasts where the probability of correctly forecasting directional change was introduced. Values of this measure were computed for eleven well-known macro econometric forecasting models. An inequality-type index of relative directional accuracy based on this measure was presented and used to evaluate the models in terms of their relative accuracy. Hsu and Wu (2008) performed a similar study for interval data with different evaluation techniques. They defined a criterion which was more efficient to evaluate forecasting performance for interval data, where they presented evaluation techniques for interval time series forecasting. The forecast results were compared by the mean squared error of the interval and mean relative interval error.

Amirkhalkhali et al. (1995) examined the relative forecasting performance of different estimators proposed for a structural equation in a large system using Monte Carlo experiments with antithetic varieties. The performance of the estimators was compared in terms of the accuracy of the within-sample as well as post-sample predictions for 10 structural equations by using the mean absolute percentage error (MAPE) of forecasts. It concluded that the ridge-type estimator performed consistently better than other estimators in both the within-sample predictions and ex-post forecasts. Though many forecast evaluation techniques are available, most are designed for the end user of the forecasts. Most statistical evaluation procedures rely on a particular loss function. Forecast evaluation procedures, such as mean squared error and mean absolute error, that have different underlying loss functions, may provide conflicting results. Diersen and Manfredo (1998) developed a new approach of evaluating forecasts, a likelihood scoring method that does not rely on a particular loss function. The method takes a Bayesian approach to forecast evaluation and uses information from forecast prediction intervals.

Most of the earlier community policy models dealt with the modeling issues and estimating relationships of several variables with labor market variables. Few of them have attempted to evaluate the forecasting performance of community policy models, Kovalyova and Johnson (2006), being one of them. They suggested that forecasting performance could improve model accuracy and validation. They ran simulations with all satisfactory models and looked for the best model (in terms of minimum error) from a statistical point of view to generate realistic economic predictions. They used several indicators to validate the Missouri Show Me model developed by Johnson and Scott (2006), which was estimated on the basis of cross-sectional data. They used several quantitative indicators for each equation and each county in the sample to analyze the forecasting accuracy. Results showed that the "best" model performed with about 10 percent error, as indicated by root mean square percent error and mean absolute percent error and concluded that the model produced forecasts of acceptable quality.

Traditionally, most of the COMPAS models were built on cross-sectional frameworks. Data availability is one of the biggest issues when constructing COMPAS type models in different states. Commuting data were historically added in the model based on the census journey to work data that are released once every decade. This results in two constraints. First, one is forced to model the commuting patterns only in a census year. Second, if one relies on census data, one might need to assume that the commuting relation holds to the years between census periods, and this incorporates some level of measurement error into the model. A major contribution of our study is the addition of newly available annual commuting data by county (parish) which allows increasing reliability of off-census year cross-sectional models. This also provides the opportunity to develop a panel data estimator as an alternative in COMPAS labor market module estimation.

This chapter concentrates on modeling the Louisiana labor market based on earlier developed community policy analysis models, and then on comparing and contrasting performance of alternative estimators using several approaches. As suggested by many researchers, we will estimate the performance using several quantitative methods where we analyze different indicators like mean error, mean square error, root mean square error and Theil's coefficients as a benchmark for comparison. This will be a novel study in terms of comparing performance of several estimators of the labor force module in COMPAS modeling.

3.3. Conceptual Framework

Labor markets involve a structural system where employment supply and employment demand are constantly changing between regions, and create a constant change in the flow of the labor force to meet demand both within and between regions. Neoclassical economics suggests that equilibrium in the labor market is the result of interactions between profit-maximizing firms and utility maximizing laborers. This interaction determines the price (wage in case of the labor market) and the quantity (number employed in case of labor market). One of the most common approaches of labor supply and labor demand could be the cases in Figure 3.3 and Figure 3.4 where a region faces an upward sloping (positively sloped) labor supply and downward sloping labor demand (negatively sloped). In such cases, wage is determined where labor supply intersects labor demand (Hamermesh 1993).

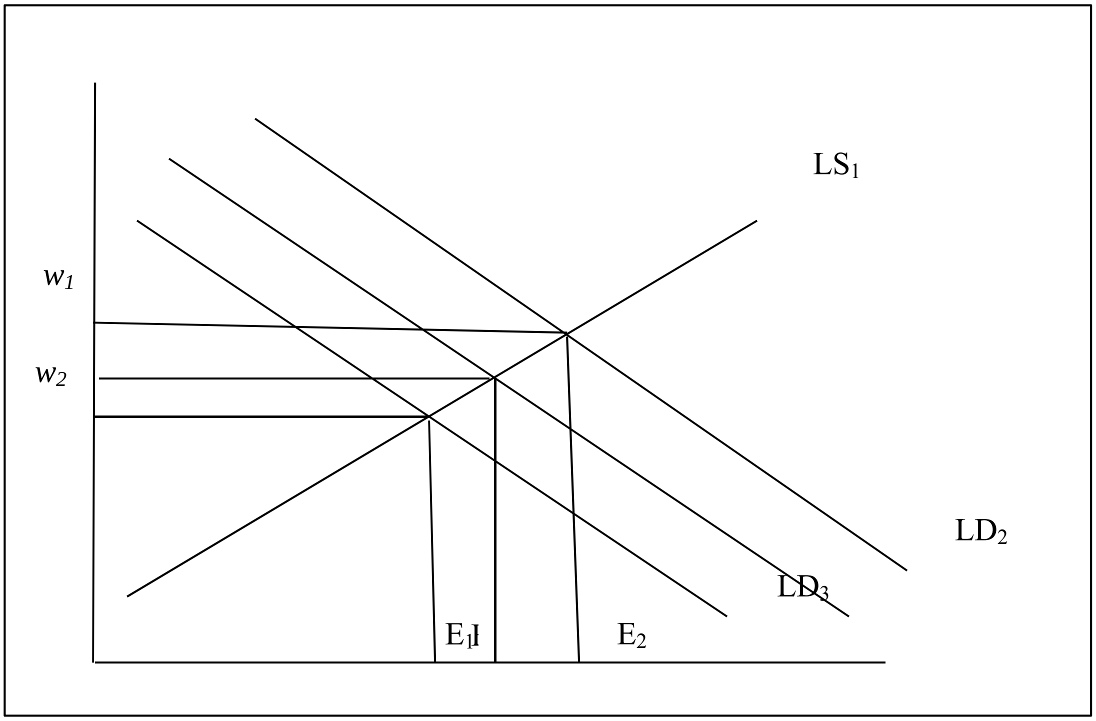

Figure 3.3. Result of labor demand change in employment and wages, assuming a constant supply.

In Figure 3.3, LS_1 and LD_1 determine labor supply and labor demand in an equilibrium condition. If labor demand increases (with constant labor supply), we see that the labor demand curve moves outward (LD_2) and thus both the employment and wages increases from E_1 to E_2 and w to w_1 respectively. If the labor demand decreases (again, labor supply being constant), labor demand curve shifts inwards (LD_3) and hence the employment decreases to E_3 and wages decreases to w_2. In case of Figure 3.4, LS_1 and LD determine labor supply and labor demand in an equilibrium condition. If there is an increase in labor supply (labor demand holding constant), labor supply curve moves to right (LS_2) and thus the employment increases from E_1 to E_2 but wage decreases from w to w_1. On contrary, if the labor supply decreases, the labor supply curve moves to the left (LS_3), resulting in the increase in wages to w_2 but the decrease in employment to E_3 (Figure 3.4). The magnitude of change in the employment and wages depend on the shift of the curve.

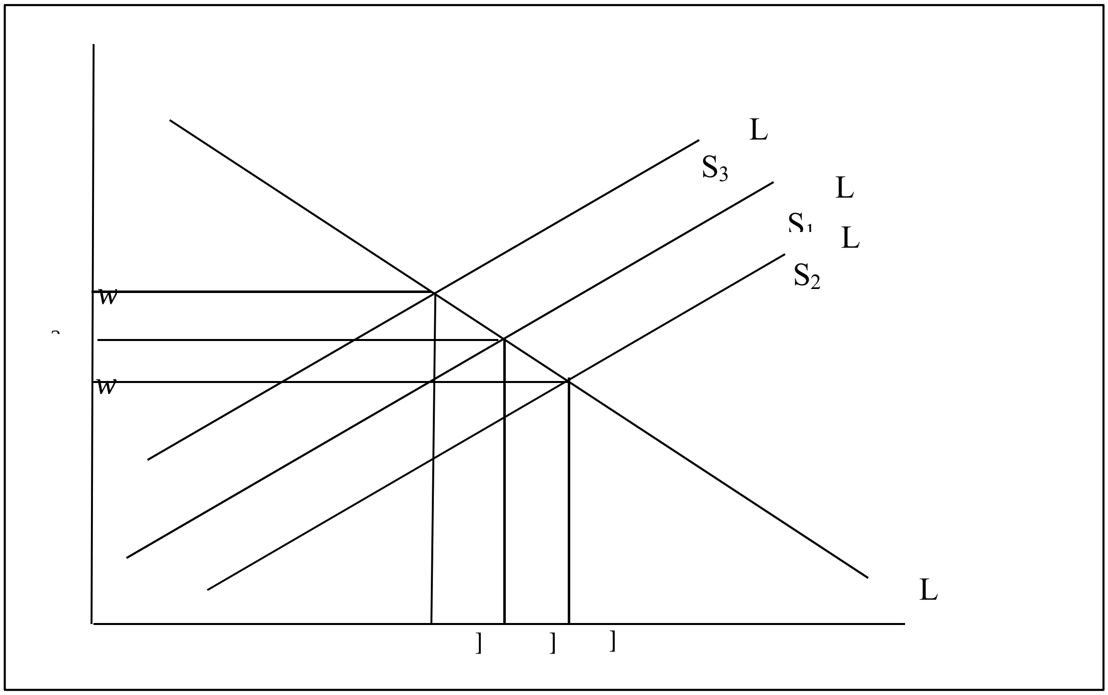

Figure 3.4. Result of labor supply change in employment and wages, assuming a constant demand.

Another approach is demonstrated by Johnson (2006), where individual labor faces a perfectly elastic labor supply, perfectly inelastic labor demand and exogenous wage[8] (Figure 3.5). This approach is particularly relevant in the context of the COMPAS modeling framework since the model is implemented in a small open economy region, for example, a county or a city. Such a region faces a perfectly elastic labor supply because of its residents, in-commuters and in-migrants (Bhandari 2003).

In Figure 3.5, a case of a small economy, labor supply is displayed as L_S (which is infinitely elastic, as shown by horizontal line) and labor demand is displayed as L_D (which is completely inelastic, as shown by vertical line). Wages are exogenous and shown as *w* in the vertical axis. An increase in labor demand from L_D to L_{D1} would not change the wage rate but changes the total employment from E_1 to E_2.

8 Here, we consider a small region, say county, and thus the change is labor demand may not necessarily change the wage rate. Hence, wage in such a case is exogenously calculated.

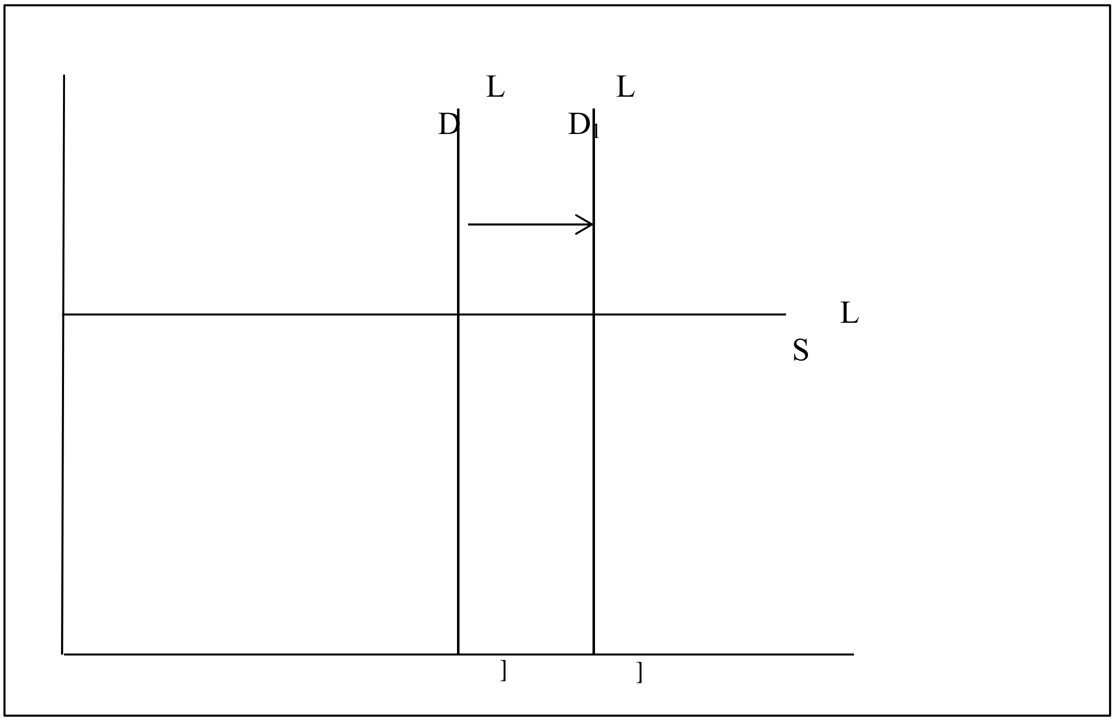

Figure 3.5. Result of perfectly elastic labor supply and perfectly inelastic labor demand.

Changes in labor markets and how these labor market changes are influenced by changes in employment demand are described hereafter. Estimation of the labor force module plays a key role in our model, as is also the case with other COMPAS- based models. The Louisiana labor force module estimates structural equations for labor force, in-commuters and out-commuters, which closely explains the relationship between employment demand and the supply of labor needed to meet that demand. In the COMPAS modeling framework, labor supply is a function of labor force, unemployment, out-commuters and in-commuters within a region. Similarly, labor demand is the function of the wage rate. As shown in Figure 3.1, the labor force module lies between exogenous changes in employment and the ultimate fiscal effects (local government revenue and expenditures that occur in the local economy) in the COMPAS framework (Block 3).

Local and regional labor markets play a vital role in COMPAS-based models. These models assume that economic growth is caused mostly by an exogenous increase in employment. Conceptually, the labor force module intersects labor force demand and labor force supply:

(E3.1) $L_D = L_S$

where L_D is labor force demand and L_S is labor force supply (Johnson 2006). The demand curve for the labor force is a function of the wage rate:

(E3.2) $L_D = f(w)$

where w is the wage rate. We can invert the labor demand equation to obtain

(E3.3) $w = g(L_D)$

We can also evaluate the supply as disaggregated into the following components:

(E3.4) $L_S = LF - U - OC + IC$

where *LF* is the total labor force, *U* is the total unemployment, *OC* is the total number of out-commuters, and *IC* is the total number of in-commuters. We can then evaluate each component of the total labor supply as a function of employment as well as a vector of supply shifters (Johnson, Otto and Deller, 2006).

(E3.5) $LF = f_L (w, Z_{LF}) = f_L (g (L_D), Z_{LF})$
(E3.6) $OC = f_L (w, Z_{OC}) = f_L (g (L_D), Z_{OC})$
(E3.7) $IC = f_L (w, Z_{IC}) = f_L (g (L_D), Z_{IC})$

where *Z* is a vector of supply shifters for labor force, out-commuters, and in-commuters.

3.4. Objectives of the Study

This study aims to develop a model to forecast labor demand in terms of labor force, in-commuters, and out-commuters for the labor force module of Louisiana Community Impact Model (LCIM) using alternative procedures that are capable of increasing the performance over traditional COMPAS estimators. The specific objective includes modeling the labor force module (labor force, in-commuters and out-commuters) for all parishes of Louisiana with cross-sectional, three stage least squares (3sls), and panel approaches to compare the relative forecasting performance of the alternative estimators.

3.5. Data and Methodology

Estimation is based on the COMPAS model for all parishes of Louisiana that includes all 64 parishes[9], where the variables for the labor force module were selected on the basis of Fannin et al. (2008) and were modified depending upon the requirements of our model. Louisiana is a good candidate for such a test because of the heterogeneity of the local labor force within the state. Seven different equations are estimated by a cross-section Ordinary Least Square (OLS) model as a base control with three stage least squares and the panel data model also estimated. We estimate the model using data from the Bureau of Economic Analysis (BEA) regional economic data series. In-commuting and Out-commuting Data come from the U.S. Census Bureau's new Local Employment Dynamics Project. All regressions are performed using STATA. The forecasting performance is evaluated based on the procedures outlined in Johnson, Otto, and Deller (2006) and Kovalyova and Johnson (2006).

9 A few outliers were removed using the r-student procedure.

The labor market equations in this module are based on the conceptual labor market discussed earlier in the paper. A cross-sectional OLS model is used as a base control model using the sample year of 2008. A panel data method is applied to observe whether the model performs better with increased observations, and the three stage least squares method is used to both improve model specification by explicitly modeling endogeneity between equations in the model, and to correct for any correlation, present between each individual equation's error terms. Following the work by Johnson (1996); Swenson (1996); Shields (1998); and Fannin et al. (2008), the Louisiana labor force module empirically specifies several equations for these variables.

Equations for Louisiana labor force module are specified as:

(E3.8) $WAGE = \beta_{20} + \beta_{21}EMP + \beta_{22}UNEMP + \beta_{23}WAGLAG + \varepsilon$

(E3.9) $POP = \beta_{30} + \beta_{31}EMP + \varepsilon$

(E3.10) $UNEMP = \beta_{40} + \beta_{41}EMPOP + \beta_{42}WAGE + \beta_{43}UNEMPLAG + \varepsilon$

(E3.11) $INCOMM = \beta_{50} + \beta_{51}RELLOCWA + \beta_{52}RELLOCUN + \beta_{53}EMPOP + \varepsilon$

(E3.12) $OUTCOMM = \beta_{60} + \beta_{61}RELLOCWA + \beta_{62}RELLOCUN + \beta_{63}EMPOP + \varepsilon$

(E3.13) $LABFOR = \beta_{70} + \beta_{71}POP + \beta_{72}ELDPOP + \beta_{73}WAGE + \varepsilon$;

where, LABFOR (labor force), UNEMP (unemployment), WAGE (average wage per job), POP (population), OUTCOMM (out-commuters), INCOMM (in-commuters) are endogenous variables and EMP (place of work employment), WAGLAG (wage lag), EMPOP (employment opportunities), UNMPLAG (unemployment lag), RELLOCWA (relative local wage), RELLOCUN (relative local unemployment), and ELDPOP (percentage of elderly population) are exogenous variables. The expected signs based on previous studies (Shields 1998; Johnson, Otto, and Deller 2006; Fannin et al. 2008) for these variables can be seen in the Table 3.1 below.

The labor market equations provide the information on all the components of labor supply and labor demand. Most employed (including self-employed) workers commute some distance. The data that we use are organized as if jobs and workers were located in discontinuous locations. When data are recorded, some workers are identified as residents of a different location than that of their jobs. These workers are defined as commuters. This definition, however, is very much dependent on the arbitrary boundary of data cells; especially the size of the data cells. In practice, these data cells are typically counties or census places. Functional forms for each of the equations were based on Fannin et al. (2008); however, we also tested the functional forms for each equation by the box-cox test and results suggested the log-log form to be the most appropriate functional form based on the data. The log-log form was incorporated in the remainder of the equations.

Table 3.1. Expected signs for different variables for labor force module equations.

Dependent Variables	Independent Variables		
WAGE	EMP (+)	UNEMP (-)	WAGLAG (+)
UNEMP	EMPOP (+)	WAGE (-)	UNEMPLAG (+)
POP	EMP (+)		
INCOMM	RELLOCWA (+)	RELLOCUN (-)	EMPOP (+)
OUTCOMM	RELLOCWA (-)	RELLOCUN (+)	EMPOP (-)
LABFOR	POP (+)	ELDPOP (-)	WAGE (+)

As stated earlier, the primary purpose of this chapter is the performance measurement of alternative estimators based on newly available datasets and to check whether the uniqueness of cross-sectional units matter. This is performed by evaluating different estimators of the general labor force module of Louisiana. We are interested in choosing an optimal model that maximizes the forecasting performance for the labor force module equations of the Louisiana COMPAS model. A cross-sectional OLS, 3sls, and a panel approach will be applied in order to model the labor force. Based on the results, we evaluate if the model specification addressing endogeneity (as observed from 3sls) or additional time series data (panel data set that incorporates both spatial and temporal dimensions) is relatively more important for increasing the forecasting performance.

We start with the OLS/GLS framework where we take a single year's worth of data as performed by Johnson et al. (2006). The base year as a sample for estimation is 2008. Next, we take into account the three stage least squares model (2000–2008) and a panel model (2000–2008) that takes into account the newly available annual data on commuting.

Comparing the performance of different estimators is an important step in the model building process since it can suggest the best model to be selected and different ways in which the model can be improved. Because on data availability, we compare forecasted labor market estimates for 2008 to actual labor market data reported in the same year. The performance of estimators is compared on the basis of quantitative evaluation methods. These methods include analysis of mean simulation error (ME), mean percent error (MPE), mean absolute error (MAE), mean absolute percent error (MAPE), mean square error (MSE), root mean square error (RMSE), root mean square percent error (RMSPE), and Theil's coefficient U1 and U2 (Theil, 1970, 1975; Pindyck and Rubinfield 1991, 1998; Johnson, Otto, and Deller 2006). These performance metrics will be provided for both in-sample years (2008) and selected year's out-of-sample (2000–2008).

3.6. Results and Discussion

Results from Table 3.2 demonstrate the descriptive statistics of variables used in the labor market equations of the labor force module of Louisiana. As can be seen, there is measurable variability in the data. It should be noted that unlike COMPAS type models in other states that incorporate only a subset of counties in a state for analysis, this model incorporates all Louisiana parishes, large and small, resulting in greater variability.

Table 3.2. Variable description and summary statistics for analysis of Louisiana parishes.

Variable	Variable Description	Mean	Standard Deviation	Min	Max
EMP (#)	Place of work/employment	30,165	43,908	1,944	221,739
WAGE ($)	Average wage per job	30,072	7,156	17,653	55,730
UNEMP (#)	Unemployment	1,615	2,189	114	13,931
POP (#)	Total population	69,315	95,303	5,671	483,663
INCOMM (#)	Total in-commuters	10,754	19,890	272	118,882
OUTCOMM (#)	Total out-commuters	10,552	13,194	488	86,044
LABFOR (#)	Total labor force	31,555	40,133	2,196	236,340
WAGLAG ($)	Wage lag	29,222	6,615	17,653	51,685
UNEMPLAG (#)	Unemployment lag	1,640	2,224	114	13,931
RELLOCWA ($)	Relative local wage (avg local wage/avg continuous wage)	1.009	0.147	0.718	1.507
RELLOCUN (#)	Relative local unemployment (local unemployment/contiguous unemployment)	0.305	0.569	0.010	4.512
EMPOP (#)	Relative employment opportunities (local employment/contiguous employment)	0.318	0.561	0.012	4.997
ELDPOP (%)	% population over 65 years of age	12.64	2.28	6.96	18.05

Results shown in Table 3.3 demonstrate parameter estimates comparison of the OLS estimators, 3sls estimators, and panel estimators for all equations of the labor force module of Louisiana. Most of the signs in the parameter estimates are as expected; however, there are some counter-intuitive estimates.

Table 3.3. Parameter estimates for OLS, 3sls, and panel regressions of Louisiana labor force module.

Labor Force Module	Linear (OLS)		3SLS		Panel	
	Coeff.	t-stat	Coeff.	z-stat	Coeff.	z-stat
Wage						
Employment	0.008	0.62	-0.002	-0.21	0.024***	4.73
Unemployment	-0.010	-0.72	0.001	0.11	-0.026***	-4.50
Wage lag	1.00***	59.86	1.008***	94.18	0.990***	127.03
Intercept	0.051	0.34	-0.025	-0.28	0.092	1.22
Unemployment						
Employment opportunities	0.008	0.44	0.042**	3.14	0.036***	4.11
Wage	0.103	1.32	-0.072	-1.58	-0.066***	-3.20
Unemployment lag	0.995***	37.70	0.926***	56.38	0.945***	85.04
Intercept	-0.874	-1.29	1.316***	2.86	1.112***	4.45
Population						
Employment	0.906***	32.57	0.889***	50.22	0.881***	35.27
Intercept	1.788***	7.01	1.979***	11.45	2.050***	8.92
In-commuters (Dep var) (log-log model)						
Relative local wage	1.534**	2.35	1.673***	6.38	0.701	1.64
Relative local unemployment	-0.630***	-5.73	-0.443***	-6.27	-0.283**	-2.46
Relative employment opportunities	0.172	1.49	0.158**	2.26	0.202***	4.05
Intercept	10.286***	51.21	9.536***	122.48	9.400***	35.16
Out-commuters (Dep var) (log-log model)						
Relative local wage	-0.242	-0.43	-0.257	-1.36	-0.481	-1.10
Relative local unemployment	0.515***	5.15	0.334***	6.87	0.306***	4.49
Relative employment opportunities	0.110	1.24	0.055	1.14	0.126	1.04
Intercept	10.336***	78.51	9.531***	158.27	9.714***	63.07
Labor force (Dep var) (log-log model)						
Population	1.024***	22.56	0.888***	49.65	0.858***	12.87
% population over 65 years of age	0.110	0.48	-0.139***	3.19	-0.415**	2.02
Wage	-0.280	-1.04	0.676***	10.32	0.128***	2.57
Intercept	1.695	0.59	7.022***	10.31	-1.620**	-2.22

***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

Parameter estimates for the labor force module are presented in the Table 3.3. Predictably, in the wage equation, the current wage rate is significantly related to its lagged value. Parameter estimates for lagged wages close to one suggest that almost all effects are captured by the lagged variable and that the lagged wages are considered to be important determinants of current wages. Similar interpretation could be made in the case of the unemployment equation that the current unemployment rate is significantly related to its lagged value and the parameter estimates for lagged unemployment close to one suggest relative year-to-year stability of labor markets. The negative sign (3sls and panel model) for wage is consistent with the theory suggesting that an increase in wage would attract more people and that would be an incentive for a decrease in unemployment.

Place of work employment is considered to be the primary variable that drives changes in variables from the labor force module in COMPAS, since it determines the changes in population in the regions of study. Results from the population equation suggest that economic opportunity, as measured by the number of local jobs, has an important influence on the number of local residents. This is consistent with the theory, since people tend to live close to their place of work. Hence, as new local jobs are created, people migrate into the region: here 100 new jobs result in about 90 additional local residents.

In case of the in-commuters equation (for all models), we see that an increase in the relative local wage would attract more in-commuters. When region A has more jobs than contiguous regions B, C, and D, people will in-commute to region A from B, C, and D in search of employment opportunities. Similarly, a negative sign for the relative local unemployment is consistent with theory, as it depicts that an increase in unemployment in region A compared to regions B, C, and D would decrease the number of in-commuters into region A; the workers from B, C, and D would work in their place of residence rather than commuting to region A. Furthermore, a positive sign for employment opportunity depicts that an increase in employment in region A compared to regions B, C, and D would increase the in-commuters of region A. There would be increased supply of jobs in region A and thus people from regions B, C, and D would out-commute to region A to meet this newly available supply.

In case of the out-commuters equation, the negative sign of the relative local wage variable indicates that an increase in the local wage of region A compared to regions B, C, and D would lead to a decrease in out-commuters from region A. This is also consistent with the theory because an increase of local wages in region A works as an incentive for the workers of region A to live and work in their own region which certainly would decrease the number of out-commuters. Similarly, a positive sign for the relative local unemployment is consistent with theory, as it depicts that an increase in unemployment in a region A compared to regions B, C, and D would increase the out-commuters of region A as they would explore for jobs in their contiguous regions. Though the signs on the coefficients for relative employment opportunities run counter to theory, they are not statistically significant.

Not surprisingly, population is the greatest determinant of the local labor force, as evident from the labor force equation. As observed from the panel data model, 100 additional residents lead to an around 85 person increase in the local labor force. The negative sign on the percent population above 65 years of age depicts that an increase in elderly population leads to decreases in the labor force of a region since fewer at this age will continue to work. Similarly, results show that an increase in wages lead to an increase in the labor force, which is consistent with the theory, because an increase in wages would be an incentive for people to starting looking for jobs and hence join the labor force.

Table 3.4. Average performance estimation measures for dependent variables in Louisiana labor force module.

Labor Force Module	Linear (OLS)	3sls	Panel
Wage			
Mean Percent Error	0.002	-0.003	0.0005
Mean Absolute Percent Error	0.026	0.020	0.019
Root Mean Square Percent Error	0.004	0.002	0.001
Theil's Coeff (U1)	0.010	0.048	0.046
Theil's Coeff (U2)	0.021	0.276	0.275
Unemployment			
Mean Percent Error	0.027	0.027	0.026
Mean Absolute Percent Error	0.181	0.173	0.172
Root Mean Square Percent Error	0.068	0.068	0.068
Theil's Coeff (U1)	0.141	0.140	0.140
Theil's Coeff (U2)	0.689	0.690	0.689
Population			
Mean Percent Error	0.044	0.054	0.038
Mean Absolute Percent Error	0.183	0.191	0.174
Root Mean Square Percent Error	0.059	0.067	0.054
Theil's Coeff (U1)	0.077	0.081	0.075
Theil's Coeff (U2)	0.176	0.192	0.385
In-commuters			
Mean Percent Error	0.300	0.434	0.422
Mean Absolute Percent Error	0.711	0.892	0.855
Root Mean Square Percent Error	1.698	1.688	1.685
Theil's Coeff (U1)	0.246	0.267	0.206
Theil's Coeff (U2)	0.745	0.707	0.798
Out-commuters			
Mean Percent Error	0.291	0.317	0.257
Mean Absolute Percent Error	0.632	0.651	0.617
Root Mean Square Percent Error	0.845	0.915	0.815
Theil's Coeff (U1)	0.264	0.138	0.136
Theil's Coeff (U2)	0.475	0.634	0.626
Labor force			
Mean Percent Error	0.051	0.097	0.042
Mean Absolute Percent Error	0.233	0.281	0.215
Root Mean Square Percent Error	0.128	0.143	0.107
Theil's Coeff (U1)	0.051	0.052	0.047
Theil's Coeff (U2)	0.281	0.282	0.264

When testing the relative performance between the models, for most cases, the panel data model outperformed both the ordinary least squares and three stage least squares models in terms of mean error, root mean square percent error, and Theil's coefficients (Table 3.4). Theil's coefficients are calculated based on root mean square error and zero value of the coefficient indicates perfect prediction and any value up to 10% is considered effective.

Referring to Figure 3.6, a comparison is made on the off-years forecasting performance between these models for the labor force equations. Our OLS model is based on cross-sectional data for the year 2008. Our 3sls and panel data are based on years ranging from 2000 to 2008. Results display a similar pattern in most cases (2005 and 2006 display some unusual pattern which might have resulted from the effects of hurricanes Katrina and Rita); panel data model outperform both the OLS and 3sls model, measured in terms of average absolute mean percent error measures.

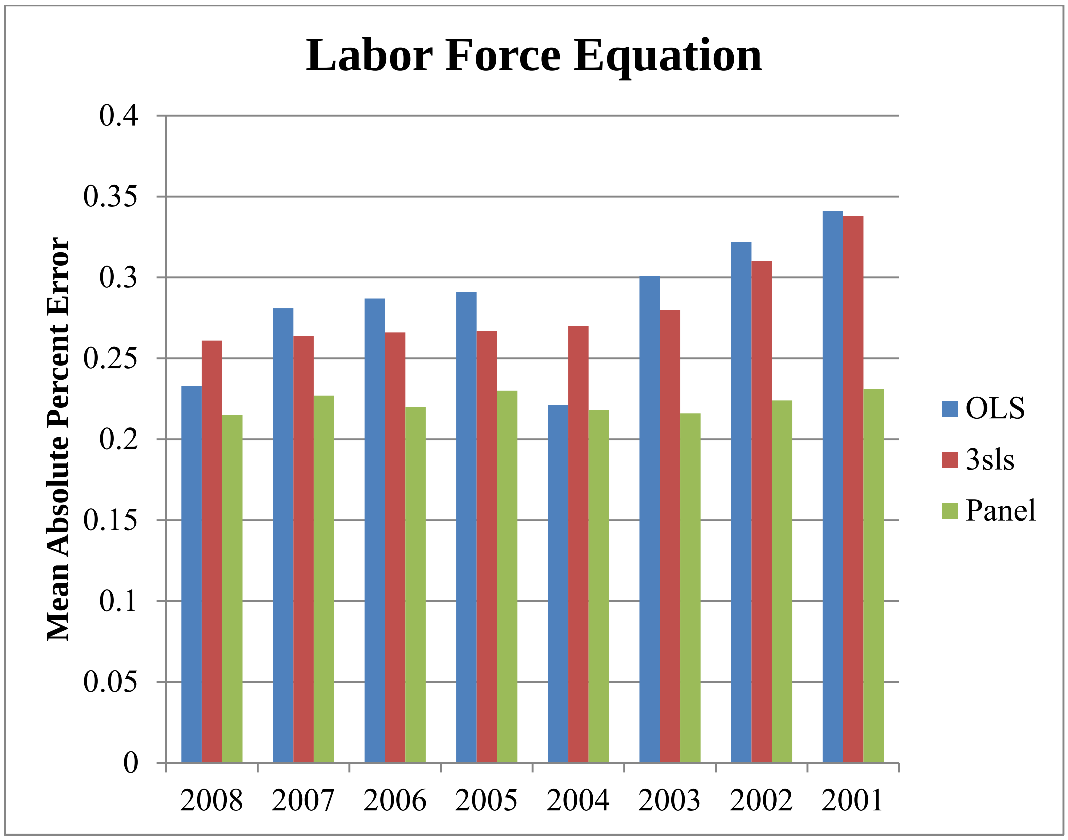

Figure 3.6. Comparing off-years MAPE by OLS, 3sls, and panel data models.

When we compare OLS and 3sls by same sets of error measures, 3sls seems to outperform OLS on all three equations. This might be consistent with the theory because 3sls procedure improved model specification (by incorporating endogenous regressors) increased forecasting performance. Further, as expected, inaccuracy of forecasts increased as we back-casted further from the cross-sectional date from which the parameter estimates were constructed (2008).

Although error measures were suggested by Kovalyova and Johnson (2006) to evaluate what would be considered quality forecasting performance, we conducted a mean comparison test in STATA to compare the base OLS model with 3sls and panel data models for four different equations (wage, in-commuter, out-commuter, and labor force) of the labor force module. The test performs a comparison of means for all possible combinations of groups. For instance, we have three types of models (OLS, 3sls, and panel) and we would like to see if there are differences in means between groups, this test computes the t-test for all three possible combinations. The output is presented in a table of differences in means (as denoted by magnitude) and includes the value (as denoted by t-stat), and significance level of the t-test (as denoted by single, double, and triple asterisks for indicating statistical significance at 10%, 5%, and 1% respectively. These results are presented in Tables 3.5–3.8.

Table 3.5. Mean comparison test for wages, based on MAPE.

Wages					
	OLS	3sls		Panel	
		Magnitude	t-stat	Magnitude	t-stat
OLS		-127	-4.35***	-0.002	-1.74**
3sls				127	4.35***
Panel					

***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively

Table 3.6. Mean comparison test for in-commuter, based on absolute mean percent error.

In-commuter					
	OLS	3sls		Panel	
		Magnitude	t-stat	Magnitude	t-stat
OLS		0.106	2.22**	0.069	1.132
3sls				-0.036	-1.37
Panel					

***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively

Table 3.7. Mean comparison test for out-commuter, based on MAPE.

Out-commuter					
	OLS	3sls		Panel	
		Magnitude	t-stat	Magnitude	t-stat
OLS		0.020	0.521	0.035	0.860
3sls				0.014	1.36
Panel					

***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively

Table 3.8. Mean comparison test for labor force, based on MAPE.

Labor Force					
	OLS	3sls		Panel	
		Magnitude	t-stat	Magnitude	t-stat
OLS		-0.088	-4.064***	-0.051	-2.338**
3sls				0.036	1.236
Panel					

***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

Overall, results from Tables 3.5–3.8 suggest that although the panel data model is always lower in magnitude in terms of error measures as compared to the base OLS model and the 3sls model for all five labor force module equations (e.g., Figure 3.6), it is not always significantly lower (in terms of absolute mean percent error) than the OLS or 3sls model. In most equations, either the 3sls or panel data model maintained a significantly lower mean absolute percent error than the OLS model. However, the test statistics were inconclusive as to whether a panel model taking into account endogeneity (3sls) or without endogeneity (panel) generated statistically superior forecasts.

Average error measures are not a perfect method for evaluating the performance of entire region. We can, therefore, take individual parish data and evaluate the performance of estimators in terms of quantitative measures like mean error, mean percent error and root mean square error to figure out how much the predicted value deviates from the actual value. For the labor force equation (in case of OLS), we could see that the average mean percent error, average absolute mean percent error, and average root mean square percent error are 0.051, 0.233, and 0.128 respectively (Table 3.4). However, because of the heterogeneity in space, some parishes, like West Feliciana, Plaquemines, Assumption, East Baton Rouge, Iberville, and Orleans, are not performing as well on average, because their predicted values are measurably different than their actual values and thus are the reason for higher error values. On the contrary, parishes like Calcasieu, Bossier, Caldwell, Claiborne, Richland, St. Helena, Terrebonne, Union, and Madison are performing better than the average error measures as the difference between the predicted and actual values are close to zero.

3.7. Conclusion and Limitations

This research identified newly available data from which to evaluate alternative models for improving forecasting performance for labor market module estimators in Community Policy Analysis System-type models. In particular, we applied new labor market data on commuting from the U.S. Census Bureau to apply more time accurate commuting data for OLS and three stage least squares models as well as develop a panel dataset of commuting to apply a panel data estimator to estimate and forecast labor force, in-commuting, and out-commuting.

Panel data and the three stage least squares, in most of the cases, have advantages over cross-sectional OLS regressions in improving model forecasting performance. The case can be made that the sample year (2008) for the OLS cross-section equation might not be a good year for the labor force module given this year falls within the most recent national recession that impacted the country.

One limitation of this study is the exclusion of spatial econometric analysis to build the models that might take into account spatial behavior in terms of distance measures. These spatial estimators might also be used as alternatives to the COMPAS model to evaluate whether these estimators would increase the forecasting performance by including a space variable in the model. Their inclusion would be a future extension of this research.

An additional limitation of this research is the unfortunate timing of the exogenous shock of hurricanes Katrina and Rita during the modeling period. The 2005 and 2006 years are likely outliers in terms of temporary labor market shifts that did not settle out until 2007. Including these two years in our panel dataset may have reduced the forecasting performance of the panel data estimator. Future research may investigate panel data windows that exclude this period.

An evaluation of the alternative methodologies performed in this study are expected to give regional economic modelers better information from which to choose econometric models for labor force modeling in COMPAS-type models. Using the data from different sources, this study developed a model to forecast different sectors of the labor force module using cross-sectional linear, three stage least squares, and panel data regression. Future optimal applications of these estimators will improve forecasts and increase the demand and application of these models by local governments and other constituencies.

CHAPTER 4. MODELING THE LOUISIANA LOCAL GOVERNMENT FISCAL MODEL IN A DISEQUILIBIRUM ENVIRONMENT: A MODIFIED COMPAS MODEL APPROACH

4.1 INTRODUCTION AND BACKGROUND INFORMATION

Most of the public service expenditure models under the community policy analysis system (COMPAS) are structured under an equilibrium condition assumption, i.e., supply equals demand (Johnson, Otto, and Deller 2006). Based on Inman (1978), the expenditure equations tend to describe the equilibrium of public expenditure demand and supply. First, we explain the demand side, which determines how revenue is raised to pay for goods and services and/or how the goods and services will be produced. Second, we explain the supply (production) side by the process of transforming inputs to outputs. These models have rarely been tested in an environment where the public sector may be argued to operate in a disequilibrium environment.[10]

The primary objective of this study is to assess whether the forecasting performance of public sector expenditure under a COMPAS fiscal module (an equilibrium model) fits reasonably well under a disequilibrium environment. Conceptually, the fiscal module under a COMPAS framework represents an equilibrium concept and this equilibrium is operationalized by demand shifters modeled empirically. These shifters, however, may not work well in a disequilibrium environment, where exogenous shocks push the public sector into an intermediate period (or long-term period) where local government public sector supply in less sensitive to traditional demand curve shifting conditions. In such cases, one should consider alternative models for forecasting local government revenues and expenditures during the period of supply-demand disequilibrium. This study is focused on evaluating the conceptual framework for modern day local government revenue and expenditure forecasting along with the strengths and weaknesses of such modeling in terms of empirical specification. We compare the traditional COMPAS model with a modified COMPAS model and analyze the forecasting performance of several indicators under disequilibrium conditions. The study evaluates forecasting performance during the time frame of proposed disequilibrium, where the data represents a period of time of major exogenous shocks (hurricanes Katrina, Rita, and Gustav)[11] to local government.

A traditional equilibrium public service model is tested as compared to a naïve model (that incorporates dynamics with inclusion of a lagged dependent variable) where we evaluate public service expenditure forecasting in a disequilibrium environment. The naïve model (lagged dependent variable) then is tested against the naïve plus model (an inclusion of revenue capacity variables in the naïve model) and a modified naïve model (a hybrid model that includes the naïve plus model as well as demand shifter co-variates from the traditional COMPAS empirical

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10 This chapter is a reprint from Adhikari, Arun, and J. Matthew Fannin. (2013). "Modeling the Louisiana Local Government Fiscal Module in a Disequilibrium Environment: A Modified COMPAS Model Approach." *Journal of Regional Analysis and Policy*. 43(2): 138-156. Permission to reprint granted from the editor of the journal.

11 Hurricanes Katrina and Rita made landfall in Louisiana in 2005 and Hurricane Gustav made landfall in Louisiana in 2008.

specification). In addition, a comparatively newer approach (quantile regression) is also introduced to evaluate its performance among existing single year cross-sectional data-based COMPAS estimators.

The remainder of the study begins with a section that presents a historical background of local fiscal modeling. We explain the theoretical and conceptual background of local public service modeling in terms of COMPAS frameworks and alternative frameworks in this section. This will be followed by the empirical specification of the fiscal module, where we set forth the empirical model with revenue capacity and expenditure equations. The succeeding section describes the data and methodology used for the analysis. We will then analyze the data and discuss the results and key findings of the regressions and the performance comparison of different estimators from various underlying models and compare them based on their relative forecasting performance. Finally, we conclude the study by pointing out some limitations of the study and the future opportunities for research.

4.2. LITERATURE ON LOCAL FISCAL MODELING

Several studies have focused on the construction and evaluation of fiscal modules by local governments to determine the level of public services provided to its residents. In the 1960s and 1970s, ad hoc expenditure models dominated the modeling issues of the local public sector. Other models developed during this period incorporated the concept of modeling public services, concentrating on empirical analysis but often lacking a conceptual framework. We present a snapshot of some of these studies built on the empirical frameworks used to model local public service delivery in Table 4.1.

The introduction of IMPLAN (Alward et al. 1989) created a revolution in regional economics for studying impact analysis, starting in the 1980s. IMPLAN was a major modeling accomplishment because of its creation of local input-output models based on secondary data that could be updated annually as compared to other models dependent on primary data for construction that were for typically larger regions and costly to construct and update (Johnson, Otto, and Deller 2006). Unfortunately, despite IMPLAN’s success at generating contribution and impact projections for community-wide current account variables such as output, value-added, labor income, and employment, it was less effective in providing valuable information for a community’s public sector.

Table 4.1. Summary of determinants of local public service expenditures in the 1960s and 1970s.

Author (Year)	Model Used	Objectives of the Study	Dependent Variables	Major Regressors	Major Findings
Fisher (1961)	Simple linear regression	To estimate per capita expenditure of state and local government	Per capita expenditure of state and local government	Population, population density, per capita income	Income positive and significant, population density negative and significant
Sacks and Harris (1964)	Ordinary least squares	To analyze total direct expenditures on several categories of local government	Total direct expenditures, health and hospital, education, and other expenditures	Population, federal and state aids, per capita income, % urban	Income and federal and state aids significantly describe local government expenditures
Barr and Davis (1966)	Simple and multiple regression	To analyze determinants of several expenditure categories of Pennsylvania counties	General government expenditure, highways expenditure, judicial expenditure, and other expenditure	Property holdings, median income, median education, voting preferences	Differences in preferences for expenditures significantly explains several local government expenditure
Bahl and Saunders (1966)	Ordinary least squares, non-linear regression	To analyze the temporal pattern of determinants of state and local government expenditures	State and local government expenditures	Per capita federal grant, per capita income, population, % urban	Per capita federal grant, income, population density and % urban were all positive and significant
MacMohan (1970)	Ordinary least squares	To analyze determinants of public primary and secondary education expenditures by cross-sectional and time series data	Public primary and secondary education expenditures	Pupil per teacher, assessed value, federal and state aids, personal income, population	Federal and state aids, pupil enrollment over time significantly explain growth of public primary and secondary education expenditures
Bergstrom and Goodman (1973)	Ordinary least squares	To estimate demand functions for municipal public services	General expenditures, police expenditures, parks and recreation expenditures	Tax share, population change, crowding parameter, income	Expenditures on different categories depend on locality. Income plays major role in most localities

Consequently, researchers then focused on building models that could cater to the customized needs of communities for public sector impacts and forecasting based on secondary data. In an effort to develop advanced fiscal models for local communities, the regional rural development centers and the Rural Policy Research Institute (RUPRI) supported several rural studies that intended to generate an empirically tractable approach to local public sector modeling (RUPRI 1995). RUPRI then extended its help and support for conducting multistate interdisciplinary research by building an outreach network, known as the community policy analysis network (CPAN) (Scott and Johnson, 1998). The network was made up of a group of social scientists who attend periodic meetings to develop new models and support tools on emerging issues that were important to rural communities. Their efforts began by developing a stylized model that was originally intended as a true general equilibrium-type fiscal model where one could formally model separately local public sector demand and supply. In an effort to explore a model that accounts for both the empirical and the conceptual framework and could be customized based on the needs of local public supply and demand, they developed what is today known as the community policy analysis system (COMPAS) models (Johnson, Otto, and Deller 2006). These models originated from mostly CPAN researchers from Midwestern states developing models for rural counties in their respective states where these regions were quite homogenous and equilibrium assumptions held during the slow steady growth of these rural regions in the 1990s. They were developed, as their name implies, to focus on evaluating local community policies on labor markets and local governments; however, as their development and use evolved, modelers began applying these empirical tools to assist local governments with general forecasting.

4.2.2. COMPAS Modeling Framework

The COMPAS model is an effective tool to estimate the fiscal impacts of different policy/development scenarios on a region (Scott and Johnson 1997). COMPAS models are regional economic models that combine two different approaches (typically input-output and parametric econometric modeling) to build an integrated, or conjoined, model of rural economic structure (Johnson, Otto, and Deller 2006). These models are mostly used to evaluate the impacts within a small city, region or a county. COMPAS models typically treat employment demand as an exogenous driver of changes in the labor market which ultimately impact the fiscal sector. The fiscal module in this research is an extension to the module used by Fannin et al. (2008) and Adhikari and Fannin (2010a).

COMPAS models incorporate statistically estimated relationships to forecast changes in demographic, economic and fiscal conditions under exogenous changes in economic activity. The model includes a system of cross sectional econometrically estimated equations estimated for communities in respective states (Johnson, Otto, and Deller 2006). These estimates, though in some cases statistically significant, might not perform well in terms of forecasting performance. These equilibrium COMPAS estimators could be tested under disequilibrium conditions in order to compare the relative forecasting performance based on multiple quantitative evaluation methods. The block recursive diagram of the COMPAS model is displayed in Figure 4.1.

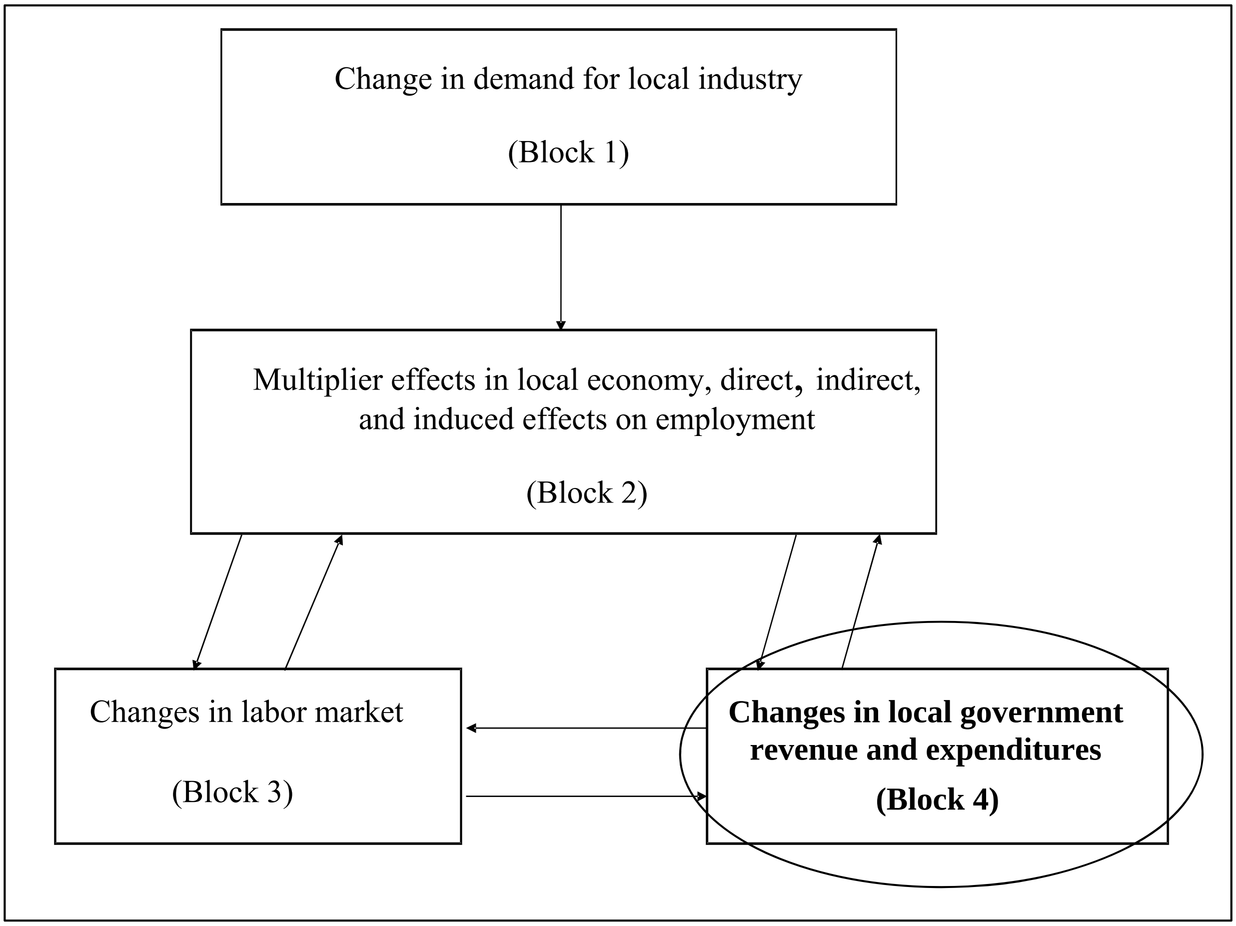

Figure 4.1. Highlighting the fiscal module in the COMPAS modeling framework.

The median voter model was introduced to develop the conceptual framework of public sector demand and supply based on the early voter theory of Black (1958). This median voter theory was used extensively to model the local public sector since the service demands of median voters were addressed by the political parties in order to carry elections. As was stated earlier, the local government's fiscal behavior is demand driven (for public goods and services). In situations of majority rule, a median voter model has been used in many instances to analyze the fiscal behavior of a region. This approach of the median voter[12] was initially developed by Barr and Davis (1966), but was then was applied by several scholars to replace the then popular ad hoc expenditure model. Median income levels, population, tax prices of public goods, and consumer's tastes and preferences at the local level are assumed to determine the level of demand for local public goods and services. Any elected official approving government spending far from the median will be driven out of office by an opposition that proposes an expenditure level closer to the demands of the median voter.

12 See Shaffer et al. (2004) for detailed explanation for median voter model, where the author has compared similarity between median voter model and Hotelling model by using a beach vendor example.

There are a few limitations which could hinder the effectiveness of the model. Some of the factors that limit the supply demand equilibrium in the traditional conceptual framework are, but are not limited to, downward sloping supply curves, the nature of private and public goods, and the non-excludability and non-rivalrous nature of public goods (Buchanan 1965). Hence, applied researchers interested in providing local stakeholders valuable research tools developed an alternative framework that simply attempts to forecast the movement of public expenditure between equilibrium points over time (Johnson, Otto, and Deller 2006).

In particular, they described an equilibrium point where structural demand meets structural supply. We can estimate a set of equations that models this equilibrium point as proposed by Johnson, Otto, and Deller (2006).

$$e = \beta_1 + \beta_2 \varphi + \beta_3 N + \beta_4 I + \sum_{i=5}^{n} \beta_i Z, \quad \text{(E4.1)}$$

where e is the expenditure (spending) of local governments, β are regression coefficients to be estimated, φ is the tax share of median voters, N is the population of local government jurisdictions, I is income and Z are vectors of exogenous variables in the model.

A plethora of studies was then developed based on these empirical applications of modern COMPAS modeling built on the foundation of the conceptual foundations of the median voter model. A comprehensive fiscal impact model for Virginia counties was estimated by Swallow and Johnson (1987) in which they developed a model to forecast the economic, demographic and fiscal impacts of regional economic shocks. The entire analysis was carried out by estimating sets of local government revenue capacity and local government expenditure equations. An extension and a slight modification of this work was presented by Shields (1998) who estimated different sectors of the local economy using two revenue capacity equations, six expenditure equations, and two housing market equations. A seemingly unrelated regression (SUR) model was then used to estimate the local government expenditures on a per capita basis on the health sector, government administration, public safety, public works and other amenities. His findings showed that local government expenditures were significantly impacted by variables such as income, assessed property values, and property taxes.

Johnson and Scott (2006) proposed the Show Me Community Policy Analysis model, in which they collected data from county and city governments of Missouri to estimate the labor market and the fiscal module coefficients. The model was actually a spreadsheet-based model that was used in conjunction with the IMPLAN model. They regressed police expenditure, jail expenditure, court expenditure, road expenditure, administrative expenditure, and other expenditure with several socio-economic variables that served as demand shifters. Major results showed that demands for public services were a function of income, wealth, age, education, and few other factors, such as input and other demand conditions. Based on this conceptualized framework and data for the model, they constructed and estimated a labor force module and fiscal module for all counties of Missouri using three stage least squares. Their fiscal module included two revenue base equations, three revenue equations and six expenditure equations.

Swenson and Otto (2000) provided continuity from earlier research and estimated an economic/fiscal impact modeling system for Iowa counties, in which they introduced the concept of housing market equations. The fiscal module was quite similar to the one used by Swallow and Johnson (1987), which included six revenue capacity equations and various sets of expenditure equations. An extension of earlier studies was proposed by Evans and Stallmann (2006), in which they proposed the Small Area Fiscal Estimation Simulator for Texas counties using a two-stage least squares procedure. A labor force module and fiscal module were estimated using a 14-equation model.

Most of the empirical models rely on the median voter model assumption heavily for their empirical specification. Further, COMPAS modelers assume that local governments consider the demands and provide the desired level of services at the lowest possible cost. When tax bases and demand for expenditures are known, local governments are assumed to adjust tax rate to balance their budget. Public services may be subject to increasing or decreasing (or both) returns to scale. Unit costs of public services could be hypothesized as a function of the level and quality of services, input and output factors, input prices, and the rate of population growth.

4.2.3. Alternative Conceptual Frameworks for Public Service Delivery

The CPAN network acknowledges an alternative conceptual framework for modeling public service delivery (Deller 2006): the bureaucratic approach (Niskansen 1971; Poole and Rosenthal 1996). The bureaucratic approach of the local budget allocation decision was set forth initially by Niskansen (1971) and concentrates more on political practices than economic approaches. Bureaucrats regulate the local level budget request and allocation process and present them to elected officials. It depends on the bureaucrats whether to adjust budget requests taking into account the behavior of elected officials who might cut-off some portions of the proposed request. A regional economic modeler must consider the political attributes in addition to the economic attributes when modeling the local public sector. The supply/demand equilibrium model that we described earlier focuses more on the economic backgrounds and thus the political aspect of decision making is ignored.

In this study, we focused on evaluating a fiscal module that was built in the equilibrium COMPAS modeling tradition. We explored alternative empiricial formulations that are more consistent with a bureaucratic model, focusing on the disquilibrium period immediately before and after the 2005 hurricane season in Louisiana. We estimate traditional OLS regressions with the COMPAS equilibrium model and compare it with panel data and a quantile regression model. Local governments may make decisions about the total expenditures in the fiscal year under a bureaucratic model conceptual framework based on the spending that was made in the previous year plus the total revenues that would be projected available in the current fiscal year. Our contribution would be the addition of dynamics in the model by incorporating the lagged dependent variable for different expenditure categories. We estimate the forecasting performance by several quantitative methods incorporating different indicators such as mean simulation error, mean square simulation error, root mean square simulation error, and Theil's coefficients as a benchmark for comparison.

4.3. EMPIRICAL SPECIFICATION OF FISCAL MODULE

The fiscal module in a COMPAS framework is composed of two components, local government revenue and local government expenditures that use outcomes from the labor force module as exogenous variables. The endogenous variables from the labor force module (in-commuter earnings, out-commuter earnings) serve as exogenous variables in the fiscal module that determine the factors contributing to total revenue. Local government revenue is generated by different forms of tax revenues (typically property taxes and sales taxes which are dependent on assessed property value and retail sales) and self-generated revenue (fees) and intergovernmental transfers (block grants from the federal and state governments, etc). Two equations measure revenue capacity in our fiscal module: assessed property value and retail sales[13].

(E4.2) *ASDVAL = f(LNDNSTY, OUTCERN, RESEMPERN*)
(E4.3) *RETSALE = f(LNDNSTY, INCERN, OUTCERN, RESEMPERN*)

Expenditure equations are explained by factors that measure the quantity of public services, quality of public services, demand conditions related to public services, and input conditions (Johnson 1996). For this study, four expenditure equations are accounted for through regression analysis, where a total of seven explanatory variables are used. The expenditure equations are presented as:

(E4.4) *GG EXP = f(ASDVAL, RETSALE, TOTINC, LNDNSTY, LCLRDMLS, POP*)
(E4.5) *HW EXP = f(ASDVAL, RETSALE, TOTINC, PERAFAM, POPPLUS, LCLRDMLS, POP)*
(E4.6) *PS EXP = f(ASDVAL, RETSALE, TOTINC, PERAFAM, POPPLUS, POP)*
(E4.7) *PW EXP = f(ASDVAL, RETSALE, TOTINC, PERURB, LNDNSTY, LCLRDMLS, POP)*

Variable descriptions are provided in Table 4.3.

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13 Other non-tax revenue, such as intergovernmental transfers, also make up the total public sector revenue available for spending on public services. However, many of these transfers are based on formulas that include the demand shifter co-variates in the public service expenditure equations. As a result, other public revenue sources are not included as covariates in the expenditure variables.

4.4. DATA AND METHODOLOGY

An initial comparison is made by modeling each of the equations using Ordinary Least Squares (OLS) regression, panel regression, and the quantile regression approach. As an alternative approach for the COMPAS models, OLS, panel, and quantile regressions are useful in measuring forecasting performance. OLS (and, to a lesser extent, panel) regression has been historically applied in COMPAS fiscal modeling. The inclusion of quantile regression represents an additional iteration (or sensitivity analysis) in COMPAS regression modeling.

For a distribution function $F_Y(y)$, one can determine the probability φ of occurrence for a given value of the dependent variable y. However, quantiles are meant to do exactly the opposite. That is, one wants to determine for a given probability φ of the sample data set the corresponding value y. In OLS, given some explanatory variable x_i, $E[Y \mid x_i]$, we would determine the conditional mean of the random variable Y. Cross-sectional data are used in the analysis process.

Quantile Regression goes beyond this and enables one to pose such a question at any quantile of the conditional distribution function. Hence, quantile regression overcomes various problems of OLS and panel models because it focuses on the interrelationship between a dependent variable and its explanatory variables for a given quantile. Frequently, error terms are not constant across a distribution, thereby violating the axiom of homoscedasticity. Also, by focusing on the mean as a measure of location, information about the tails of a distribution is lost. Also, OLS and panel regressions are sensitive to extreme outliers, which can distort the results significantly. As has been indicated in the small example of Boston Housing data (Besley, Kuh, and Welsch 1980), sometimes a policy based on OLS might not yield the desired result because a certain subsection of the population does not react as strongly to this policy or, even worse, responds in a negative way, which was not indicated by OLS. Finally, quantile regression addresses a specific issue of public service delivery; that is, it accounts for differences in the quantity and quality of public services based on quantiles being defined on per capita expenditure levels of the dependent variable. Historically, COMPAS models have included quantity and quality demand conditions as exogenous regressors explaining expenditure variation. However, there may be unknown demand conditions explaining public expenditure variation or factors than are not easily measurable. Quantile regression is an alternative in these situations.

This section also develops and demonstrates a model evaluation process for community policy analysis models and highlights a number of key steps in this evaluation process. In particular, the study evaluates, through theoretical discussion and empirical investigation, the quality of forecasts generated by one particular module, the fiscal module of the Louisiana Community Impact Model (LCIM). The base year for estimation is 2007, which is a desired time period because many parishes had measurably recovered from the serious damages caused by hurricanes Katrina and Rita and were not impacted by another sizeable hurricane, Gustav, which made landfall in 2008. Although the base year for estimation of OLS and quantile regression estimators is 2007 data, the study also assesses multi-year data (from 2004 to 2009) for forecasting purposes to compare performance within and outside of the in-sample year (see Figure 4.2. for on- and off-sample year forecasting performance comparison for different sets of models for the general government expenditure category).

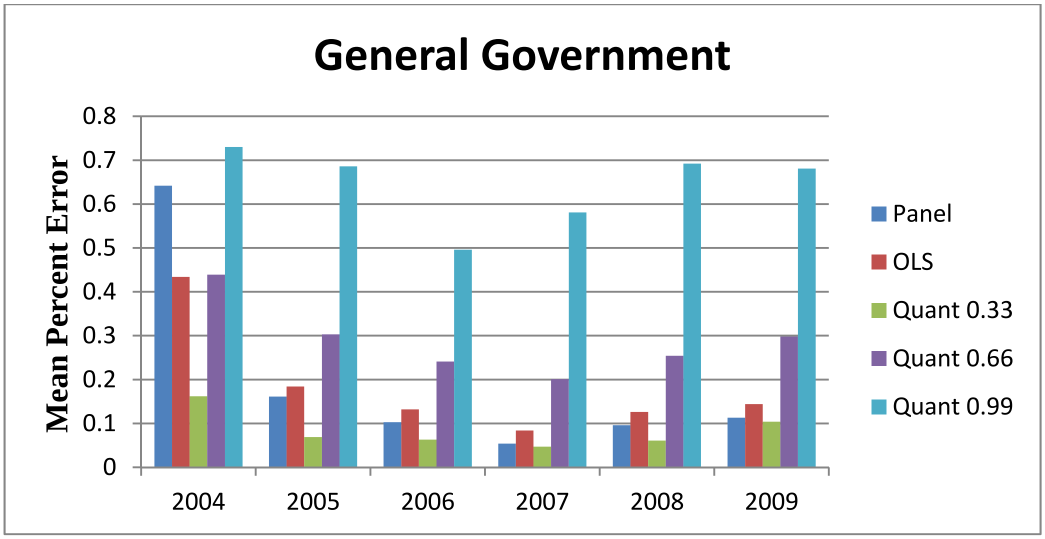

Figure 4.2. Mean percent error of OLS, panel, and quantile estimators of COMPAS model.

The performance of estimators is compared on the basis of quantitative evaluation methods. These methods include analysis of mean simulation error (ME), mean percent simulation error (MPE), mean absolute simulation error (MAE), mean absolute percent simulation error (MAPE), mean square simulation error (MSE), root mean square simulation error (RMSE), root mean square percent simulation error (RMSPE), and Theil's coefficient U1 and U2[14] (Theil 1970, 1975; Pindyck and Rubinfield 1991; Kovalyova and Johnson 2006).

Estimation is based on the COMPAS model for Louisiana that includes all 64 parishes, where the variables for the fiscal module were selected on the basis of Fannin et al. (2008) and were modified depending on the requirements of our model and applied geographically to all

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14 Theil (1958) recommended an accuracy measure in forecasting, widely known as U1. The value of U1 lies between 0 and 1, regardless of how data are defined. Theil's U1 normalizes RMSE with sum of root squares of actual and predicted values. A value of 0 indicates perfect prediction and the value of 1 corresponds to inequality or negative proportionality between actual and predicted values.

$$U1 = \frac{\sqrt{\frac{1}{n}\sum(\hat{Y}_t - Y_t)^2}}{\sqrt{\sum Y_t^2} + \sqrt{\sum \hat{Y}_t^2}}$$

$$\text{or, } U1 = \frac{RMSE}{\sqrt{\sum Y_t^2} + \sqrt{\sum \hat{Y}_t^2}}$$

To address the shortcomings of U1, Theil (1966) proposed another modified error measure (U2) that normalizes RMSE with the root mean square actual values. The statistics U2 is bounded below by 0, same as the case in U1 but the upper bound is lacking in this case and would thus it is constrained to take the values between 0 and $+\infty$. The choice of using U1 or U2 depends on the researcher and the objectives of the study. Again, a value of 0 indicates perfect prediction (smaller the better).

Louisiana parishes. Louisiana parish level fiscal module data are obtained from audited financial statements of parish governments. The data collected uses a common federal accounting standard (Government Accounting Standards Board Standard 34). It has been collected annually by the Louisiana Legislative Auditor since 2004 and allows for the creation of a panel dataset of common local government expenditure categories for modeling purposes. Within the fiscal module, different expenditure equation data on public safety, public works, general government, and health and welfare sectors are estimated by a cross-section Ordinary Least Square (OLS) model as a base control with quantile and panel data regressions also estimated. Other major data sources for the co-variates include the Louisiana Department of Education, U.S. Census Bureau, and Bureau of Economic Analysis. We apply OLS regression and quantile regression using STATA. The forecasting performance is evaluated based on the procedures outlined in Johnson, Otto, and Deller (2006) and Kovalyova and Johnson (2006).

4.5. Results and Discussion

Descriptions of variables used in the study are presented in Table 4.2. The average spending for a Louisiana parish is about $13 million for general government, $3 million for health and welfare, $12.5 million for public safety and $14.5 million for public works categories respectively in 2007. Assessed value and retail sales average $418 million and $901 million respectively. Total income of the 64 Louisiana parishes average $2 billion, with measurable variation, from a low of $163 million (Tensas) to $19 billion (Jefferson). Average parish population totaled just over 68,000.

Table 4.2. Variable description and summary statistics, Louisiana, 2007.

Variables (Units)	Description (Expected Sign)	Mean	Standard Deviation	Min	Max
GEN_GOV (*$*)	General govt. expenditure	12,907,252	37,669,961	593,955	210,722,026
HEL_WEL (*$*)	Health & welfare expenditure	3,357,312	7,399,740	5,664	13,602,439
PUB_SAF (*$*)	Public safety expenditure	12,561,498	40,169,582	232,882	189,130,903
PUB_WRK (*$*)	Public works expenditure	14,526,595	31,200,493	847,070	65,739,927
GG_LAG (*$*)	*GEN_GOV* lag (+)	9,097,823	25,819,736	555,209	191,462,016
HW_LAG (*$*)	*HEL_WEL* lag (+)	2,894,097	5,003,084	5,016	28,751,486
PS_LAG (*$*)	*PUB_SAF* lag (+)	11,361,581	30,625,856	178,617	17,260,2185
PW_LAG (*$*)	*PUB_WRK* lag (+)	12,895,400	29,179,849	685,291	20,744,981
ASDVAL (*$*)	Assessed value (+)	418,151,563	553,860,439	36,056,864	3,466,560,930
RETSALE (*$*)	Retail sales (+)	901,353,145	1,355,501,809	29,883,946	7,612,001,075
LNDNSTY (sq. miles)	Arable land density (+)	770	431	190	2,413
LCLRD (miles)	Local road miles (+)	1,513	717	284	3,635
POP (#)	Population (+)	68,376	90,951	5,788	440,339
TOTINC (thousands $)	Total income (+/-)	2,447,161	3,864,120	163,901	18,996,431
PERAFAM (%)	Percent African American (+)	32	14	3	68
PERURB (%)	Percent urban (+/-)	48	28	0	99
POPPLUS (#)	Population above 65 years old (+/-)	8,290	10,291	660	58,362

Results from Table 4.3 demonstrate parameter estimates of the panel estimator, OLS estimator and quantile estimators, divided in three quantiles (0.33, 0.66, and 0.99) for four different expenditure categories within 64 parishes of Louisiana. Quantiles were divided based on the per capita expenditure levels of each of the dependent variables. Varying per capita expenditures highlight the differences in the quantity or quality (or both) of public services consumed. We might expect to see differing factors drive expenditures based on the quantity or quality of public services consumed per capita. Only three quantiles were chosen so that we could have enough degrees of freedom in each quantile. Most of the signs in the parameter estimates are as expected. If one focuses on the general government category, it is as expected; an increase in assessed value leads to an increase in the expenditure of the general government. That is, general government is a normal good given that incomes and assessed value are positively correlated, consumption of the public service increases as the assessed value increases. We see that public safety is also a normal good.

Results are mixed in identifying a superior model for forecasting when comparing panel, OLS and quantile regression (Table 4.4) in our traditional COMPAS model. In the general government category, the lowest quantile (0.33) on the quantile regression performs better than OLS and panel models in terms of mean percent simulation error, mean absolute percent simulation error, mean square percent simulation error and Theil's coefficient (U1 and U2). Higher quantiles are far higher in terms of error measures (which demonstrate poorer model fit).

Table 4.3. Parameter estimates for panel, OLS, and quantile regressions, Louisiana.

Expenditure Category	Panel		OLS		Quantile Regression					
					0.33		0.66		0.99	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
GEN_GOV										
Constant	0.051	0.96	-2.049	0.28	-2.590	0.46	-2.768	0.29	0.637	0.78
ASDVAL	0.425***	0.001	0.175	0.36	0.067	0.82	0.338	0.28	0.195	0.60
RETSALE	0.252***	0.009	0.415*	0.07	0.584	0.26	0.361	0.43	0.242	0.56
TOTINC	0.213*	0.09	1.988***	0.001	2.025***	0.003	2.049***	0.01	1.239*	0.07
LNDNSTY	0.227**	0.06	0.120	0.28	0.103	0.72	0.061	0.69	0.234	0.30
LCLRD	-0.45***	0.003	-0.309*	0.06	-0.359	0.32	-0.223	0.33	-0.437*	0.09
POP	0.047	0.62	-1.98***	0.001	-0.207**	0.03	-2.201***	0.001	-0.884	0.29
HEL_WEL										
Constant	-0.488	0.84	-8.612**	0.04	-10.244	0.19	-6.966	0.18	-6.243	0.59
ASDVAL	0.494**	0.015	0.617***	0.009	0.520	0.33	0.449	0.40	0.772	0.45
RETSALE	0.410*	0.09	0.085	0.81	0.540	0.34	0.423	0.39	0.066	0.96
LCLRD	-0.580**	0.02	-0.120	0.70	-0.073	0.90	-0.260	0.61	0.209	0.79
PERAFAM	0.0006	0.99	0.279	0.12	0.104	0.63	0.169	0.56	0.059	0.91
POP	0.017	0.96	-1.946*	0.06	-1.776	0.24	-3.817**	0.02	1.230	0.68
TOTINC	-0.385	0.29	1.878**	0.02	1.647	0.26	2.311	0.13	-0.333	0.89
POPPLUS	0.705**	0.02	0.363	0.63	-0.144	0.91	1.572	0.23	-0.583	0.82
PUB_SAF										
Constant	-8.40***	0.001	-15.92***	0.001	-12.62***	0.003	-17.49***	0.001	-17.52***	0.008
ASDVAL	0.633***	0.001	0.528**	0.02	0.765*	0.09	0.454	0.28	0.247	0.31
RETSALE	0.012	0.92	0.316	0.19	-0.198	0.77	0.505	0.24	0.555	0.28
TOTINC	0.791***	0.001	3.795***	0.001	0.018	0.95	0.045	0.77	0.171	0.68
POPPLUS	-0.621*	0.06	-1.018**	0.05	-0.009	0.99	-1.546**	0.04	-2.623**	0.02
PERAFAM	0.126	0.46	0.152	0.23	3.705***	0.001	3.993***	0.001	3.289***	0.001
POP	0.406	0.25	-2.929***	0.003	-3.369**	0.02	-2.782***	0.005	-0.67*	0.09
PUB_WRK										
Constant	-0.373	0.77	-0.219	0.89	0.398	0.92	0.369	0.89	1.912	0.56
ASDVAL	0.459***	0.003	0.304	0.11	0.251	0.54	0.555	0.11	0.113	0.71
RETSALE	0.223*	0.06	0.258	0.25	0.372	0.42	-0.011	0.98	0.182	0.70
PERURB	-0.077*	0.09	-0.020	0.68	-0.014	0.86	-0.027	0.58	0.028	0.88

LCLRD	-0.28***	0.002	-0.064	0.60	-0.175	0.56	-0.226	0.20	0.035	0.90
POP	-0.42**	0.05	-0.759	0.20	-1.143	0.32	0.192	0.86	-1.268	0.29
TOTINC	0.625***	0.009	0.870*	0.09	1.063	0.30	0.180	0.82	1.486	0.19
LNDNSTY	0.110	0.35	0.194*	0.06	0.198	0.59	0.336***	0.01	0.128	0.56

For the health and welfare category, again the mean percent simulation error, mean absolute percent simulation error, mean square percent simulation error, and Theil's coefficient (U1 and U2) are least in the lowest quantile (0.33), as compared to other higher quantiles and OLS and panel models. Public works and public safety categories follow a similar pattern as other categories described earlier. However, OLS has the advantage over panel regression in the cases of both public works and public safety.

Although the lower quantiles displayed superior forecasting performance relative to other quantiles and the other two models in all four categories of expenditure, a more robust model is preferable to estimate and forecast public sector expenditure. As suggested by Johnson, Otto, and Deller (2006), the best way to validate model performance is by comparing the forecasts with those of naïve extrapolation. We applied a naïve model (cross-sectional) where all four categories of expenditures were regressed with its one year lagged value. This approach makes for a reasonable baseline because it suggests that any model estimated should forecast at least as well as simply using the information from last year's expenditure. In addition, this approach forms the basis for a bureaucratic model conceptual framework to public sector expenditure given that local governments often make decisions on their spending for the fiscal year based on the spending that was made last year plus some adjustment for the current year. More specifically, bureaucrats use the previous year's budget as a baseline to inflate budgets constrained by the level of expected growth in revenue collections. We also add revenue capacity variables in the naïve model to develop a new model (Naïve plus) for comparing the forecasting performance that incorporates expected revenues that can be spent in the current year. We further introduce a modified naïve model which includes the original COMPAS covariates to compare with the naïve and naïve plus model. The expenditure equations in the new models are now expressed as:

NAÏVE MODEL

(E4.8) *GEN_GOV=f(GG_LAG)*

(E4.9) *HEL_WEL=f(HW_LAG)*

(E4.10) *PUB_SAF=f(PS_LAG)*

(E4.11) *PUB_WRK=f(PW_LAG)*

NAÏVE PLUS MODEL

(E4.12) *GEN_GOV=f(GG_LAG,ASDVAL,RETSALE)*

(E4.13) *HEL_WEL=f(HW_LAG,ASDVAL,RETSALE)*

(E4.14) *PUB_SAF=f(PS_LAG,ASDVAL,RETSALE)*

(E4.15) *PUB_WRK=f(PW_LAG,ASDVAL,RETSALE)*

MODIFIED NAÏVE MODEL

(E4.16) *GEN_GOV = f(GG_LAG, ASDVAL, RETSALE, TOTINC, LNDNSTY, LCLRD, POP)*

(E4.17) *HEL_WEL = f(HW_LAG, ASDVAL, RETSALE, TOTINC, PERAFAM, POPPLUS, LCLRD, POP)*

(E4.18) *PUB_SAF = f(PS_LAG, ASDVAL, RETSALE, TOTINC, PERAFAM, POPPLUS, POP)*

(E4.19) *PUB_WRK = f(PW_LAG, ASDVAL, RETSALE, TOTINC, PERURB, LNDNSTY, LCLRD, POP)*

Table 4.4. Average performance estimation measures for different categories of expenditure.

Expenditure Category	Panel	OLS	Quantile Regression 0.33	0.66	0.99
GEN_GOV					
Mean Percent Simulation Error	0.054	0.084	0.047	0.201	0.581
Mean Absolute Percent Simulation Error	0.365	0.341	0.323	0.319	0.790
Mean Square Percent Simulation Error	0.211	0.201	0.148	0.211	1.321
Theil's Coeff (U1)	0.285	0.246	0.183	0.206	0.583
Theil's Coeff (U2)	0.322	0.297	0.238	0.255	0.718
HEL_WEL					
Mean Percent Simulation Error	0.443	0.276	0.271	0.524	2.097
Mean Absolute Percent Simulation Error	0.888	0.682	0.562	0.749	2.097
Mean Square Percent Simulation Error	2.354	0.846	0.645	1.305	10.934
Theil's Coeff (U1)	0.278	0.261	0.260	0.401	0.469
Theil's Coeff (U2)	0.337	0.304	0.296	0.514	0.608
PUB_SAF					
Mean Percent Simulation Error	0.281	0.414	0.264	0.387	0.422
Mean Absolute Percent Simulation Error	0.188	0.130	-0.063	0.512	2.254
Mean Square Percent Simulation Error	0.570	0.439	0.306	0.624	2.254
Theil's Coeff (U1)	0.678	0.337	0.176	0.876	12.051
Theil's Coeff (U2)	0.209	0.372	0.200	0.343	0.347
PUB_WRK					
Mean Percent Simulation Error	0.132	0.089	0.077	0.478	0.446
Mean Absolute Percent Simulation Error	0.441	0.365	0.274	0.575	0.547
Mean Square Percent Simulation Error	1.322	0.236	0.135	0.978	0.641
Theil's Coeff (U1)	0.184	0.194	0.174	0.326	0.325
Theil's Coeff (U2)	0.237	0.279	0.196	0.382	0.361

Results from Table 4.5 demonstrate a parameter estimates comparison of the OLS and panel estimators of the naïve, naïve plus, and modified naïve model for four different expenditure categories within the Louisiana parishes. Similarly, results from Table 4.6 display parameter estimates for the naïve model, naïve plus model and modified naïve model based on three quantiles (0.33, 0.66, and 0.99) through quantile regression. The results are quite similar to earlier models. However, results are superior compared to earlier COMPAS equilibrium models because we observe the forecasting performance increases with inclusion of the lagged dependent variable (naïve model) in our earlier model. The lagged variable is highly significant for all models and for all categories of expenditure and suggests that previous year's expenditure plays an important role in determining the future year's expenditure. Except for the public works category, assessed value is positive which indicates an increase in assessed value leads to an increase in the expenditure of general government, public safety and health and welfare.

Table 4.5. Parameter estimates for the naïve model, naïve plus model, and modified naïve model, for both OLS and panel data regressions.

	OLS Naïve	Naïve Plus	Modified Naive	Panel Naïve	Naïve Plus	Modified Naive
GEN_GOV						
Constant	-0.23	-0.45	-0.04	0.15*	-0.54***	-0.49
ASDVAL		0.08	0.11***		0.11**	0.07
RETSALE		-0.03	-0.11**		-0.03	-0.01
TOTINC			0.06			0.29***
LNDNSTY			-0.01			0.04
LCLRD			-0.03			-0.09
GG_LAG	1.02***	0.97***	0.95***	0.99***	0.93***	0.88***
POP			0.04			-0.24**
HEL_WEL						
Constant	0.004	-1.33**	-4.71***	0.40*	-1.32***	-1.06
ASDVAL		0.25***	0.22***		0.12**	0.12**
RETSALE		-0.14***	-0.16		0.03	0.06
TOTINC			0.78**			-0.007
LCLRD			-0.16**			-0.05
POPPLUS			-0.16			0.09
PERAFAM			0.19**			-0.002
HW_LAG	0.99***	0.94***	0.91***	0.97***	0.87***	0.86***
POP			-0.64			-0.10
PUB_SAF						
Constant	0.23	-1.10**	-2.84***	0.70***	-1.58***	-1.89***
ASDVAL		0.13*	0.08		0.22***	0.20**
RETSALE		-0.05	-0.01		-0.004	-0.07
TOTINC			0.64**			0.19
POPPLUS			-0.16			-0.28*
PERAFAM			0.12***			0.02
PS_LAG	0.98***	0.97***	0.90***	0.95***	0.82***	0.79***
POP			-0.46			0.20
PUB_WRK						
Constant	0.47	0.05	-1.63**	1.06**	-0.49	-0.61
ASDVAL		0.01	-0.003		-0.23***	-0.16***
RETSALE		0.05	0.15**		0.06	0.004
TOTINC			0.27*			0.35*
PERURB			0.01			-0.006
LNDNSTY			0.07*			0.07*
LCLRD			0.13**			-0.03
PW_LAG	0.98***	0.92***	0.89***	0.93***	0.66***	0.66***
POP			-0.46***			-0.24

Table 4.6. Parameter estimates for the naïve model, naïve plus model, and modified naïve model, for quantile regressions.

	Naïve			**Naïve Plus**			**Modified Naive**		
	0.33	**0.66**	**0.99**	**0.33**	**0.66**	**0.99**	**0.33**	**0.66**	**0.99**
GEN_GOV									
Constant	-0.52**	-0.19	-4.77*	-0.87***	-0.54	2.04	-0.69	-0.36	-0.94
ASDVAL				0.11***	0.14	0.22	0.10	0.12	0.17
RETSALE				0.16	-0.09	0.03	-0.05	-0.16**	-0.19
TOTINC							0.05	0.29	0.14
LNDNSTY							-0.002	-0.01	-0.10
LCLRD							-0.01	-0.02	0.14
GG_LAG	1.03***	1.02***	1.38***	0.96***	0.99***	1.13***	0.95***	0.95***	0.99***
POP							-0.01	-0.17	-0.04
HEL_WEL									
Constant	0.02	-0.11	-1.01	-1.22	-1.12	-1.52	-4.08**	-5.66***	-2.04
ASDVAL				0.25***	0.19	0.09	0.20*	0.15	0.33
RETSALE				-0.14*	-0.11	0.06	-0.09	-0.07	-0.18
TOTINC							0.26	0.94***	-0.29
LCLRD							0.25*	0.20	0.07
POPPLUS							-0.71	-0.42	0.24
PERAFAM							0.19	0.17*	0.04
HW_LAG	0.99***	1.01***	1.12***	0.95***	0.97***	0.92***	0.94***	0.92***	0.89***
POP							0.24	-0.59	0.23
PUB_SAF									
Constant	-0.01	-0.11	1.86***	-1.78	-0.31	-1.34	-1.32	-3.01**	-2.12
ASDVAL				0.20	0.02	0.24	0.004	0.04	-0.01
RETSALE				-0.09	-0.005	-0.09	0.04	0.01	0.06
TOTINC							0.31	0.79*	0.78*
POPPLUS							0.14	-0.19	-0.42
PERAFAM							0.11	0.10	0.11
PS_LAG	1.00***	1.01***	0.92***	0.96***	1.00***	0.93***	0.97***	0.93***	0.85***
POP							-0.48	-0.64	-0.14
PUB_WRK									
Constant	0.47	0.41	1.17***	0.03	-0.08	1.27	-1.13	-2.33**	0.123
ASDVAL				0.05	-0.06	-0.03	0.01	-0.06	-0.04
RETSALE				-0.0006	0.08	0.02	0.07	0.22**	0.08
TOTINC							0.53	0.29	0.02
PERURB							0.02	0.002	0.07*
LNDNSTY							0.04	0.066	0.08
LCLRD							0.03	0.16*	0.19
PW_LAG	0.97***	0.98***	0.95***	0.93***	0.99***	0.96***	0.86***	0.95***	0.89***
POP							-0.60	-0.54**	-0.12

There is again a mixed result in performance between OLS and quantile regression models (Table 4.7). All models including the lagged dependent variable outperform the baseline COMPAS models; however, performance varies in the quantile regression with lagged dependent variables. In most of the models, lower quantiles (0.33) perform better as compared to the middle (0.66) and higher quantiles (0.99). The OLS model outperforms the panel model (except in case of public works category) in most of the expenditure categories for naïve, naïve plus, and modified naïve, as measured in terms of the aforementioned error measures. Although the naïve model is superior when compared to our earlier model, the naïve plus model displays better forecasting performance than the naïve model measured in terms of mean percent simulation error, absolute mean percent simulation error, mean square percent simulation error and Theil's coefficient.

To get a better understanding of the relative performance of these estimators, we performed a mean absolute percent simulation error comparison test in STATA, where we compared the base OLS cross-section model with the cross-section models of each of the equations that incorporated the lagged dependent variable (naïve, naïve plus, and modified naïve). These results are presented in Tables 4.8–4.11.

In considering only the lowest magnitudes (highest forecasting performance), we found the modified naïve model displayed superior results as compared to the naïve and naïve plus model, if measured in terms of absolute mean percent error. Overall, results from Tables 4.8–4.11 suggested that lagged models are significantly lower in terms of error measures as compared to the base OLS model in all four categories of expenditure. However, the modified naïve model is not always significantly lower (in terms of absolute mean percent error) than the naïve and naïve plus model and thus one should not infer that modified naïve model outperforms the other lagged dependent variable models. In Table 4.8, one can observe that the modified naïve model displays better forecasting performance as compared to the base OLS model and naïve model, but there is no significant difference between the naïve plus and the modified naïve model. Also, the naïve plus model displays significantly better performance compared to the base OLS and naïve model. For public safety and health and welfare category of expenditure, test results show a similar pattern (Table 4.9 and 4.10). In the case of public works (Table 4.11), the modified naïve model performs significantly better than the base OLS and naïve models but not the naïve plus model. These results suggest that during this period, Louisiana parish governments were driven more by bureaucratic forces than equilibrium based supply and demand factors.

Table 4.7. Average performance estimation measures for different categories of expenditure.

Error Measures	**Panel**			**OLS**			**Quantile Regression**								
	Naive	**Naïve Plus**	**Mod. Naive**	**Naive**	**Naïve Plus**	**Mod. Naive**	**Naive**			**Naïve Plus**			**Mod. Naive**		
							0.33	**0.66**	**0.99**	**0.33**	**0.66**	**0.99**	**0.33**	**0.66**	**0.99**
GEN_GOV															
Mean Percent Simulation Error	0.17	0.13	0.11	0.12	0.11	0.05	-0.09	0.08	0.41	-0.06	0.06	0.32	-0.05	0.05	0.25
Mean Absolute Percent Simulation Error	0.16	0.12	0.12	0.10	0.10	0.08	0.10	0.16	0.43	0.08	0.13	0.32	0.08	0.11	0.25
Mean Square Percent Simulation Error	0.14	0.10	0.09	0.13	0.09	0.06	0.03	0.09	0.19	0.02	0.03	0.16	0.01	0.02	0.09
Theil's Coeff (U1)	0.11	0.09	0.07	0.06	0.04	0.04	0.05	0.08	0.31	0.03	0.07	0.21	0.03	0.07	0.20
Theil's Coeff (U2)	0.16	0.12	0.09	0.09	0.07	0.07	0.08	0.10	0.42	0.06	0.11	0.29	0.06	0.09	0.24
HEL_WEL															
Mean Percent Simulation Error	0.13	0.13	0.09	0.10	0.05	0.03	0.07	0.17	0.61	0.02	0.10	0.66	0.01	0.09	0.54
Mean Absolute Percent Simulation Error	0.37	0.26	0.17	0.33	0.20	0.18	0.25	0.29	0.58	0.12	0.27	0.66	0.14	0.22	0.54
Mean Square Percent Simulation Error	0.83	0.14	0.14	0.91	0.10	0.07	0.23	0.24	0.77	0.04	0.20	0.72	0.06	0.11	0.58
Theil's Coeff (U1)	0.26	0.19	0.16	0.23	0.17	0.12	0.18	0.29	0.23	0.06	0.18	0.18	0.08	0.16	0.17
Theil's Coeff (U2)	0.33	0.24	0.21	0.27	0.19	0.16	0.22	0.35	0.30	0.10	0.22	0.20	0.10	0.19	0.20
Mean Percent Simulation Error															
Mean Absolute Percent Simulation Error	0.12	0.14	0.11	0.08	0.08	0.06	-0.07	0.14	0.36	-0.05	0.13	0.34	0.03	0.11	0.23
Mean Square Percent Simulation Error	0.33	0.19	0.15	0.25	0.15	0.14	0.25	0.15	0.31	0.24	0.16	0.34	0.11	0.14	0.23
Theil's Coeff (U1)	0.39	0.09	0.06	0.32	0.09	0.08	0.12	0.09	0.21	0.07	0.05	0.16	0.05	0.04	0.09
Theil's Coeff (U2)	0.28	0.16	0.11	0.21	0.11	0.08	0.14	0.15	0.17	0.11	0.07	0.07	0.06	0.06	0.03
Mean Percent Simulation Error	0.37	0.23	0.19	0.29	0.19	0.13	0.17	0.20	0.24	0.16	0.10	0.09	0.09	0.08	0.07
PUB_WRK															

Mean Percent Simulation Error	0.08	0.03	0.03	0.05	0.04	0.04	-0.05	0.13	0.33	-0.03	0.10	0.27	-0.03	0.09	0.21
Mean Absolute Percent Simulation Error	0.21	0.11	0.09	0.16	0.14	0.12	0.12	0.17	0.31	0.10	0.18	0.27	0.08	0.13	0.21
Mean Square Percent Simulation Error	0.09	0.03	0.02	0.04	0.03	0.02	0.04	0.07	0.17	0.02	0.04	0.13	0.01	0.03	0.10
Theil's Coeff (U1)	0.16	0.05	0.04	0.10	0.07	0.06	0.08	0.14	0.18	0.07	0.10	0.14	0.04	0.07	0.09
Theil's Coeff (U2)	0.22	0.12	0.10	0.15	0.11	0.09	0.10	0.18	0.27	0.10	0.16	0.20	0.07	0.10	0.11

Table 4.8. Mean absolute percent simulation error comparison test for general government expenditure, based on OLS model.

	Base	Naïve		Naïve Plus		Modified Naive	
		Magnitude	t-stat	Magnitude	t-stat	Magnitude	t-stat
Base		0.209	6.01***	0.223	6.55***	0.261	6.92***
Naive				0.014	1.38*	0.052	1.75**
Naïve Plus						0.038	0.69
Modified Naive							

*, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 4.9. Mean absolute percent simulation error comparison test for public safety expenditure, based on OLS model.

	Base	Naïve		Naïve Plus		Modified Naive	
		Magnitude	t-stat	Magnitude	t-stat	Magnitude	t-stat
Base		0.189	2.32**	0.289	5.50***	0.299	6.19***
Naive				0.102	1.54*	0.112	1.79**
Naïve Plus						0.010	1.04
Modified Naive							

*, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 4.10. Mean absolute percent simulation error comparison test for health and welfare expenditure, based on OLS model.

	Base	Naïve		Naïve Plus		Modified Naive	
		Magnitude	t-stat	Magnitude	t-stat	Magnitude	t-stat
Base		0.352	1.38*	0.482	5.54***	0.502	5.84***
Naive				0.130	1.53*	0.150	1.68**
Naïve Plus						0.021	1.17
Modified Naive							

*, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 4.11. Mean absolute percent simulation error comparison test for public works expenditure, based on OLS model.

	Base	Naïve		Naïve Plus		Modified Naive	
		Magnitude	t-stat	Magnitude	t-stat	Magnitude	t-stat
Base		0.205	4.81***	0.225	5.12***	0.245	5.38***
Naive				0.023	1.21	0.041	1.57*
Naïve Plus						0.020	0.90
Modified Naive							

*, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

4.6. CONCLUSION

In this study, we evaluated whether the forecasting performance of public sector expenditure models under traditional COMPAS supply/demand equilibrium assumptions fit reasonably well in a disequilibrium environment. This study focused on evaluating the conceptual framework for modern day local government revenue and expenditure forecasting and the strengths and weaknesses of such modeling in terms of empirical specification. We compared the traditional COMPAS model with a modified COMPAS model and analyzed the forecasting performance of several indicators under disequilibrium conditions. The study evaluated forecasting performance during a time frame of supply demand disequilibrium, during a period of major exogenous shocks (Hurricanes Katrina, Rita and Gustav) to local government operations. Different models were compared parametrically using the cross-sectional OLS, panel data, and quantile regression.

Most of the original COMPAS models were developed in Midwestern states where there was measurable homogeneity in economic and fiscal structure of rural regions (the focus of many of these models) during the period of their original creation. Our results showed that newer alternative methods, such as Quantile regression, have potential statistical advantages over traditional COMPAS model OLS and panel regression in improving model performance (as evidenced by our original model particularly in the lowest quantile). Consequently, Quantile regressions are proposed as another COMPAS estimator alternative because they apply varying parameter estimates in forecasting, depending on a county's relative position within the distribution of a given public expenditure category among all counties in a state. Though early COMPAS models may have segmented based on rural or urban regions, these results suggest that segmentation may also occur on spending levels; such spending levels may or may not be related to population size.

Further, results indicated that a bureaucratic model may have been a more appropriate conceptual framework during this public service delivery period of Louisiana local government history. However, these results are limited in that one cannot infer the bureaucratic model superior in all disequilibrium environments. In particular, due to data limitations, one cannot evaluate the pre-Katrina and Rita forecasting performance between traditional COMPAS models and the bureaucratic model. The panel dataset starts from the year 2004, the first year in which there were quality comparable public sector data across all parish jurisdictions. That is, Louisiana parish public sector spending may have followed a more bureaucratic model prior to the disequilibrium period brought about by the storms.

There are some additional limitations. The greatest is the tradeoff of forecasting performance for potential reduced policy analysis. From a modeling perspective, the magnitude of the parameters that serve as demand shifters in the public service equation are measurably reduced in the modified naïve model (with lagged dependent variable) in Table 6 as compared to the base models in Table 3. Because the demand shift variables are typically the variables through which proposed policies are incorporated into COMPAS, reducing their influence on expenditure projections through the addition of a lagged dependent variable may be problematic for those interested in using COMPAS models for policy analysis. Because most COMPAS policy analysis includes evaluating the policy effect through the difference between baseline expenditure and policy enacted expenditure projections, much of the forecasting error is likely to drop out in the difference between the two. The second limitation is that states with small numbers of counties will be limited in using the quantile regression approach because an insufficient number of counties would exist for generating statistically reliable results for each quantile subset.

An evaluation of the alternative methods performed in this study are expected to give regional economic modelers better information from which to construct models projecting local public sector expenditures. Using data from different sources, this study developed a model to forecast different categories of expenditure in the fiscal module using OLS, panel, and quantile regression. Future research should focus on a further narrowing of the confidence interval around these forecasts. As increased quantity and quality of public sector data become available due to compulsory reporting requirements, researchers should be able to construct models with increasing forecast reliability that can be used by analyst-deficient local governments for more informed public sector decision making.

CHAPTER 5. MEASURING THE FISCAL EFFECTS BASED ON CHANGES IN DEEPWATER OFFSHORE DRILLING ACTIVITIES

5.1. Introduction

The *Deepwater Horizon* oil spill has brought to the forefront negative physical externalities related to offshore drilling. These costs have included damages to marine habitat, the oiling of beaches and wetlands, and the direct and indirect negative economic impacts these physical changes have had on service based sectors, such as tourism.

However, the deepwater offshore oil industry has brought positive economic benefits to areas that have supplied its labor and served its onshore infrastructure (Fannin et al. 2008). Benefits in terms of jobs, income and value-added are created in many coastal communities around ports and fabrication facilities that supply the inputs for this industry. At the same time this industry provides these benefits, there are both benefits and costs to local governments from their operations. They receive sales taxes and property taxes from the deepwater support businesses and also income taxes and sales taxes from employees who earn and spend their wages and salaries. Conversely, the industry puts pressures on critical local infrastructure (e.g., roads, schools, water, sewer, and communications). Understanding the net fiscal effects in both local fiscal revenue received and incurred expenditures is important in evaluating how much better or worse off local governments are due to the existence and expansion or contraction of this industry.

In terms of the policy perspective, regional economists and policy makers are interested in forecasting economic changes that are likely to take place at local and state levels after exogenous shocks to an economy. If changes in deepwater offshore drilling activities are termed as an example of an exogenous shock, then the impacts of such shocks could be observed at the level of employment, unemployment, commuting patterns, revenue streams like property and sales taxes, and local-level government expenditures. This paper focuses on determining fiscal impacts that would be created by an alteration of drilling activities in deepwater offshore areas of the Gulf of Mexico on an individual community, Lafayette Parish, Louisiana. This paper's objective is accomplished by applying a Community Policy Analysis System (COMPAS) model for Louisiana based on Adhikari and Fannin (2009). In that model, wells drilled are treated as final demand in an input-output model framework to estimate exogenous changes in employment demand. This demand is then applied to a block recursive labor force module that measures changes in key labor market variables. These variables then serve as exogenous variables in revenue capacity equations. These revenue capacity variables are finally applied to local government expenditure demand equations. Per capita demand changes for key local government variables are then estimated. The results from this paper are intended to inform local and national policymakers of the strengths and weaknesses that COMPAS type models have in identifying policy impacts on a historically cyclical industry such as oil and gas extraction.

5.2. Literature Review

5.2.1. Fiscal Impact Modeling

The Community Policy Analysis System (COMPAS) modeling framework has become a very efficient tool applied across the country to address labor market and fiscal impacts from initial changes in economic activity (Johnson, Otto, and Deller 2006). At its foundation, COMPAS is an employment driven model. Employment demand is generated by changes in local product demand. The definition of employment demand may vary but the exogenous shock that appears from the changes in employment demand is the basis of the modeling system in COMPAS based models (Adhikari and Fannin 2010b). In many cases, this product is converted to employment demand through the use of input-output models. The input-output (I/O) model is a case where the final demand is exogenous and the labor market supply is perfectly elastic to meet the labor demands generated by the product demands (Beaumont 1990). In this I/O framework, an exogenous change in demand for the product and services interacts with the rest of the economy through linkages of industrial material goods and services in an economy, its local labor market, and ultimately, its fiscal sector.

There have been several studies regarding the construction of the fiscal module in COMPAS models and the use of spatial and non-spatial estimators for different purposes. These estimators are used in different fields of study, in which the heterogeneity issue needs to be accounted in a more sophisticated manner. A comprehensive fiscal impact model for Virginia counties was estimated by Swallow and Johnson (1987), in which they explained the model to forecast the economic, demographic and fiscal impacts of regional economic shocks. The entire analysis was carried out by estimating sets of local government revenue capacity and local government expenditure equations. An extension and a slight modification of this work was presented by Shields (1998), who estimated different sectors of local economy using two revenue capacity equations, six expenditure equations and two housing market equations.

Using a three stage least squares approach, Johnson and Scott (2006) constructed and estimated a labor force module and fiscal module for all counties of Missouri. Their fiscal module included two revenue base equations, three revenue equations and six expenditure equations. Swenson and Otto (1999) provided continuity from earlier research and estimated an economic/fiscal impact modeling system for Iowa counties, where they introduced the concept of housing market equations. The fiscal module was quite similar to the one used by Swallow and Johnson (1987), which included six revenue capacity equations and various sets of expenditure equations. An extension of earlier studies was proposed by Evans and Stallmann (2006), which proposed the Small Area Fiscal Estimation Simulator for Texas counties using a two-stage least squares procedure. A labor force module and fiscal module were estimated using a 14-equation model.

5.2.2. Lafayette Parish, Louisiana

Lafeyette Parish is located in South Central Louisiana and is the center of the Acadiana cultural region. It is the central parish of the Lafayette Metropolitan Statistical Area (MSA). The parish population, as of the 2010 census, totaled 221,578. Population grew by 31,075, or 16.31% from the 2000 census estimate of 190,503. Lafayette Parish has been a hub for employment growth with the larger Lafayette Parish, Louisiana, MSA, having the largest percentage growth rate in non-farm payrolls of any MSA in the United States growing at a rate of 10.1% between November 2011 and November 2012 (BLS 2013)[15].

At the same time, the parish has faced challenges with public service delivery. The rapid employment growth has not resulted in similar population growth for the Lafayette Parish. The growth in population over approximately the same one-year period for the parish was only 0.7%. Though some of the employment growth might have been met by an increased number of unemployed moving to employed status, a greater number is likely to have been driven by non-residents commuting into the parish. This is supported by recent U.S. Census Bureau data showing that the Lafayette MSA had the 10th highest percentage of mega-commuters–hose commuters who travel more than 90 minutes and 50 miles to work (Rapino and Fields 2013).

Such non-resident demand can have increased impacts on public services, such as road infrastructure. Further, increases in business establishments have other demands on public services, such as further increased demand on roads, water, sewer, and public safety, among others. Also, Lafayette Parish is one of the few public sector entities to own and operate its own fiber optic system providing extremely fast broadband Internet speed through fiber to the home and fiber to business services. The consequence of such an investment and keeping up demand for public services has resulted in measurable investments in public assets.

5.3. Objective and Method

The objective of this study is to examine the potential fiscal impacts from a loss of oil and gas activities of the Gulf of Mexico region using a revised version of the Louisiana Community Impact Model (LCIM). An early iteration of similar study was carried out by Fannin et al. (2008), using the original LCIM model. They applied the model to address fiscal impacts of the newly developing the deepwater energy industry (DEI) on the local economy of Lafourche parish, the parish from which Port Fourchon, the major service port for a majority of the deepwater oil and gas industry, was located. Their results showed that the expansion of DEI led to the growth in both local government revenues and expenditures.

In applying this revised version of LCIM, following the block recursive nature of the COMPAS model, demand for the final product, oil and gas, generates an employment demand. In this case, final demand is the number of wells to be drilled. Given that employment drives the COMPAS model, employment generated to drill the provided number of wells was derived by

15 The Lafayette MSA consists of Lafayette Parish and St. Martin Parish. According to the 2010 census, Lafayette Parish represents approximately 81% of the MSA’s population.

the MAGPLAN model (Saha and Phillips 2005) that offers direct, indirect, and induced employment impacts. (MAGPLAN is an IMPLAN-based input output model with algorithms that convert various Gulf of Mexico oil and gas operations, such as wells drilled, into employment final demand by major IMPLAN sector before applying to a standard multiplier matrix from IMPLAN). This total employment impact number is then inserted into the labor force module (Adhikari 2012) which ultimately feeds into the fiscal module of the revised LCIM (Adhikari and Fannin, forthcoming) for measuring local government revenue and expenditure impacts.

The estimation method used to determine the number of wells drilled is presented in the Appendix. Results indicate that the total number of wells (119) to be drilled in 2011 would generate around 3,643 jobs from MAGPLAN in the LA-2 region as defined by the Bureau of Ocean Energy Management (BOEM, formerly MMS).[16] Lafayette Parish makes up more than half of the total Mining jobs in the LA-2 region. We assumed the job losses for Lafayette Parish were equivalent to their proportion of total LA-2 region mining jobs. The fiscal impacts were generated based on two revenue capacity equations and four expenditure equations (Adhikari and Fannin, forthcoming). Estimates of assessed value and retail sales make up the revenue capacity equations. Local government revenue is commonly generated by different tax revenues and transfer revenues and these tax revenues are based upon assessed value and retail sales respectively. On the other hand, expenditure equations are built up in such a way that the expenditures are explained by factors that measure the quantity of public services, quality of public services, demand conditions related to the public services, and input conditions related to public services (Johnson 1996).

5.4. Estimation Results

What would be the impact in terms of expenditure if those 119 wells were not drilled? This would be a fundamental question that needs to be addressed in order to evaluate the marginal effects of losing the jobs in that region. In the immediate short run, the demand for these public expenditure categories would not change significantly; however, as time passes, the demand for these categories might increase or decrease, depending on the preference and necessities of the people in the region. People who are no longer employed after losing their jobs may be interested in maintaining these public services. On the other hand, because of the loss of their jobs, people might not be able to afford these public services and the expenditure in any of these categories might decrease.

As can be seen from Table 5.1, there is about 11% percent change in the health and welfare expenditure when moving from 2009 to 2010 and around 15% change when moving from 2010 to 2011. Thus, there is a difference of about 4%, which accounts for the spending effects as evaluated by the difference in the growth rates between years. For other categories of expenditure, these effects are 1%, 2%, and 5% for general government, public safety and public works respectively. If we think of the wells drilled as wells that will not be drilled because of the

16 LA-2 region is described by MMS as few southern parishes of Louisiana that includes seven parishes, namely, Acadia, Evangeline, Iberia, Lafayette, St. Landry, St. Martin, and Vermillion.

Deepwater Horizon spill, then the additional Health and Welfare spending effects above baseline growth would reduce Health and Welfare spending per capita back about halfway to 2009 levels. Similar effects occur in the other expenditure categories. It should also be noted that the per capita expenditure change is three to six times inflation.

Table 5.1. Per capita fiscal expenditure effects on Lafayette Parish from oil and gas wells drilled in the Gulf of Mexico.

Year	General Government	% Change	Health and Welfare	% Change	Public Safety	% Change	Public Works	% Change
2009	$149		$76		$90		$483	
2010	$175	17%	$85	11%	$107	19%	$561	16%
2011	$206	18%	$98	15%	$130	21%	$680	21%

5.5. THE POLICY MODELING CHALLENGE

The COMPAS model built for Louisiana and applied to Lafayette, Louisiana, seems to have performed rather poorly. Though the model predicts a loss of 3,643 direct jobs, there was an actual increase in jobs according to the County Business Patterns of 6,275 jobs between 2010 and 2011 (County Business Patterns). Further, local government expenditure actually increased by $27 million rather than declining $41 million. Is this a function of a poor model, a poor scenario, or both?

The answer to the first question is partially addressed by the source data for developing the COMPAS model (Adhikari and Fannin, forthcoming). A panel regression model was applied to each of the public service expenditure between 2004 and 2009. There was measurable volatility in both revenue and expenditure estimates during this period. Some of this volatility was driven by large amounts federal reimbursement dollars to cover emergency operations, debris removal, and re-construction expenses for those parishes closest to the coast. For those parishes further inland, there were less direct federal transfer payments, but for a larger parish like Lafayette, it became the temporary (and later permanent) home for some of the thousands of evacuees. While Lafayette witnessed a population increase of over 7,000 between 2005 and 2006, its per capita expenditure actually declined 3.64%. They declined then again another 2.68% between 2006 and 2007 and then increased 17.86% from 2007 to 2008. Some of the parishes along the coast saw the opposite–larger increases immediately after the storms and reductions in the growth of spending as time further passed. In each of these cases, the increased volatility in such a disequilibrium environment makes it difficult for even panel data models to identify meaningful statistical relationships that improve local government revenue and expenditure forecasting.

The second issue, and one that is more difficult to model, is the pattern of behavior of the oil and gas industry after the moratorium. The assumption incorporated here would have been that it would have followed other recent historical downturns in economic activity of the sector. The most recent glaring example of the downturn in this region was in the middle 1980s when a crash in oil prices occurred. At that time, there was a massive de-investment in both onshore and offshore drilling. The great number of layoffs resulted in a massive out-migration of residents from the state. The model predicting the number of jobs losses (the MAGPLAN model) is a linear model and assumes that impacts on jobs are the same in both directions; that is, the increase in jobs created from new wells drilled would be similar to the number of jobs losses had the wells not been drilled.

This assumption of the model and its application to this moratorium policy is one of the problem dimensions in the lack of performance of the COMPAS modeling system. In fact, though there were some reductions in workforce due to the moratorium, much of the larger oil and gas companies used the time to invest in repair and maintenance of rigs and performed other down-time procedures that are typically more difficult to accomplish at full drilling capacity. As a result, there was not a great number of job losses. Further, the oil spill itself created short-term employment opportunities for individuals to obtain jobs.

The second assumption that is made is that expenditures on public services will be reduced as revenue availability declines. In our COMPAS model, revenue capacity (as measured by assessed valuation and retail sales) typically has a positive and significant effect on public sector expenditure. As a result, in the Louisiana COMPAS model, we might expect that as revenue capacity of the region increases or decreases, the expenditures would also increase or decrease, respectively.

However, given that public expenditures actually increased, what might explain this? First, given that employment actually increased, we saw revenue capacity increases that resulted in increased public service expenditures. Second, even if we had seen declining revenue capacity, we may not have seen the symmetric reduction in public service expenditures. Deller and Maher (2007) showed that for Wisconsin municipalities, reductions in intergovernmental aid did not result in similar reductions in public service expenditures. This held especially for wealthier Wisconsin municipalities. Local governments were more likely to substitute other local revenue for lost intergovernmental aid. As a result, a larger parish government, such as Lafayette's, may be more likely to tap savings from their balance sheets to mitigate the reduction in public services and soften the blow rather than proportionately reduce their expenditures by the reduction in revenues that are generated to cover expenditure demands.

5.6. CONCLUSION

This paper attempts to estimate how the oil and gas industry activities impact a region's onshore economies that service offshore drilling. In particular, an econometric model was developed to forecast the number of wells that would not be drilled in 2011 as a result of the U.S. Deepwater Drilling Moratorium, following the *Deepwater Horizon* oil spill. The reduced number of wells drilled was applied to an input-output model developed by a federal agency and applied by the researchers to evaluate total projected employment losses on Lafayette Parish, Louisiana. Further, these results were applied to a community policy analysis modeling framework which projected changes in local government expenditure demands on the parish.

Impacts from the model showed that, though revenues would decline, expenditure demands would see greater declines. However, local government revenues and expenditures both increased in the parish between 2010 and 2011. It was hypothesized that many of the declines did not materialize because the offshore oil and gas industry used the period to focus on maintenance and repair and expected the moratorium to be lifted at some point in the future.

A few limitations should be noted. The COMPAS modeling framework, in many cases, has been used to look at policy impacts that have added employment to a locality. Results by Deller and Maher (2007) suggest that the COMPAS model may have challenges in forecasting expenditure declines when there are corresponding reductions in local revenue capacity. Local government officials are likely to try to find other methods, such as raising new revenue or tapping reserves, to maintain expenditure levels.

Second, one might expect that COMPAS-type models are limited to how representative the data used to construct them can project about the future. Historical single-year cross-section COMPAS fiscal modules were vulnerable to the base year of data chosen not being a representative of a normal year of a local government's activities. Though this study used a panel model containing six years of data, the panel covered a very disruptive period of time in local government financing and public service demands through both the 2005 and 2008 hurricane seasons in the state of Louisiana. Future research should consider how to properly incorporate major economic shocks, such as natural disasters or economic recessions, into their choice of data or economic model construction.

This research took a commonly used policy projection tool and applied it to a policy shock that resulted from a technological disaster in a region with an economy in transition between recovering from multiple natural disasters and entering a period of national economic downturn. The lessons learned from the application of this tool suggest that policy modelers should be very cautious in using source data during periods of major economic upheaval to project policy impacts during less stressful economic periods. Further, counter-factual scenarios in policy analysis should be closely scrutinized to address unintended consequences. Adopting these best practices should help community policy modelers avoid these pitfalls and provide higher quality decision support information to local stakeholders.

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APPENDIX A. DETAILED TABLES OF FUZZY SET MEMBERSHIP

This appendix contains quantitative source data and the membership set of each parish or school district in each of the Fuzzy Sets presented in Figures 1.1–1.38. For example, source data for Figure 1.1 is located in Table A1.1, Figure 1.2 data is located in Table A1.2, etc.

Table A1.1. Large Population fuzzy set scores for Louisiana parishes.

Louisiana Parish	**Resident population estimate (July, 2009)**	**Large Population Set Score**
Jefferson	443,342	1
East Baton Rouge	434,633	1
Orleans	354,850	1
Caddo	253,623	1
St. Tammany	231,495	1
Lafayette	210,954	1
Calcasieu	187,554	1
Ouachita	151,502	1
Rapides	133,937	1
Livingston	123,326	1
Tangipahoa	118,688	1
Bossier	111,492	1
Terrebonne	109,291	1
Ascension	104,822	1
Lafourche	93,682	0.874
St. Landry	92,326	0.847
Iberia	75,101	0.502
Acadia	60,095	0.202
Vermilion	56,141	0.123
St. Martin	52,217	0.044
St. Charles	51,611	0.032
St. Mary	50,815	0.016
St. John the Baptist	47,086	0
Vernon	46,616	0
Washington	45,669	0
Lincoln	43,286	0
Avoyelles	42,511	0
St. Bernard	40,655	0
Webster	40,544	0
Natchitoches	39,255	0
Beauregard	35,419	0
Evangeline	35,330	0

Iberville	32,505	0
Jefferson Davis	31,097	0
Morehouse	28,223	0
De Soto	26,401	0
Allen	25,636	0
Sabine	23,733	0
Assumption	22,874	0
West Baton Rouge	22,638	0
Union	22,584	0
Pointe Coupee	22,447	0
St. James	21,054	0
East Feliciana	20,970	0
Plaquemines	20,942	0
Richland	20,422	0
Grant	20,164	0
Franklin	19,807	0
Concordia	18,989	0
Claiborne	16,118	0
Winn	15,331	0
Jackson	15,063	0
West Feliciana	15,055	0
Bienville	14,729	0
La Salle	13,964	0
Madison	11,385	0
West Carroll	11,329	0
St. Helena	10,551	0
Catahoula	10,460	0
Caldwell	10,439	0
Red River	9,003	0
East Carroll	8,102	0
Cameron	6,584	0
Tensas	5,609	0

Table A1.2. Small Population fuzzy set scores for Louisiana parishes.

Louisiana Parish	**Resident population estimate (July, 2009)**	**Small Population Set Score**
Tensas	5,609	1
Cameron	6,584	1
East Carroll	8,102	1
Red River	9,003	1
Caldwell	10,439	1
Catahoula	10,460	1
St. Helena	10,551	1
West Carroll	11,329	1
Madison	11,385	1
La Salle	13,964	1
Bienville	14,729	1
West Feliciana	15,055	1
Jackson	15,063	1
Winn	15,331	1
Claiborne	16,118	1
Concordia	18,989	1
Franklin	19,807	1
Grant	20,164	1
Richland	20,422	1
Plaquemines	20,942	1
East Feliciana	20,970	1
St. James	21,054	1
Pointe Coupee	22,447	1
Union	22,584	1
West Baton Rouge	22,638	1
Assumption	22,874	1
Sabine	23,733	1
Allen	25,636	0.975
De Soto	26,401	0.944
Morehouse	28,223	0.871
Jefferson Davis	31,097	0.756
Iberville	32,505	0.700
Evangeline	35,330	0.587
Beauregard	35,419	0.583
Natchitoches	39,255	0.430
Webster	40,544	0.378
St. Bernard	40,655	0.374
Avoyelles	42,511	0.300
Lincoln	43,286	0.269

Washington	45,669	0.173
Vernon	46,616	0.135
St. John the Baptist	47,086	0.117
St. Mary	50,815	0
St. Charles	51,611	0
St. Martin	52,217	0
Vermilion	56,141	0
Acadia	60,095	0
Iberia	75,101	0
St. Landry	92,326	0
Lafourche	93,682	0
Ascension	104,822	0
Terrebonne	109,291	0
Bossier	111,492	0
Tangipahoa	118,688	0
Livingston	123,326	0
Rapides	133,937	0
Ouachita	151,502	0
Calcasieu	187,554	0
Lafayette	210,954	0
St. Tammany	231,495	0
Caddo	253,623	0
Orleans	354,850	0
East Baton Rouge	434,633	0
Jefferson	443,342	0

Table A1.3. Population Growth fuzzy set scores for Louisiana parishes.

Louisiana Parish	**Percent Population Change**	**Population Growth Set Score**
Ascension	36.8	1
Livingston	34.3	1
St. Tammany	21	1
Tangipahoa	18	1
Bossier	13.3	1
Lafayette	10.8	1
St. John the Baptist	9.4	1
Grant	7.9	0.92
St. Martin	7.5	0.87
Beauregard	7.4	0.86
St. Charles	7.4	0.86
Rapides	6	0.70
East Baton Rouge	5.3	0.62
St. Landry	5.3	0.62
West Baton Rouge	4.8	0.56
Terrebonne	4.6	0.53
Lafourche	4.1	0.48
Vermilion	4	0.47
Washington	4	0.47
De Soto	3.6	0.42
Ouachita	2.9	0.34
Avoyelles	2.5	0.29
Iberia	2.5	0.29
Calcasieu	2.2	0.26
Acadia	2.1	0.24
Lincoln	1.8	0.21
Sabine	1.2	0.14
Allen	0.8	0.09
Caddo	0.6	0.07
Natchitoches	0.4	0
St. Helena	0.2	0
Evangeline	-0.3	0
West Feliciana	-0.4	0
St. James	-0.7	0
Union	-1	0
Caldwell	-1.1	0

Jefferson Davis	-1.1	0
Pointe Coupee	-1.4	0
East Feliciana	-1.8	0
Assumption	-2.2	0
Jackson	-2.2	0
La Salle	-2.2	0
Iberville	-2.4	0
Jefferson	-2.7	0
Richland	-2.7	0
Webster	-3.1	0
Catahoula	-4.2	0
Claiborne	-4.3	0
St. Mary	-5	0
Concordia	-6.2	0
Red River	-6.4	0
Bienville	-6.5	0
Franklin	-6.8	0
West Carroll	-8	0
Morehouse	-9	0
Winn	-9.3	0
Vernon	-11.2	0
East Carroll	-14	0
Tensas	-15.2	0
Madison	-17.1	0
Plaquemines	-21.7	0
Orleans	-26.8	0
Cameron	-34.1	0
St. Bernard	-39.5	0

Table A1.4. Population Decline fuzzy set scores for Louisiana parishes.

Louisiana Parish	**Percent Population Change**	**Population Decline Set Scores**
St. Bernard	-39.5	1
Cameron	-34.1	1
Orleans	-26.8	1
Plaquemines	-21.7	1
Madison	-17.1	1
Tensas	-15.2	1
East Carroll	-14	1
Vernon	-11.2	1
Winn	-9.3	1
Morehouse	-9	1
West Carroll	-8	1
Franklin	-6.8	1
Bienville	-6.5	1
Red River	-6.4	1
Concordia	-6.2	1
St. Mary	-5	1
Claiborne	-4.3	1
Catahoula	-4.2	1
Webster	-3.1	1
Jefferson	-2.7	1
Richland	-2.7	1
Iberville	-2.4	1
Assumption	-2.2	1
Jackson	-2.2	1
La Salle	-2.2	1
East Feliciana	-1.8	1
Pointe Coupee	-1.4	1
Caldwell	-1.1	1
Jefferson Davis	-1.1	1
Union	-1	1
St. James	-0.7	1
West Feliciana	-0.4	1
Evangeline	-0.3	1
St. Helena	0.2	0
Natchitoches	0.4	0
Caddo	0.6	0

Allen	0.8	0
Sabine	1.2	0
Lincoln	1.8	0
Acadia	2.1	0
Calcasieu	2.2	0
Avoyelles	2.5	0
Iberia	2.5	0
Ouachita	2.9	0
De Soto	3.6	0
Vermilion	4	0
Washington	4	0
Lafourche	4.1	0
Terrebonne	4.6	0
West Baton Rouge	4.8	0
East Baton Rouge	5.3	0
St. Landry	5.3	0
Rapides	6	0
Beauregard	7.4	0
St. Charles	7.4	0
St. Martin	7.5	0
Grant	7.9	0
St. John the Baptist	9.4	0
Lafayette	10.8	0
Bossier	13.3	0
Tangipahoa	18	0
St. Tammany	21	0
Livingston	34.3	0
Ascension	36.8	0

Table A1.5. Racial Diversity fuzzy set scores for Louisiana parishes.

Louisiana Parish	**Theil Multigroup Entropy Index**	**Racial Diversity Set Score**
St. Helena	0.0103	1.000
East Feliciana	0.0123	1.000
Claiborne	0.0236	1.000
Cameron	0.0298	1.000
Caldwell	0.0373	1.000
West Baton Rouge	0.0434	1.000
Tensas	0.0475	1.000
Iberville	0.0602	1.000
West Carroll	0.0755	1.000
Bienville	0.0786	1.000
West Feliciana	0.0848	1.000
Jefferson Davis	0.0965	1.000
Franklin	0.1007	0.963
Bossier	0.1012	0.942
Jackson	0.1025	0.874
Livingston	0.1050	0.749
Allen	0.1091	0.544
Winn	0.1110	0.448
Avoyelles	0.1113	0.435
La Salle	0.1122	0.391
De Soto	0.1145	0.277
Richland	0.1189	0.053
St. Tammany	0.1208	0.000
Red River	0.1226	0.000
St. Martin	0.1256	0.000
Concordia	0.1262	0.000
Evangeline	0.1276	0.000
Tangipahoa	0.1289	0.000
Vernon	0.1359	0.000
Catahoula	0.1445	0.000
Terrebonne	0.1485	0.000
Natchitoches	0.1512	0.000
St. Landry	0.1581	0.000
Webster	0.1618	0.000
Plaquemines	0.1641	0.000
St. John the Baptist	0.1658	0.000
Iberia	0.1659	0.000

Pointe Coupee	0.1668	0.000
Beauregard	0.1697	0.000
Union	0.1734	0.000
St. Mary	0.1767	0.000
Vermilion	0.1781	0.000
Sabine	0.1785	0.000
St. Bernard	0.1797	0.000
St. Charles	0.1822	0.000
East Carroll	0.1860	0.000
St. James	0.1869	0.000
Acadia	0.1895	0.000
Washington	0.1923	0.000
Lafourche	0.1968	0.000
Morehouse	0.2131	0.000
Ascension	0.2278	0.000
Assumption	0.2285	0.000
Lafayette	0.2390	0.000
Jefferson	0.2535	0.000
Lincoln	0.2801	0.000
Rapides	0.3211	0.000
Calcasieu	0.3311	0.000
Caddo	0.3442	0.000
East Baton Rouge	0.3472	0.000
Grant	0.3574	0.000
Orleans	0.3740	0.000
Madison	0.4397	0.000
Ouachita	0.4613	0.000

Table A1.6. Old and Aging Population fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of Population Age 65 and Older	Old and Aging Set Score
Ascension	8.5	0
Cameron	9.1	0
St. Bernard	9.2	0
St. John the Baptist	9.5	0
Livingston	9.9	0
St. Charles	9.9	0
West Feliciana	10	0
Vernon	10.5	0
Lafayette	10.6	0
West Baton Rouge	10.8	0
East Baton Rouge	10.9	0
St. Martin	10.9	0
Plaquemines	11	0
Tangipahoa	11.3	0
Terrebonne	11.5	0
Orleans	11.7	0
Madison	11.9	0
Bossier	12	0
Lincoln	12	0
Iberia	12.2	0
St. Tammany	12.2	0
Evangeline	12.3	0
Iberville	12.3	0
Lafourche	12.3	0
Ouachita	12.3	0
Assumption	12.4	0.17
Acadia	12.5	0.33
St. James	12.6	0.50
Calcasieu	12.7	0.67
East Feliciana	12.7	0.67
Allen	12.8	0.83
Natchitoches	12.9	1
Vermilion	13	1
Beauregard	13.1	1
East Carroll	13.1	1
Grant	13.1	1
St. Mary	13.3	1

Avoyelles	13.4	1
St. Helena	13.5	1
Caddo	13.6	1
Jefferson	13.7	1
Jefferson Davis	13.7	1
Rapides	13.8	1
St. Landry	13.9	1
De Soto	14	1
Washington	14.3	1
Red River	14.5	1
Richland	14.5	1
Winn	14.5	1
Caldwell	15	1
La Salle	15	1
Tensas	15	1
Catahoula	15.2	1
Morehouse	15.3	1
Concordia	15.4	1
Pointe Coupee	15.5	1
Claiborne	16.4	1
Sabine	16.4	1
Franklin	16.6	1
West Carroll	16.8	1
Union	16.9	1
Webster	17	1
Jackson	17.2	1
Bienville	18	1

Table A1.7. Young Parish fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of Population 18 Years Old or Younger	Young Parish Set Score
West Feliciana	16.8	0
Claiborne	21	0
Lincoln	21.1	0
East Feliciana	21.4	0
Orleans	21.5	0
Winn	22.4	0
Cameron	22.8	0
Jackson	23	0
Jefferson	23	0
Iberville	23.1	0
Caldwell	23.2	0
Bienville	23.2	0
Union	23.3	0
Allen	23.4	0
Assumption	23.8	0
Webster	23.9	0
St. Helena	24	0
West Carroll	24	0
East Baton Rouge	24	0
Pointe Coupee	24.2	0
Catahoula	24.3	0
Tensas	24.4	0.14
Lafourche	24.5	0.29
Natchitoches	24.6	0.43
Morehouse	24.9	0.86
Lafayette	25	1
Caddo	25	1
West Baton Rouge	25.1	1
Franklin	25.2	1
Sabine	25.2	1
La Salle	25.3	1
De Soto	25.3	1
Avoyelles	25.5	1
Washington	25.6	1
Tangipahoa	25.6	1
Bossier	25.7	1
Concordia	25.8	1
Grant	25.8	1

Calcasieu	25.8	1
St. Tammany	25.8	1
Richland	26	1
Beauregard	26	1
Rapides	26.1	1
East Carroll	26.4	1
Vermilion	26.4	1
Ouachita	26.5	1
St. James	26.7	1
St. Martin	26.7	1
Terrebonne	26.7	1
St. Bernard	26.8	1
St. Charles	26.9	1
Vernon	27.1	1
St. Mary	27.1	1
Red River	27.2	1
Plaquemines	27.2	1
Madison	27.3	1
Livingston	27.5	1
Jefferson Davis	27.6	1
Evangeline	27.6	1
Acadia	27.6	1
St. Landry	27.6	1
St. John the Baptist	27.7	1
Iberia	27.7	1
Ascension	28.6	1

Table A1.8. Wealthy Parish fuzzy set scores for Louisiana parishes.

Louisiana Parishes	**Median Household Income in 2008 ($)**	**Wealthy Parish Set Score**
East Carroll	25100	0
Madison	25788	0
Tensas	26135	0
Evangeline	29733	0
Concordia	29807	0
Franklin	29904	0
Richland	30504	0
Washington	30725	0
West Carroll	30922	0
Natchitoches	31000	0
Winn	31108	0
Catahoula	31236	0
Claiborne	31386	0
Bienville	31440	0
Red River	31495	0
Morehouse	32168	0
St. Landry	32373	0
Avoyelles	32744	0
St. Helena	33075	0
Caldwell	34298	0
Sabine	34786	0
Union	35624	0
Webster	35981	0
Jackson	36073	0
Caddo	36527	0
Lincoln	36720	0
Orleans	37047	0
De Soto	37490	0
St. Martin	37779	0
Acadia	37862	0
Jefferson Davis	38577	0
Iberville	38672	0
Grant	38896	0
La Salle	38926	0
Ouachita	39056	0
St. Bernard	39106	0
East Feliciana	39244	0

Pointe Coupee	39379	0
Tangipahoa	39604	0
St. Mary	39856	0
Allen	40131	0
Iberia	40610	0
Rapides	41200	0
Vernon	41284	0
Assumption	41319	0
Vermilion	41414	0
Beauregard	43398	0
Calcasieu	44826	0.14
West Baton Rouge	45177	0.18
St. James	45303	0.20
East Baton Rouge	46563	0.35
Jefferson	47065	0.41
Lafayette	48119	0.53
Lafourche	49182	0.66
Bossier	49331	0.68
St. John the Baptist	49525	0.70
Terrebonne	49786	0.73
Cameron	49984	0.76
West Feliciana	50095	0.77
Plaquemines	50948	0.87
Livingston	53237	1
St. Charles	56886	1
St. Tammany	57129	1
Ascension	61345	1

Table A1.9. Poor Parish fuzzy set scores for Louisiana parishes.

Louisiana Parishes	Percent of Population Living Under Federal Poverty Line in 2008	Poor Parish Set Score
East Carroll	43.7	1
Madison	34.6	1
Tensas	32.4	1
Natchitoches	31.7	1
Claiborne	28.7	1
Franklin	26.1	1
St. Landry	25.6	1
Concordia	25.2	1
Morehouse	25.2	1
Richland	24.2	1
Washington	24.1	1
Winn	23.9	1
West Carroll	23.7	1
Lincoln	23.6	1
Red River	23.4	1
Orleans	22.9	1
Evangeline	22.7	1
Tangipahoa	22.2	1
Avoyelles	21.9	1
Catahoula	21.9	1
Ouachita	21.9	1
West Feliciana	21.9	1
Iberville	21.6	1
Caldwell	21.5	1
East Feliciana	21.2	1
Bienville	21	1
Pointe Coupee	21	1
Sabine	20.9	1
Allen	20.7	1
St. Bernard	20.3	1
Caddo	19.8	1
St. Helena	19.8	1
Acadia	19.7	1
St. Martin	19.5	1
Assumption	19.3	1
Iberia	18.8	1
St. Mary	18.5	1
Jackson	18.4	1

Union	18.3	1
De Soto	18.1	1
Rapides	18	1
Vermilion	17.9	1
Webster	17.9	1
Grant	17.3	0.93
East Baton Rouge	17.2	0.91
Jefferson Davis	16.7	0.80
La Salle	16.2	0.68
West Baton Rouge	16.1	0.66
Lafourche	15.9	0.61
St. James	15.8	0.59
Terrebonne	15.8	0.59
Calcasieu	15.4	0.50
Vernon	15.4	0.50
Plaquemines	15.1	0.43
Lafayette	14.7	0.34
St. John the Baptist	14.7	0.34
Beauregard	14	0.18
Bossier	13.6	0.09
Jefferson	12.9	0
Cameron	12.7	0
St. Charles	11.6	0
Livingston	11.4	0
St. Tammany	10	0
Ascension	9.9	0

Table A1.10. Adult Education fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of People 25 Years and Older With High School Diploma	Adult Education Set Score
St. Tammany	83.9	1
East Baton Rouge	83.9	1
Bossier	83	1
Lincoln	80.4	1
Vernon	80.1	0.95
St. Charles	80	0.93
Lafayette	79.8	0.89
Ascension	79.6	0.86
Jefferson	79.3	0.80
Caddo	78.7	0.70
Ouachita	78.6	0.68
Livingston	77.2	0.43
Calcasieu	77	0.39
St. John the Baptist	76.9	0.38
Beauregard	75	0.04
Orleans	74.7	0
Rapides	74.6	0
St. James	73.9	0
Jackson	73.6	0
West Baton Rouge	73.4	0
St. Bernard	73.1	0
Grant	73.1	0
Natchitoches	72.7	0
Bienville	71.9	0
Union	71.7	0
Tangipahoa	71.5	0
Sabine	70.8	0
Webster	70.8	0
East Feliciana	70.7	0
De Soto	70.3	0
Jefferson Davis	69.4	0
Pointe Coupee	69.1	0
Plaquemines	68.7	0
La Salle	68.5	0
Washington	68.2	0
Cameron	68.1	0
St. Helena	67.5	0

Red River	67.4	0
Terrebonne	67.1	0
Iberia	66.9	0
Morehouse	66.6	0
Lafourche	66.3	0
St. Mary	65.9	0
Iberville	65.7	0
Claiborne	65.7	0
Vermilion	65.6	0
Caldwell	65.4	0
Winn	65.4	0
Acadia	64.7	0
Concordia	64.6	0
Madison	63.4	0
Allen	63.2	0
Tensas	63.2	0
St. Martin	62.9	0
St. Landry	62	0
Richland	61.9	0
Catahoula	61.4	0
Franklin	61.4	0
Avoyelles	59.8	0
West Carroll	59.5	0
Assumption	59.4	0
East Carroll	57.9	0
Evangeline	55.5	0
West Feliciana	53.3	0

Table A1.11. High Crime fuzzy set scores for Louisiana parishes.

Louisiana Parish	Number of Violent Crimes Reported	High Crime Set Score
East Baton Rouge	3562	1
Orleans	2893	1
Jefferson	2865	1
Caddo	2064	1
Lafayette	1701	1
Tangipahoa	1668	1
Bossier	1493	1
Rapides	1016	1
Calcasieu	871	0.74
Ouachita	758	0.52
Terrebonne	645	0.29
St. Tammany	623	0.25
De Soto	502	0
St. Mary	438	0
Ascension	406	0
Iberia	400	0
Washington	336	0
Natchitoches	334	0
Vermilion	299	0
Acadia	288	0
Lafourche	277	0
St. Martin	257	0
Livingston	256	0
Vernon	239	0
Iberville	229	0
Lincoln	217	0
St. James	204	0
Concordia	172	0
St. Charles	172	0
St. Landry	168	0
St. John the Baptist	161	0
Assumption	151	0
Avoyelles	150	0
Catahoula	150	0
Morehouse	147	0
Madison	140	0
Jefferson Davis	139	0

St. Bernard	139	0
Claiborne	131	0
Evangeline	121	0
Beauregard	110	0
West Baton Rouge	105	0
Webster	99	0
Union	91	0
St. Helena	86	0
Winn	71	0
Caldwell	62	0
East Carroll	61	0
Pointe Coupee	56	0
Plaquemines	55	0
West Feliciana	51	0
Cameron	49	0
East Feliciana	45	0
Allen	43	0
Bienville	43	0
Red River	43	0
Sabine	40	0
La Salle	29	0
West Carroll	28	0
Grant	23	0
Franklin	11	0
Jackson	10	0
Richland	9	0
Tensas	0	0

Table A1.12. List of urban and rural parishes.

Louisiana Parishes	Urban Parish	Rural Parish
Acadia	0	1
Allen	0	1
Ascension	1	0
Assumption	0	1
Avoyelles	0	1
Beauregard	0	1
Bienville	0	1
Bossier	1	0
Caddo	1	0
Calcasieu	1	0
Caldwell	0	1
Cameron	1	0
Catahoula	0	1
Claiborne	0	1
Concordia	0	1
De Soto	1	0
East Baton Rouge	1	0
East Carroll	0	1
East Feliciana	1	0
Evangeline	0	1
Franklin	0	1
Grant	1	0
Iberia	0	1
Iberville	1	0
Jackson	0	1
Jefferson Davis	0	1
Jefferson	1	0
La Salle	0	1
Lafayette	1	0
Lafourche	1	0
Lincoln	0	1
Livingston	1	0
Madison	0	1
Morehouse	0	1
Natchitoches	0	1
Orleans	1	0
Ouachita	1	0
Plaquemines	1	0
Pointe Coupee	1	0

Louisiana Parishes	Urban Parish	Rural Parish
Rapides	1	0
Red River	0	1
Richland	0	1
Sabine	0	1
St. Bernard	1	0
St. Charles	1	0
St. Helena	1	0
St. James	0	1
St. John the Baptist	1	0
St. Landry	0	1
St. Martin	1	0
St. Mary	0	1
St. Tammany	1	0
Tangipahoa	0	1
Tensas	0	1
Terrebonne	1	0
Union	1	0
Vermilion	0	1
Vernon	0	1
Washington	0	1
Webster	0	1
West Baton Rouge	1	0
West Carroll	0	1
West Feliciana	1	0
Winn	0	1

Table A1.13. Natural Amenities fuzzy set scores for Louisiana parishes.

Louisiana Parishes	Natural Amenity Rank	Natural Amenities Set Score
Acadia	3	0
Allen	2	0
Ascension	3	0
Assumption	3	0
Avoyelles	3	0
Beauregard	3	0
Bienville	3	0
Bossier	4	1
Caddo	4	1
Calcasieu	3	0
Caldwell	4	1
Cameron	4	1
Catahoula	4	1
Claiborne	4	1
Concordia	3	0
De Soto	4	1
East Baton Rouge	3	0
East Carroll	3	0
East Feliciana	3	0
Evangeline	3	0
Franklin	3	0
Grant	3	0
Iberia	4	1
Iberville	3	0
Jackson	4	1
Jefferson Davis	4	1
Jefferson	3	0
La Salle	3	0
Lafayette	2	0
Lafourche	4	1
Lincoln	3	0
Livingston	4	1
Madison	3	0
Morehouse	3	0
Natchitoches	4	1
Orleans	4	1
Ouachita	4	1
Plaquemines	4	1

Pointe Coupee	4	1
Rapides	3	0
Red River	4	1
Richland	3	0
Sabine	4	1
St. Bernard	3	0
St. Charles	4	1
St. Helena	3	0
St. James	3	0
St. John the Baptist	3	0
St. Landry	3	0
St. Martin	3	0
St. Mary	4	1
St. Tammany	4	1
Tangipahoa	3	0
Tensas	3	0
Terrebonne	4	1
Union	4	1
Vermilion	4	1
Vernon	4	1
Washington	3	0
Webster	4	1
West Baton Rouge	3	0
West Carroll	2	0
West Feliciana	3	0
Winn	3	0

Table A1.14. Interstate Highway fuzzy set scores for Louisiana parishes.

Louisiana Parish	Presence of Interstate Highway					Interstate Highway Set Score
	I-10	I-12	I-49	I-20	I-55	
Caddo	0	0	1	1	0	1
East Baton Rouge	1	1	0	0	0	1
Lafayette	1	0	1	0	0	1
St. John the Baptist	1	0	0	0	1	1
St. Tammany	1	1	0	0	0	1
Tangipahoa	0	1	0	0	1	1
Acadia	1	0	0	0	0	1
Ascension	1	0	0	0	0	1
Avoyelles	0	0	1	0	0	1
Bienville	0	0	0	1	0	1
Bossier	0	0	0	1	0	1
Calcasieu	1	0	0	0	0	1
De Soto	0	0	1	0	0	1
Iberville	1	0	0	0	0	1
Jefferson Davis	1	0	0	0	0	1
Jefferson	1	0	0	0	0	1
Lincoln	0	0	0	1	0	1
Livingston	0	1	0	0	0	1
Madison	0	0	0	1	0	1
Natchitoches	0	0	1	0	0	1
Orleans	1	0	0	0	0	1
Ouachita	0	0	0	1	0	1
Rapides	0	0	1	0	0	1
Richland	0	0	0	1	0	1
St. Charles	1	0	0	0	0	1
St. James	1	0	0	0	0	1
St. Landry	0	0	1	0	0	1
St. Martin	1	0	0	0	0	1
Webster	0	0	0	1	0	1
West Baton Rouge	1	0	0	0	0	1
Allen	0	0	0	0	0	0
Assumption	0	0	0	0	0	0
Beauregard	0	0	0	0	0	0
Caldwell	0	0	0	0	0	0
Cameron	0	0	0	0	0	0
Catahoula	0	0	0	0	0	0

Claiborne	0	0	0	0	0	0
Concordia	0	0	0	0	0	0
East Carroll	0	0	0	0	0	0
East Feliciana	0	0	0	0	0	0
Evangeline	0	0	0	0	0	0
Franklin	0	0	0	0	0	0
Grant	0	0	0	0	0	0
Iberia	0	0	0	0	0	0
Jackson	0	0	0	0	0	0
La Salle	0	0	0	0	0	0
Lafourche	0	0	0	0	0	0
Morehouse	0	0	0	0	0	0
Plaquemines	0	0	0	0	0	0
Pointe Coupee	0	0	0	0	0	0
Red River	0	0	0	0	0	0
Sabine	0	0	0	0	0	0
St. Bernard	0	0	0	0	0	0
St. Helena	0	0	0	0	0	0
St. Mary	0	0	0	0	0	0
Tensas	0	0	0	0	0	0
Terrebonne	0	0	0	0	0	0
Union	0	0	0	0	0	0
Vermilion	0	0	0	0	0	0
Vernon	0	0	0	0	0	0
Washington	0	0	0	0	0	0
West Carroll	0	0	0	0	0	0
West Feliciana	0	0	0	0	0	0
Winn	0	0	0	0	0	0

Table A1.15. Coastal fuzzy set scores for Louisiana parishes.

Louisiana Parish	Has Coastal Lands on Gulf of Mexico or Lake Pontchartrain
Cameron	1
Iberia	1
Jefferson	1
Lafourche	1
Orleans	1
Plaquemines	1
St. Bernard	1
St. Charles	1
St. John the Baptist	1
St. Mary	1
St. Tammany	1
Tangipahoa	1
Terrebonne	1
Vermilion	1
Acadia	0
Allen	0
Ascension	0
Assumption	0
Avoyelles	0
Beauregard	0
Bienville	0
Bossier	0
Caddo	0
Calcasieu	0
Caldwell	0
Catahoula	0
Claiborne	0
Concordia	0
De Soto	0
East Baton Rouge	0
East Carroll	0
East Feliciana	0
Evangeline	0
Franklin	0
Grant	0
Iberville	0

Jackson	0
Jefferson Davis	0
La Salle	0
Lafayette	0
Lincoln	0
Livingston	0
Madison	0
Morehouse	0
Natchitoches	0
Ouachita	0
Pointe Coupee	0
Rapides	0
Red River	0
Richland	0
Sabine	0
St. Helena	0
St. James	0
St. Landry	0
St. Martin	0
Tensas	0
Union	0
Vernon	0
Washington	0
Webster	0
West Baton Rouge	0
West Carroll	0
West Feliciana	0
Winn	0

Table A1.16. Major Port fuzzy set scores for Louisiana parishes.

Louisiana Parish	**Parish Has A Major Port**
Ascension	1
Bossier	1
Calcasieu	1
East Baton Rouge	1
Iberia	1
Lafourche	1
Orleans	1
Plaquemines	1
St. Bernard	1
St. Charles	1
St. James	1
St. John the Baptist	1
Vermilion	1
West Baton Rouge	1
Acadia	0
Allen	0
Assumption	0
Avoyelles	0
Beauregard	0
Bienville	0
Caddo	0
Caldwell	0
Cameron	0
Catahoula	0
Claiborne	0
Concordia	0
De Soto	0
East Carroll	0
East Feliciana	0
Evangeline	0
Franklin	0
Grant	0
Iberville	0
Jackson	0
Jefferson Davis	0
Jefferson	0

La Salle	0
Lafayette	0
Lincoln	0
Livingston	0
Madison	0
Morehouse	0
Natchitoches	0
Ouachita	0
Pointe Coupee	0
Rapides	0
Red River	0
Richland	0
Sabine	0
St. Helena	0
St. Landry	0
St. Martin	0
St. Mary	0
St. Tammany	0
Tangipahoa	0
Tensas	0
Terrebonne	0
Union	0
Vernon	0
Washington	0
Webster	0
West Carroll	0
West Feliciana	0
Winn	0

Table A1.17. Substantial Mining Employment fuzzy set scores for Louisiana parishes.

Louisiana Parish	**Mining Employment**	**Total Employment**	**Mining Employment Set Score**
Acadia	708	25143	0.68
Allen	.	12813	.
Ascension	.	65484	.
Assumption	50	7019	0.00
Avoyelles	29	16763	0.00
Beauregard	82	13268	0.00
Bienville	183	6720	0.09
Bossier	1531	59793	1.00
Caddo	5169	161883	1.00
Calcasieu	1207	107064	1.00
Caldwell	35	4031	0.00
Cameron	184	4056	0.09
Catahoula	81	4352	0.00
Claiborne	485	6425	0.43
Concordia	253	7917	0.17
De Soto	520	9325	0.47
East Baton Rouge	849	298175	0.83
East Carroll	.	3258	.
East Feliciana	.	7867	.
Evangeline	42	11379	0.00
Franklin	.	9208	.
Grant	.	5310	.
Iberia	3467	43628	1.00
Iberville	121	17385	0.02
Jackson	.	5520	.
Jefferson	2287	253727	1.00
Jefferson Davis	303	12283	0.23
La Salle	431	5698	0.37
Lafayette	16385	165459	1.00
Lafourche	910	56844	0.90
Lincoln	298	23038	0.22
Livingston	186	34980	0.10
Madison	(L)	4848	.
Morehouse	.	10899	.
Natchitoches	44	19955	0.00
Orleans	4282	217865	1.00
Ouachita	486	91311	0.43

Plaquemines	1900	18838	1.00
Pointe Coupee	.	8812	.
Rapides	162	76113	0.07
Red River	81	3191	0.00
Richland	.	8365	.
Sabine	91	8587	0.00
St. Bernard	.	14368	.
St. Charles	.	28764	.
St. Helena	.	4272	.
St. James	.	8702	.
St. John the Baptist	422	19290	0.36
St. Landry	623	33899	0.58
St. Martin	489	15660	0.43
St. Mary	1336	33858	1.00
St. Tammany	593	105664	0.55
Tangipahoa	160	54342	0.07
Tensas	.	2534	.
Terrebonne	5780	61253	1.00
Union	.	8119	.
Vermilion	1220	20656	1.00
Vernon	73	27123	0.00
Washington	116	16817	0.02
Webster	571	18260	0.52
West Baton Rouge	.	12613	.
West Carroll	.	4761	.
West Feliciana	.	6710	.
Winn	62	6764	0.00

Table A1.18. Small Business Intensive fuzzy set scores for Louisiana parishes.

Louisiana Parish	Total Number of Businesses	Number of Businesses with Fewer than 10 Employees	Percent with Fewer than 10 Employees	Small Business Intensive Set Score
Acadia	1057	792	74.93%	0.99
Allen	341	275	80.65%	1.00
Ascension	1823	1248	68.46%	0.22
Assumption	256	199	77.73%	1.00
Avoyelles	709	543	76.59%	1.00
Beauregard	629	479	76.15%	1.00
Bienville	248	192	77.42%	1.00
Bossier	2244	1561	69.56%	0.35
Caddo	6336	4370	68.97%	0.28
Calcasieu	4250	2899	68.21%	0.19
Caldwell	203	159	78.33%	1.00
Cameron	146	106	72.60%	0.71
Catahoula	186	143	76.88%	1.00
Claiborne	246	181	73.58%	0.83
Concordia	353	266	75.35%	1.00
De Soto	376	286	76.06%	1.00
East Baton Rouge	12036	8310	69.04%	0.29
East Carroll	134	103	76.87%	1.00
East Feliciana	254	193	75.98%	1.00
Evangeline	538	417	77.51%	1.00
Franklin	424	329	77.59%	1.00
Grant	218	182	83.49%	1.00
Iberia	1681	1124	66.86%	0.02
Iberville	522	354	67.82%	0.14
Jackson	278	217	78.06%	1.00
Jefferson	12142	8713	71.76%	0.61
Jefferson Davis	597	443	74.20%	0.90
Lafayette	7459	5226	70.06%	0.41
Lafourche	1878	1367	72.79%	0.73
La Salle	302	235	77.81%	1.00
Lincoln	1000	697	69.70%	0.36
Livingston	1542	1181	76.59%	1.00
Madison	205	143	69.76%	0.37
Morehouse	516	391	75.78%	1.00
Natchitoches	812	581	71.55%	0.59
Orleans	7888	5931	75.19%	1.00

Ouachita	4278	3021	70.62%	0.47
Plaquemines	674	462	68.55%	0.23
Pointe Coupee	370	280	75.68%	1.00
Rapides	3251	2290	70.44%	0.45
Red River	142	102	71.83%	0.62
Richland	412	320	77.67%	1.00
Sabine	500	399	79.80%	1.00
St. Bernard	629	522	82.99%	1.00
St. Charles	980	658	67.14%	0.06
St. Helena	103	69	66.99%	0.04
St. James	313	214	68.37%	0.20
St. John the Baptist	717	475	66.25%	0.00
St. Landry	1626	1205	74.11%	0.89
St. Martin	794	605	76.20%	1.00
St. Mary	1344	932	69.35%	0.32
St. Tammany	5659	4354	76.94%	1.00
Tangipahoa	2242	1609	71.77%	0.61
Tensas	102	83	81.37%	1.00
Terrebonne	2841	1988	69.98%	0.40
Union	331	260	78.55%	1.00
Vermillion	994	756	76.06%	1.00
Vernon	649	481	74.11%	0.89
Washington	688	499	72.53%	0.70
Webster	812	595	73.28%	0.79
West Baton Rouge	474	290	61.18%	0.00
West Carroll	201	164	81.59%	1.00
West Feliciana	202	156	77.23%	1.00
Winn	336	239	71.13%	0.54

Table A1.19. Large Business Presence fuzzy set scores for Louisiana parishes.

Louisiana Parish	Businesses with More than 100 Employees	Large Business Presence Set Score
Acadia	13	0.10
Allen	7	0.00
Ascension	42	1.00
Assumption	4	0.00
Avoyelles	12	0.07
Beauregard	10	0.00
Bienville	4	0.00
Bossier	42	1.00
Caddo	171	1.00
Calcasieu	103	1.00
Caldwell	2	0.00
Cameron	1	0.00
Catahoula	1	0.00
Claiborne	2	0.00
Concordia	6	0.00
De Soto	8	0.00
East Baton Rouge	363	1.00
East Carroll	1	0.00
East Feliciana	6	0.00
Evangeline	10	0.00
Franklin	6	0.00
Grant	3	0.00
Iberia	50	1.00
Iberville	17	0.23
Jackson	4	0.00
Jefferson	272	1.00
Jefferson Davis	9	0.00
Lafayette	211	1.00
Lafourche	38	0.93
La Salle	5	0.00
Lincoln	26	0.53
Livingston	14	0.13
Madison	5	0.00
Morehouse	9	0.00
Natchitoches	9	0.00
Orleans	216	1.00
Ouachita	92	1.00

Plaquemines	19	0.30
Pointe Coupee	6	0.00
Rapides	75	1.00
Red River	5	0.00
Richland	7	0.00
Sabine	6	0.00
St. Bernard	9	0.00
St. Charles	35	0.83
St. Helena	1	0.00
St. James	11	0.03
St. John the Baptist	19	0.30
St. Landry	28	0.60
St. Martin	11	0.03
St. Mary	36	0.87
St. Tammany	80	1.00
Tangipahoa	46	1.00
Tensas	0	0.00
Terrebonne	91	1.00
Union	5	0.00
Vermillion	8	0.00
Vernon	12	0.07
Washington	11	0.03
Webster	21	0.37
West Baton Rouge	16	0.20
West Carroll	3	0.00
West Feliciana	5	0.00
Winn	10	0.00

Table A1.20. High Unemployment fuzzy set scores for Louisiana parishes.

Louisiana Parish	Unemployment Rate (%)	High Unemployment Set Score
Acadia	5.9	0.00
Allen	10.6	1.00
Ascension	7.1	0.37
Assumption	10.4	1.00
Avoyelles	8.2	0.73
Beauregard	7.5	0.50
Bienville	8.9	0.97
Bossier	5.8	0.00
Caddo	7.4	0.47
Calcasieu	7	0.33
Caldwell	9.8	1.00
Cameron	6.2	0.07
Catahoula	10.1	1.00
Claiborne	9	1.00
Concordia	10.9	1.00
De Soto	8.1	0.70
East Baton Rouge	7.2	0.40
East Carroll	15.2	1.00
East Feliciana	8.5	0.83
Evangeline	8.6	0.87
Franklin	11.2	1.00
Grant	7.8	0.60
Iberia	7.8	0.60
Iberville	10.4	1.00
Jackson	7.3	0.43
Jefferson	6.9	0.30
Jefferson Davis	6.3	0.10
Lafayette	5.7	0.00
Lafourche	5.2	0.00
La Salle	6	0.00
Lincoln	8.3	0.77
Livingston	7.2	0.40
Madison	10.6	1.00
Morehouse	14.2	1.00
Natchitoches	8.1	0.70
Orleans	8.8	0.93
Ouachita	7.7	0.57
Plaquemines	6.6	0.20

Pointe Coupee	8.5	0.83
Rapides	7	0.33
Red River	8.8	0.93
Richland	10.1	1.00
Sabine	6.9	0.30
St. Bernard	7	0.33
St. Charles	7.2	0.40
St. Helena	13	1.00
St. James	11.4	1.00
St. John the Baptist	10.1	1.00
St. Landry	8.3	0.77
St. Martin	7.3	0.43
St. Mary	9.3	1.00
St. Tammany	5.8	0.00
Tangipahoa	8.9	0.97
Tensas	15.1	1.00
Terrebonne	5.5	0.00
Union	8.6	0.87
Vermilion	7.1	0.37
Vernon	6.9	0.30
Washington	9.8	1.00
Webster	8	0.67
West Baton Rouge	8.2	0.73
West Carroll	16.1	1.00
West Feliciana	8.3	0.77
Winn	8.2	0.73

Table A1.21. Job Growth fuzzy set scores for Louisiana parishes.

Louisiana Parish	New Jobs as a Percent of Total Jobs	Job Growth Set Scale
Acadia	2.31	1.00
Allen	-3.21	0.00
Ascension	-0.76	0.00
Assumption	-2.65	0.00
Avoyelles	1.24	0.62
Beauregard	1.96	0.98
Bienville	4.09	1.00
Bossier	0.45	0.22
Caddo	0.44	0.22
Calcasieu	-0.56	0.00
Caldwell	-0.83	0.00
Cameron	-0.58	0.00
Catahoula	1.55	0.78
Claiborne	0.85	0.42
Concordia	-0.90	0.00
De Soto	0.43	0.21
East Baton Rouge	-0.75	0.00
East Carroll	-1.89	0.00
East Feliciana	-0.74	0.00
Evangeline	-0.24	0.00
Franklin	0.58	0.29
Grant	-0.83	0.00
Iberia	-3.19	1.00
Iberville	-0.73	0.00
Jackson	0.83	0.42
Jefferson	0.88	0.44
Jefferson Davis	-0.42	0.00
Lafayette	-0.06	-0.03
Lafourche	0.08	0.04
La Salle	7.06	1.00
Lincoln	0.83	0.42
Livingston	-0.76	0.00
Madison	-2.08	0.00
Morehouse	-0.56	0.00
Natchitoches	0.15	0.08
Orleans	0.86	0.43
Ouachita	0.14	0.07
Plaquemines	0.88	0.44

Pointe Coupee	-0.75	0.00
Rapides	-0.83	0.00
Red River	5.53	1.00
Richland	2.78	1.00
Sabine	2.55	1.00
St. Bernard	0.88	0.44
St. Charles	0.88	0.44
St. Helena	-0.71	0.00
St. James	-0.04	-0.02
St. John the Baptist	0.86	0.43
St. Landry	0.83	0.42
St. Martin	-0.06	-0.03
St. Mary	-1.50	0.00
St. Tammany	0.89	0.44
Tangipahoa	0.61	0.31
Tensas	-5.19	0.00
Terrebonne	0.08	0.04
Union	0.13	0.06
Vermilion	-1.53	0.00
Vernon	2.10	1.00
Washington	-0.70	0.00
Webster	3.41	1.71
West Baton Rouge	-0.75	0.00
West Carroll	-1.46	0.00
West Feliciana	-0.74	0.00
Winn	2.37	1.00

Table A1.22. Per Capita Personal Income fuzzy set scores for Louisiana parishes.

Louisiana Parish	Mean Per Capita Income	Per Capita Income Set Score
Allen	$19,386	0.00
Madison	$20,184	0.00
Evangeline	$20,216	0.00
West Feliciana	$21,591	0.00
Winn	$21,613	0.00
East Carroll	$22,021	0.00
West Carroll	$22,159	0.01
Avoyelles	$22,286	0.02
Morehouse	$22,748	0.07
Franklin	$22,828	0.08
Sabine	$22,856	0.08
Red River	$22,869	0.08
Richland	$22,937	0.09
Catahoula	$22,972	0.09
Grant	$23,034	0.10
Caldwell	$23,166	0.11
Vermillion	$23,358	0.13
Washington	$23,365	0.13
Concordia	$23,393	0.14
Jefferson Davis	$23,472	0.15
St Martin	$23,626	0.16
Bienville	$23,723	0.17
Beauregard	$23,727	0.17
Cameron	$23,961	0.20
Claiborne	$24,250	0.22
LaSalle	$24,497	0.25
St Landry	$24,731	0.27
Tangipahoa	$24,836	0.28
Acadia	$25,037	0.31
St James	$25,094	0.31
Jackson	$25,116	0.31
Union	$25,354	0.34
Natchitoches	$25,482	0.35
Livingston	$25,919	0.40
Tensas	$25,932	0.40
DeSoto	$25,983	0.40
Lincoln	$26,080	0.41

St Helena	$26,094	0.41
Iberville	$26,481	0.45
East Feliciana	$26,905	0.50
Pointe Coupee	$27,006	0.51
Webster	$27,143	0.52
St John the Baptist	$27,257	0.53
Ouachita	$28,993	0.71
Assumption	$29,329	0.74
West Baton Rouge	$29,378	0.75
Iberia	$29,507	0.76
Bossier	$29,622	0.77
St Charles	$29,640	0.78
Calcasieu	$30,488	0.86
Terrebonne	$30,848	0.90
Ascension	$31,196	0.94
Rapides	$31,977	1.00
St Mary	$32,202	1.00
Lafourche	$32,395	1.00
Vernon	$32,636	1.00
Plaquemines	$32,836	1.00
Caddo	$33,539	1.00
East Baton Rouge	$34,367	1.00
St Tammany	$34,760	1.00
Jefferson	$35,968	1.00
Lafayette	$36,925	1.00
Orleans	$59,449	1.00
St Bernard	$61,201	1.00

Table A1.23. Competitive Teacher Salary fuzzy set scores for Louisiana parishes.

Louisiana Parish	LDE Actual Salary	Fuzzy set score
Acadia	$42,543	0.00
Allen	$45,347	0.87
Ascension	$47,873	1.00
Assumption	$42,959	0.00
Avoyelles	$41,426	0.00
Beauregard	$45,348	0.87
Bienville	$52,251	1.00
Bossier	$47,959	1.00
Caddo	$47,701	1.00
Calcasieu	$46,630	1.00
Caldwell	$44,132	0.37
Cameron	$40,579	0.00
Catahoula	$35,491	0.00
Claiborne	$43,125	0.00
Concordia	$42,166	0.00
DeSoto	$49,677	1.00
East Baton Rouge	$50,014	1.00
East Carroll	$41,449	0.00
East Feliciana	$41,462	0.00
Evangeline	$46,395	1.00
Franklin	$40,837	0.00
Grant	$40,131	0.00
Iberia	$47,171	1.00
Iberville	$45,054	0.75
Jackson	$49,377	1.00
Jefferson	$51,416	1.00
Jefferson Davis	$46,723	1.00
Lafayette	$46,371	1.00
Lafourche	$43,453	0.09
LaSalle	$43,433	0.08
Lincoln	$47,393	1.00
Livingston	$47,416	1.00
Madison	$43,906	0.28
Morehouse	$46,454	1.00
Natchitoches	$52,389	1.00
Orleans	$48,224	1.00
Ouachita	$47,612	1.00
Plaquemines	$45,218	0.82

Pointe Coupee	$43,878	0.27
Rapides	$44,665	0.59
Red River	$45,890	1.00
Richland	$45,499	0.93
Sabine	$43,428	0.08
St. Bernard	$45,596	0.97
St. Charles	$51,737	1.00
St. Helena	$34,670	0.00
St. James	$48,907	1.00
St. John the Baptist	$49,703	1.00
St. Landry	$42,833	0.00
St. Martin	$46,465	1.00
St. Mary	$45,761	1.00
St. Tammany	$50,060	1.00
Tangipahoa	$46,611	1.00
Tensas	$38,797	0.00
Terrebonne	$44,717	0.61
Union	$47,357	1.00
Vermilion	$45,445	0.91
Vernon	$45,933	1.00
Washington	$43,373	0.06
Webster	$50,762	1.00
West Baton Rouge	$46,047	1.00
West Carroll	$44,033	0.33
West Feliciana	$49,498	1.00
Winn	$45,248	0.83
City of Monroe	$51,469	1.00
City of Bogalusa	$52,045	1.00
Zachary Community	$49,298	1.00
City of Baker	$43,008	0.00
Central Community	$46,002	1.00

Note: SREB average = $45,662; Bottom Quarter = $43,227

Table A1.24. Substantial Local Capacity fuzzy set scores for Louisiana parishes.

Louisiana Parish	Eligible Revenue AC	Local Share AD	Percent of Eligible Revenue	Substantial Local Capacity Set Score
Acadia	$5,791,101	$2,246,136	38.79%	0.09
Allen	$7,502,448	$2,478,899	33.04%	0.00
Ascension	$31,557,724	$18,037,006	57.16%	0.55
Assumption	$6,853,635	$2,154,893	31.44%	0.00
Avoyelles	$1,826,520	$527,791	28.90%	0.00
Beauregard	$8,669,346	$3,328,197	38.39%	0.08
Bienville	$4,292,543	$3,675,344	85.62%	1.00
Bossier	$32,717,693	$19,212,091	58.72%	0.59
Caddo	$73,944,451	$39,490,774	53.41%	0.46
Calcasieu	$56,757,242	$37,740,842	66.50%	0.79
Caldwell	$1,815,619	$554,308	30.53%	0.00
Cameron	$3,064,417	$2,540,524	82.90%	1.00
Catahoula	$1,160,739	$315,043	27.14%	0.00
Claiborne	$3,509,608	$1,290,609	36.77%	0.04
Concordia	$4,227,986	$1,468,971	34.74%	0.00
DeSoto	$8,873,439	$4,989,251	56.23%	0.53
East Baton Rouge	$78,835,984	$73,290,661	92.97%	1.00
East Carroll	$732,348	$175,090	23.91%	0.00
East Feliciana	$1,206,690	$449,970	37.29%	0.06
Evangeline	$6,429,855	$2,024,967	31.49%	0.00
Franklin	$830,798	$252,071	30.34%	0.00
Grant	$1,792,969	$337,688	18.83%	0.00
Iberia	$19,063,877	$8,768,011	45.99%	0.27
Iberville	$8,043,766	$7,999,557	99.45%	1.00
Jackson	$4,187,687	$3,188,689	76.14%	1.00
Jefferson	$76,751,971	$83,115,630	108.29%	1.00
Jefferson Davis	$9,180,697	$3,298,698	35.93%	0.02
Lafayette	$50,944,288	$40,569,993	79.64%	1.00
Lafourche	$24,637,228	$14,166,307	57.50%	0.56
LaSalle	$3,204,006	$1,094,463	34.16%	0.00
Lincoln	$11,603,627	$7,087,171	61.08%	0.65
Livingston	$24,083,073	$5,973,180	24.80%	0.00
Madison	$1,784,826	$465,397	26.08%	0.00
Morehouse	$5,750,054	$2,153,073	37.44%	0.06
Natchitoches	$10,078,818	$4,668,468	46.32%	0.28
Orleans	$57,564,633	$50,406,586	87.57%	1.00
Ouachita	$31,596,652	$11,162,718	35.33%	0.01

Plaquemines	$6,674,084	$8,609,569	129.00%	1.00
Pointe Coupee	$2,869,930	$2,377,312	82.84%	1.00
Rapides	$27,653,687	$13,341,798	48.25%	0.33
Red River	$2,848,151	$824,471	28.95%	0.00
Richland	$4,249,539	$1,360,974	32.03%	0.00
Sabine	$4,214,346	$1,372,174	32.56%	0.00
St. Bernard	$7,651,867	$6,012,041	78.57%	1.00
St. Charles	$16,206,806	$18,227,924	112.47%	1.00
St. Helena	$626,346	$208,568	33.30%	0.00
St. James	$7,486,718	$6,076,730	81.17%	1.00
St. John the Baptist	$12,261,599	$7,368,828	60.10%	0.63
St. Landry	$13,265,908	$5,382,616	40.57%	0.14
St. Martin	$8,855,997	$3,204,879	36.19%	0.03
St. Mary	$14,194,049	$7,875,880	55.49%	0.51
St. Tammany	$64,479,887	$37,375,121	57.96%	0.57
Tangipahoa	$14,767,760	$5,776,084	39.11%	0.10
Tensas	$721,460	$325,739	45.15%	0.25
Terrebonne	$21,641,216	$13,370,463	61.78%	0.67
Union	$2,460,509	$1,038,975	42.23%	0.18
Vermilion	$4,787,721	$2,646,690	55.28%	0.51
Vernon	$8,841,484	$2,357,140	26.66%	0.00
Washington	$4,592,405	$959,721	20.90%	0.00
Webster	$12,548,372	$5,456,233	43.48%	0.21
West Baton Rouge	$6,636,074	$5,644,246	85.05%	1.00
West Carroll	$1,466,182	$382,814	26.11%	0.00
West Feliciana	$4,112,829	$4,264,247	103.68%	1.00
Winn	$3,488,356	$1,305,594	37.43%	0.06
City of Monroe	$16,253,991	$10,629,200	65.39%	0.76
City of Bogalusa	$2,606,439	$1,197,878	45.96%	0.27
Zachary Community	$7,535,214	$3,650,992	48.45%	0.34
City of Baker	$2,469,625	$844,878	34.21%	0.00
Central Community	$4,458,753	$1,897,324	42.55%	0.19

Table A1.25. Oil and Gas Revenue Influence fuzzy set scores for Louisiana parishes.

Louisiana Parish	'Other' Revenue	Total Revenue	Percent 'Other'	Oil and Gas Revenue Set Score
Acadia	$324,736	$16,677,568	1.95%	0.00
Allen	$138,337	$11,790,818	1.17%	0.00
Ascension	$178,198	$72,374,448	0.25%	0.00
Assumption	$196,069	$10,945,966	1.79%	0.00
Avoyelles	$82,536	$7,210,848	1.14%	0.00
Beauregard	$293,404	$16,015,453	1.83%	0.00
Bienville	$145,526	$17,068,925	0.85%	0.00
Bossier	$590,934	$71,072,569	0.83%	0.00
Caddo	$2,839,941	$158,391,291	1.79%	0.00
Calcasieu	$1,044,943	$129,570,437	0.81%	0.00
Caldwell	$124,102	$3,600,473	3.45%	0.48
Cameron	$1,091,662	$10,244,460	10.66%	1.00
Catahoula	$87,486	$2,714,430	3.22%	0.41
Claiborne	$189,228	$6,644,067	2.85%	0.28
Concordia	$235,828	$8,688,892	2.71%	0.24
DeSoto	$413,614	$26,712,199	1.55%	0.00
East Baton Rouge	$4,044,494	$259,981,233	1.56%	0.00
East Carroll	$155,689	$1,902,308	8.18%	1.00
East Feliciana	$160,743	$4,096,260	3.92%	0.64
Evangeline	$237,519	$12,529,634	1.90%	0.00
Franklin	$76,448	$4,013,611	1.90%	0.00
Grant	$571,386	$3,960,214	14.43%	1.00
Iberia	$536,743	$38,681,850	1.39%	0.00
Iberville	$150,313	$33,064,574	0.45%	0.00
Jackson	$184,328	$13,158,093	1.40%	0.00
Jefferson	$2,247,769	$250,714,207	0.90%	0.00
Jefferson Davis	$313,728	$15,685,392	2.00%	0.00
Lafayette	$2,134,132	$133,769,048	1.60%	0.00
Lafourche	$1,533,741	$49,465,608	3.10%	0.37
LaSalle	$84,249	$5,919,050	1.42%	0.00
Lincoln	$285,724	$28,960,630	0.99%	0.00
Livingston	$739,471	$41,571,334	1.78%	0.00
Madison	$30,746	$3,591,484	0.86%	0.00
Morehouse	$386,919	$11,724,805	3.30%	0.43
Natchitoches	$659,914	$19,608,554	3.37%	0.46
Orleans	$2,420,236	$175,910,825	1.38%	0.00
Ouachita	$787,144	$51,543,541	1.53%	0.00
Plaquemines	$206,206	$29,833,590	0.69%	0.00

Pointe Coupee	$209,427	$11,766,788	1.78%	0.00
Rapides	$1,254,990	$61,222,008	2.05%	0.02
Red River	$61,175	$4,275,738	1.43%	0.00
Richland	$224,877	$7,797,179	2.88%	0.29
Sabine	$159,381	$8,470,493	1.88%	0.00
St. Bernard	$347,404	$21,930,185	1.58%	0.00
St. Charles	$260,807	$91,821,507	0.28%	0.00
St. Helena	$72,353	$2,117,197	3.42%	0.47
St. James	$84,655	$25,802,874	0.33%	0.00
St. John the Baptist	$206,191	$28,840,726	0.71%	0.00
St. Landry	$672,058	$32,351,131	2.08%	0.03
St. Martin	$600,052	$17,956,990	3.34%	0.45
St. Mary	$681,145	$30,895,974	2.20%	0.07
St. Tammany	$1,846,208	$163,682,236	1.13%	0.00
Tangipahoa	$135,405	$37,547,168	0.36%	0.00
Tensas	$67,846	$1,996,714	3.40%	0.47
Terrebonne	$1,656,949	$57,070,583	2.90%	0.30
Union	$179,511	$6,461,152	2.78%	0.26
Vermilion	$2,338,372	$19,630,242	11.91%	1.00
Vernon	$562,268	$16,186,611	3.47%	0.49
Washington	$148,830	$8,226,859	1.81%	0.00
Webster	$372,037	$22,047,744	1.69%	0.00
West Baton Rouge	$177,385	$16,831,477	1.05%	0.00
West Carroll	$108,254	$3,434,218	3.15%	0.38
West Feliciana	$52,640	$11,646,635	0.45%	0.00
Winn	$450,845	$6,746,562	6.68%	1.00
City of Monroe	$326,807	$37,511,416	0.87%	0.00
City of Bogalusa	$217,880	$6,548,494	3.33%	0.44
Zachary Community	$58,733	$17,561,196	0.33%	0.00
City of Baker	$55,747	$4,692,142	1.19%	0.00
Central Community	$0	$8,424,713	0.00%	0.00

Table A1.26. Expenditures on Instruction fuzzy set scores for Louisiana parishes.

Louisiana Parish	Instruction Expenditure	Expenditures on Instruction Set Score
Acadia	70.83%	0.1660
Allen	73.77%	0.7540
Ascension	74.03%	0.8060
Assumption	70.02%	0.0040
Avoyelles	71.82%	0.3640
Beauregard	71.16%	0.2320
Bienville	71.28%	0.2560
Bossier	71.60%	0.3200
Caddo	71.78%	0.3560
Calcasieu	72.49%	0.4980
Caldwell	70.30%	0.0600
Cameron	68.91%	0.0000
Catahoula	69.25%	0.0000
Claiborne	74.88%	0.9760
Concordia	74.63%	0.9260
DeSoto	72.16%	0.4320
East Baton Rouge	67.87%	0.0000
East Carroll	66.70%	0.0000
East Feliciana	70.03%	0.0060
Evangeline	73.83%	0.7660
Franklin	71.39%	0.2780
Grant	70.02%	0.0040
Iberia	74.68%	0.9360
Iberville	66.67%	0.0000
Jackson	67.58%	0.0000
Jefferson	71.72%	0.3440
Jefferson Davis	73.27%	0.6540
Lafayette	72.47%	0.4940
Lafourche	75.47%	1.0000
LaSalle	71.89%	0.3780
Lincoln	76.21%	1.0000
Livingston	76.51%	1.0000
Madison	71.64%	0.3280
Morehouse	72.42%	0.4840
Natchitoches	71.26%	0.2520
Orleans	67.94%	0.0000
Ouachita	70.21%	0.0420
Plaquemines	60.22%	0.0000

Pointe Coupee	66.81%	0.0000
Rapides	77.50%	1.0000
Red River	70.59%	0.1180
Richland	70.53%	0.1060
Sabine	71.33%	0.2660
St. Bernard	73.21%	0.6420
St. Charles	71.95%	0.3900
St. Helena	62.51%	0.0000
St. James	76.32%	1.0000
St. John the Baptist	72.18%	0.4360
St. Landry	71.26%	0.2520
St. Martin	70.59%	0.1180
St. Mary	72.13%	0.4260
St. Tammany	73.80%	0.7600
Tangipahoa	75.69%	1.0000
Tensas	66.73%	0.0000
Terrebonne	74.99%	0.9980
Union	71.04%	0.2080
Vermilion	72.03%	0.4060
Vernon	71.29%	0.2580
Washington	72.70%	0.5400
Webster	76.32%	1.0000
West Baton Rouge	69.95%	0.0000
West Carroll	71.20%	0.2400
West Feliciana	70.15%	0.0300
Winn	67.58%	0.0000
City of Monroe	73.12%	0.6240
City of Bogalusa	74.71%	0.9420
Zachary Community	68.00%	0.0000
City of Baker	63.99%	0.0000

Table A1.27. Adequate School District Performance fuzzy set scores for Louisiana parishes.

Louisiana Parish	DPS	Adequate School District Performance Set Score
Acadia	87.00	0.20
Allen	97.80	1.00
Ascension	99.80	1.00
Assumption	82.40	0.00
Avoyelles	80.80	0.00
Beauregard	100.50	1.00
Bienville	81.70	0.00
Bossier	97.10	1.00
Caddo	82.30	0.00
Calcasieu	96.80	1.00
Caldwell	92.20	0.72
Cameron	87.40	0.24
Catahoula	94.50	0.95
Claiborne	79.40	0.00
Concordia	86.70	0.17
DeSoto	81.20	0.00
East Baton Rouge	74.10	0.00
East Carroll	72.00	0.00
East Feliciana	72.10	0.00
Evangeline	80.90	0.00
Franklin	71.50	0.00
Grant	92.00	0.70
Iberia	87.50	0.25
Iberville	72.10	0.00
Jackson	89.40	0.44
Jefferson	73.50	0.00
Jefferson Davis	102.90	1.00
Lafayette	91.50	0.65
Lafourche	87.80	0.28
LaSalle	97.80	1.00
Lincoln	91.90	0.69
Livingston	101.50	1.00
Madison	61.10	0.00
Morehouse	82.30	0.00
Natchitoches	76.60	0.00
Orleans	96.10	1.00

Ouachita	101.10	1.00
Plaquemines	98.30	1.00
Pointe Coupee	71.80	0.00
Rapides	92.80	0.78
Red River	77.50	0.00
Richland	79.00	0.00
Sabine	89.80	0.48
St. Bernard	87.60	0.26
St. Charles	102.10	1.00
St. Helena	57.40	0.00
St. James	91.90	0.69
St. John the Baptist	77.80	0.00
St. Landry	87.90	0.29
St. Martin	83.20	0.00
St. Mary	86.40	0.14
St. Tammany	105.70	1.00
Tangipahoa	82.10	0.00
Tensas	69.60	0.00
Terrebonne	84.40	0.00
Union	72.90	0.00
Vermilion	98.90	1.00
Vernon	103.40	1.00
Washington	83.20	0.00
Webster	84.10	0.00
West Baton Rouge	87.50	0.25
West Carroll	91.10	0.61
West Feliciana	105.90	1.00
Winn	91.80	0.68
City of Monroe School District	80.30	0.00
City of Bogalusa School District	66.80	0.00
Zachary Community School District	112.60	1.00
City of Baker School District	65.90	0.00

Table A1.28. Districts with Few Low-Performing Schools fuzzy set scores for Louisiana parishes.

Louisiana Parish	# Schools with One Star or Fewer	Total # of Schools	Percent One Star	Districts with Few Low-Performing Schools Set Score
Acadia	7	26	26.92%	0.92
Allen	0	11	0.00%	1.00
Ascension	5	21	23.81%	1.00
Assumption	3	9	33.33%	0.67
Avoyelles	10	13	76.92%	0.00
Beauregard	0	12	0.00%	1.00
Bienville	4	8	50.00%	0.00
Bossier	8	29	27.59%	0.90
Caddo	39	67	58.21%	0.00
Calcasieu	12	56	21.43%	1.00
Caldwell	0	6	0.00%	1.00
Cameron	1	4	25.00%	1.00
Catahoula	0	9	0.00%	1.00
Claiborne	6	8	75.00%	0.00
Concordia	4	10	40.00%	0.40
DeSoto	5	12	41.67%	0.33
East Baton Rouge	55	78	70.51%	0.00
East Carroll	4	5	80.00%	0.00
East Feliciana	6	7	85.71%	0.00
Evangeline	4	11	36.36%	0.55
Franklin	4	6	66.67%	0.00
Grant	1	8	12.50%	1.00
Iberia	9	26	34.62%	0.62
Iberville	7	8	87.50%	1.00
Jackson	2	5	40.00%	0.40
Jefferson	.	.	.	.
Jefferson Davis	0	13	0.00%	1.00
Lafayette	7	38	18.42%	1.00
Lafourche	7	28	25.00%	1.00
LaSalle	0	9	0.00%	1.00
Lincoln	2	12	16.67%	1.00
Livingston	1	39	2.56%	1.00
Madison	4	4	100.00%	0.00
Morehouse	7	12	58.33%	0.00
Natchitoches	.	.	.	.
Orleans	6	17	35.29%	0.59
Ouachita	2	34	5.88%	1.00
Plaquemines	2	7	28.57%	0.86
Pointe Coupee	3	6	50.00%	0.00
Rapides	13	48	27.08%	0.92
Red River	2	3	66.67%	0.00
Richland	6	11	54.55%	0.00
Sabine	3	10	30.00%	0.80
St. Bernard	0	2	0.00%	1.00
St. Charles	2	17	11.76%	1.00
St. Helena	3	3	100.00%	0.00

St. James	3	10	30.00%	0.80
St. John the Baptist	6	9	66.67%	0.00
St. Landry	12	37	32.43%	0.70
St. Martin	7	16	43.75%	0.25
St. Mary	7	26	26.92%	0.92
St. Tammany	2	49	4.08%	1.00
Tangipahoa	17	33	51.52%	0.00
Tensas	3	3	100.00%	0.00
Terrebonne	13	36	36.11%	0.56
Union	6	7	85.71%	0.00
Vermilion	2	18	11.11%	1.00
Vernon	0	18	0.00%	1.00
Washington	4	12	33.33%	0.67
Webster	8	17	47.06%	0.12
West Baton Rouge	5	10	50.00%	0.00
West Carroll	1	6	16.67%	1.00
West Feliciana	0	5	0.00%	1.00
Winn	0	8	0.00%	1.00
City of Monroe	8	18	44.44%	0.22
City of Bogalusa	4	6	66.67%	0.00
Zachary Community	0	5	0.00%	1.00
City of Baker	5	5	100.00%	0.00
Central Community	.	.	.	.

Table A1.29. District Performance fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of Schools with 3, 4, or 5 Stars	District Performance Set Score
Acadia	42.30	0.74
Allen	54.50	1.00
Ascension	52.20	1.00
Assumption	11.10	0.00
Avoyelles	0.00	0.00
Beauregard	81.80	1.00
Bienville	25.00	0.17
Bossier	45.20	0.84
Caddo	23.80	0.13
Calcasieu	35.70	0.52
Caldwell	0.00	0.00
Cameron	0.00	0.00
Catahoula	44.40	0.81
Claiborne	0.00	0.00
Concordia	10.00	0.00
DeSoto	0.00	0.00
East Baton Rouge	14.00	0.00
East Carroll	0.00	0.00
East Feliciana	14.30	0.00
Evangeline	27.30	0.24
Franklin	0.00	0.00
Grant	12.50	0.00
Iberia	19.20	0.00
Iberville	0.00	0.00
Jackson	20.00	0.00
Jefferson	13.90	0.00
Jefferson Davis	69.20	1.00
Lafayette	36.90	0.56
Lafourche	17.90	0.00
LaSalle	44.40	0.81
Lincoln	16.70	0.00
Livingston	61.50	1.00
Madison	0.00	0.00
Morehouse	8.30	0.00
Natchitoches	28.50	0.28
Orleans	41.20	0.71
Ouachita	57.10	1.00

Plaquemines	42.90	0.76
Pointe Coupee	0.00	0.00
Rapides	30.60	0.35
Red River	0.00	0.00
Richland	9.10	0.00
Sabine	20.00	0.00
St. Bernard	28.60	0.29
St. Charles	58.80	1.00
St. Helena	0.00	0.00
St. James	30.00	0.33
St. John the Baptist	11.10	0.00
St. Landry	22.90	0.10
St. Martin	18.80	0.00
St. Mary	22.70	0.09
St. Tammany	56.00	1.00
Tangipahoa	9.10	0.00
Tensas	0.00	0.00
Terrebonne	22.20	0.07
Union	0.00	0.00
Vermilion	55.60	1.00
Vernon	72.20	1.00
Washington	8.30	0.00
Webster	0.00	0.00
West Baton Rouge	10.00	0.00
West Carroll	33.30	0.44
West Feliciana	80.00	1.00
Winn	12.50	0.00
Monroe City	27.80	0.26
Bogalusa City	0.00	0.00
Zachary Community	100.00	1.00
City of Baker	0.00	0.00
Central Community	60.00	1.00

Table A1.30. First-time Freshmen fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of High School Graduates That Go to College	First-time Freshmen Set Score
Acadia	39.1	0.27
Allen	48.9	0.93
Ascension	50.0	1.00
Assumption	51.8	1.00
Avoyelles	46.5	0.77
Beauregard	48.8	0.92
Bienville	49.3	0.95
Bossier	53.6	1.00
Caddo	51.2	1.00
Calcasieu	50.5	1.00
Caldwell	42.2	0.48
Cameron	44.9	0.66
Catahoula	47.4	0.83
Claiborne	37.5	0.17
Concordia	35.7	0.05
DeSoto	44.6	0.64
East Baton Rouge	45.0	0.67
East Carroll	29.3	0.00
East Feliciana	33.6	0.00
Evangeline	41.1	0.41
Franklin	36.9	0.13
Grant	39.2	0.28
Iberia	39.4	0.29
Iberville	49.4	0.96
Jackson	53.3	1.00
Jefferson	41.0	0.40
Jefferson Davis	54.0	1.00
Lafayette	49.4	0.96
Lafourche	41.0	0.40
LaSalle	42.9	0.53
Lincoln	52.8	1.00
Livingston	49.5	0.97
Madison	44.4	0.63
Morehouse	59.6	1.00
Natchitoches	50.2	1.00
Orleans	44.5	0.63
Ouachita	54.5	1.00

Plaquemines	47.3	0.82
Pointe Coupee	33.0	0.00
Rapides	47.6	0.84
Red River	36.7	0.11
Richland	36.9	0.13
Sabine	34.8	0.00
St. Bernard	46.8	0.79
St. Charles	56.4	1.00
St. Helena	31.3	0.00
St. James	44.1	0.61
St. John the Baptist	32.8	0.00
St. Landry	42.2	0.48
St. Martin	35.3	0.02
St. Mary	42.8	0.52
St. Tammany	57.8	1.00
Tangipahoa	42.5	0.50
Tensas	28.6	0.00
Terrebonne	41.5	0.43
Union	38.8	0.25
Vermilion	40.3	0.35
Vernon	38.5	0.23
Washington	30.9	0.00
Webster	43.4	0.56
West Baton Rouge	48.0	0.87
West Carroll	41.0	0.40
West Feliciana	52.6	1.00
Winn	48.3	0.89
Monroe City	53.2	1.00
Bogalusa City	35.2	0.01
Zachary Community	58.3	1.00
City of Baker	56.1	1.00
Central Community	61.0	1.00

Table A1.31. At-risk Students fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of Students Receiving Free or Reduced Lunch	At-risk Students Set Score
Acadia	62.8	0.85
Allen	61.3	0.75
Ascension	43.7	0.00
Assumption	65.9	1.00
Avoyelles	83.6	1.00
Beauregard	51.2	0.08
Bienville	72.5	1.00
Bossier	42.9	0.00
Caddo	63.1	0.87
Calcasieu	58.1	0.54
Caldwell	64.8	0.99
Cameron	60.9	0.73
Catahoula	72.1	1.00
Claiborne	72.4	1.00
Concordia	73.4	1.00
DeSoto	66.0	1.00
East Baton Rouge	82.5	1.00
East Carroll	91.5	1.00
East Feliciana	85.1	1.00
Evangeline	76.5	1.00
Franklin	81.3	1.00
Grant	62.5	0.83
Iberia	65.8	1.00
Iberville	83.7	1.00
Jackson	58.3	0.55
Jefferson	74.8	1.00
Jefferson Davis	53.3	0.22
Lafayette	60.3	0.69
Lafourche	61.0	0.73
LaSalle	48.9	0.00
Lincoln	60.3	0.69
Livingston	50.8	0.05
Madison	90.6	1.00
Morehouse	76.9	1.00
Natchitoches	69.7	1.00
Orleans	68.6	1.00
Ouachita	51.0	0.07

Plaquemines	67.3	1.00
Pointe Coupee	76.6	1.00
Rapides	66.3	1.00
Red River	85.3	1.00
Richland	76.2	1.00
Sabine	67.0	1.00
St. Bernard	68.7	1.00
St. Charles	47.8	0.00
St. Helena	91.5	1.00
St. James	71.6	1.00
St. John the Baptist	85.5	1.00
St. Landry	74.4	1.00
St. Martin	67.1	1.00
St. Mary	72.1	1.00
St. Tammany	43.4	0.00
Tangipahoa	73.8	1.00
Tensas	93.6	1.00
Terrebonne	59.8	0.65
Union	74.7	1.00
Vermilion	60.6	0.71
Vernon	57.3	0.49
Washington	84.5	1.00
Webster	62.3	0.82
West Baton Rouge	65.6	1.00
West Carroll	75.5	1.00
West Feliciana	46.3	0.00
Winn	68.2	1.00
Monroe City	80.0	1.00
Bogalusa City	93.4	1.00
Zachary Community	41.8	0.00
City of Baker	84.6	1.00
Central Community	42.7	0.00

Table A1.32. High Percent of African American Students fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of Students Who Are African American	African American Students Set Score
Acadia	28.8	0.00
Allen	24.1	0.00
Ascension	30.6	0.02
Assumption	43.2	0.33
Avoyelles	45.7	0.39
Beauregard	16.5	0.00
Bienville	58.0	0.70
Bossier	29.9	0.00
Caddo	64.5	0.86
Calcasieu	35.9	0.15
Caldwell	18.3	0.00
Cameron	2.6	0.00
Catahoula	41.6	0.29
Claiborne	67.9	0.95
Concordia	51.5	0.54
DeSoto	50.7	0.52
East Baton Rouge	83.0	1.00
East Carroll	95.8	1.00
East Feliciana	75.1	1.00
Evangeline	40.8	0.27
Franklin	51.6	0.54
Grant	12.9	0.00
Iberia	44.5	0.36
Iberville	74.9	1.00
Jackson	37.0	0.18
Jefferson	49.5	0.49
Jefferson Davis	23.3	0.00
Lafayette	43.2	0.33
Lafourche	22.3	0.00
LaSalle	10.6	0.00
Lincoln	48.5	0.46
Livingston	6.3	0.00
Madison	92.4	1.00
Morehouse	64.5	0.86
Natchitoches	57.8	0.70
Orleans	76.5	1.00
Ouachita	31.8	0.05

Plaquemines	32.3	0.06
Pointe Coupee	58.8	0.72
Rapides	43.0	0.33
Red River	65.1	0.88
Richland	52.0	0.55
Sabine	24.3	0.00
St. Bernard	21.9	0.00
St. Charles	36.1	0.15
St. Helena	94.4	1.00
St. James	67.1	0.93
St. John the Baptist	79.3	1.00
St. Landry	57.0	0.68
St. Martin	47.1	0.43
St. Mary	45.5	0.39
St. Tammany	19.1	0.00
Tangipahoa	47.2	0.43
Tensas	91.4	1.00
Terrebonne	28.8	0.00
Union	42.8	0.32
Vermilion	22.5	0.00
Vernon	20.2	0.00
Washington	34.1	0.10
Webster	43.6	0.34
West Baton Rouge	53.0	0.58
West Carroll	18.3	0.00
West Feliciana	42.5	0.31
Winn	35.0	0.13
Monroe City	87.2	1.00
Bogalusa City	67.7	0.94
Zachary Community	42.2	0.31
City of Baker	92.7	1.00
Central Community	17.5	0.00

Table A1.33. High Student Dropouts fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of Students in Grades 8–12 Who Dropped Out	High Student Dropouts Set Score
Acadia	5.2	0.04
Allen	4.4	0.00
Ascension	4.1	0.00
Assumption	8.3	0.66
Avoyelles	7.8	0.56
Beauregard	0.8	0.00
Bienville	3.9	0.00
Bossier	4.1	0.00
Caddo	9.5	0.90
Calcasieu	4.0	0.00
Caldwell	1.9	0.00
Cameron	1.2	0.00
Catahoula	4.5	0.00
Claiborne	5.5	0.10
Concordia	6.1	0.22
DeSoto	7.7	0.54
East Baton Rouge	10.2	1.00
East Carroll	4.7	0.00
East Feliciana	6.0	0.20
Evangeline	6.6	0.32
Franklin	7.2	0.44
Grant	4.9	0.00
Iberia	7.2	0.44
Iberville	8.4	0.68
Jackson	5.8	0.16
Jefferson	8.7	0.74
Jefferson Davis	0.5	0.00
Lafayette	6.2	0.24
Lafourche	5.1	0.02
LaSalle	3.8	0.00
Lincoln	5.2	0.04
Livingston	3.6	0.00
Madison	10.3	1.00
Morehouse	13.4	1.00
Natchitoches	8.5	0.70
Orleans	3.9	0.00
Ouachita	6.8	0.36

Plaquemines	3.6	0.00
Pointe Coupee	8.6	0.72
Rapides	7.0	0.40
Red River	13.3	1.00
Richland	7.0	0.40
Sabine	3.0	0.00
St. Bernard	5.9	0.18
St. Charles	3.7	0.00
St. Helena	5.9	0.18
St. James	4.4	0.00
St. John the Baptist	9.3	0.86
St. Landry	7.0	0.40
St. Martin	6.3	0.26
St. Mary	5.8	0.16
St. Tammany	4.1	0.00
Tangipahoa	7.4	0.48
Tensas	4.6	0.00
Terrebonne	5.7	0.14
Union	9.6	0.92
Vermilion	4.2	0.00
Vernon	3.1	0.00
Washington	3.4	0.00
Webster	4.7	0.00
West Baton Rouge	4.4	0.00
West Carroll	5.5	0.10
West Feliciana	4.3	0.00
Winn	3.3	0.00
Monroe City	7.9	0.58
Bogalusa City	7.8	0.56
Zachary Community	1.5	0.00
City of Baker	10.6	1.00
Central Community	1.2	0.00

Table A1.34. Disciplinary Action fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of Students in Grades 9-12 Receiving Out of School Suspension	Disciplinary Action Set Score
Acadia	14.9	1.00
Allen	11.8	1.00
Ascension	6.7	0.59
Assumption	16.5	1.00
Avoyelles	21.9	1.00
Beauregard	7.5	0.69
Bienville	12.6	1.00
Bossier	7.4	0.68
Caddo	14.1	1.00
Calcasieu	12.7	1.00
Caldwell	0.6	0.00
Cameron	1.0	0.00
Catahoula	11.3	1.00
Claiborne	14.7	1.00
Concordia	16.1	1.00
DeSoto	13.9	1.00
East Baton Rouge	0.7	0.00
East Carroll	20.9	1.00
East Feliciana	13.3	1.00
Evangeline	17.1	1.00
Franklin	16.7	1.00
Grant	4.2	0.28
Iberia	6.8	0.60
Iberville	15.8	1.00
Jackson	1.2	0.00
Jefferson	14.6	1.00
Jefferson Davis	9.1	0.89
Lafayette	14.3	1.00
Lafourche	9.9	0.99
LaSalle	0.8	0.00
Lincoln	14.7	1.00
Livingston	12.0	1.00
Madison	20.9	1.00
Morehouse	15.8	1.00
Natchitoches	15.3	1.00
Orleans	11.2	1.00
Ouachita	9.6	0.95

Plaquemines	9.3	0.91
Pointe Coupee	9.7	0.96
Rapides	10.2	1.00
Red River	5.4	0.43
Richland	14.1	1.00
Sabine	6.5	0.56
St. Bernard	9.4	0.93
St. Charles	3.6	0.20
St. Helena	8.7	0.84
St. James	15.8	1.00
St. John the Baptist	12.6	1.00
St. Landry	11.0	1.00
St. Martin	13.7	1.00
St. Mary	2.0	0.00
St. Tammany	7.7	0.71
Tangipahoa	16.8	1.00
Tensas	3.8	0.23
Terrebonne	17.6	1.00
Union	19.2	1.00
Vermilion	9.8	0.98
Vernon	9.7	0.96
Washington	1.2	0.00
Webster	9.6	0.95
West Baton Rouge	1.9	0.00
West Carroll	6.4	0.55
West Feliciana	7.1	0.64
Winn	2.0	0.00
Monroe City	12.9	1.00
Bogalusa City	1.3	0.00
Zachary Community	1.4	0.00
City of Baker	8.2	0.78
Central Community	2.1	0.01

Table A1.35. Students Retained fuzzy set scores for Louisiana parishes.

Louisiana Parish	Percent of Students Retained or Held Back	Students Retained Set Score
Acadia	8.3	0.88
Allen	4.5	0.25
Ascension	5.5	0.42
Assumption	8.5	0.92
Avoyelles	7.9	0.82
Beauregard	4.4	0.23
Bienville	5.9	0.48
Bossier	4.5	0.25
Caddo	9.0	1.00
Calcasieu	5.2	0.37
Caldwell	4.2	0.20
Cameron	4.8	0.30
Catahoula	10.5	1.00
Claiborne	3.9	0.15
Concordia	8.7	0.95
DeSoto	5.9	0.48
East Baton Rouge	10.6	1.00
East Carroll	8.6	0.93
East Feliciana	6.8	0.63
Evangeline	7.1	0.68
Franklin	9.4	1.00
Grant	6.7	0.62
Iberia	10.4	1.00
Iberville	13.5	1.00
Jackson	5.4	0.40
Jefferson	11.0	1.00
Jefferson Davis	5.8	0.47
Lafayette	8.0	0.83
Lafourche	6.3	0.55
LaSalle	4.2	0.20
Lincoln	6.7	0.62
Livingston	5.4	0.40
Madison	7.3	0.72
Morehouse	8.8	0.97
Natchitoches	8.8	0.97
Orleans	2.6	0.00
Ouachita	6.7	0.62

Plaquemines	6.6	0.60
Pointe Coupee	9.8	1.00
Rapides	5.8	0.47
Red River	11.7	1.00
Richland	7.2	0.70
Sabine	5.6	0.43
St. Bernard	6.1	0.52
St. Charles	4.3	0.22
St. Helena	6.7	0.62
St. James	5.5	0.42
St. John the Baptist	11.6	1.00
St. Landry	11.6	1.00
St. Martin	7.2	0.70
St. Mary	6.8	0.63
St. Tammany	5.7	0.45
Tangipahoa	6.6	0.60
Tensas	10.4	1.00
Terrebonne	6.4	0.57
Union	10.3	1.00
Vermilion	6.7	0.62
Vernon	5.2	0.37
Washington	5.5	0.42
Webster	5.8	0.47
West Baton Rouge	6.3	0.55
West Carroll	8.0	0.83
West Feliciana	3.4	0.07
Winn	4.6	0.27
Monroe City	9.6	1.00
Bogalusa City	14.5	1.00
Zachary Community	2.5	0.00
City of Baker	8.8	0.97
Central Community	5.9	0.48

Table A1.36. Large School District fuzzy set scores for Louisiana parishes.

Louisiana Parish	Number of Schools	Large School District Set Score
Acadia	26	0.00
Allen	11	0.00
Ascension	21	0.00
Assumption	9	0.00
Avoyelles	13	0.00
Beauregard	12	0.00
Bienville	8	0.00
Bossier	29	0.00
Caddo	67	1.00
Calcasieu	56	1.00
Caldwell	6	0.00
Cameron	4	0.00
Catahoula	9	0.00
Claiborne	8	0.00
Concordia	10	0.00
DeSoto	12	0.00
East Baton Rouge	80	1.00
East Carroll	5	0.00
East Feliciana	7	0.00
Evangeline	11	0.00
Franklin	6	0.00
Grant	8	0.00
Iberia	30	0.00
Iberville	8	0.00
Jackson	5	0.00
Jefferson	77	1.00
Jefferson Davis	13	0.00
Lafayette	38	0.40
Lafourche	28	0.00
LaSalle	9	0.00
Lincoln	12	0.00
Livingston	39	0.45
Madison	4	0.00
Morehouse	12	0.00
Natchitoches	14	0.00
Orleans	17	0.00
Ouachita	34	0.20
Plaquemines	7	0.00
Pointe Coupee	6	0.00
Rapides	48	0.90
Red River	3	0.00
Richland	11	0.00
Sabine	10	0.00
St. Bernard	2	0.00
St. Charles	18	0.00
St. Helena	3	0.00
St. James	10	0.00
St. John the Baptist	9	0.00
St. Landry	37	0.35

St. Martin	16	0.00
St. Mary	26	0.00
St. Tammany	49	0.95
Tangipahoa	33	0.15
Tensas	3	0.00
Terrebonne	36	0.30
Union	7	0.00
Vermilion	18	0.00
Vernon	18	0.00
Washington	12	0.00
Webster	18	0.00
West Baton Rouge	10	0.00
West Carroll	6	0.00
West Feliciana	5	0.00
Winn	8	0.00
City of Monroe	18	0.00
City of Bogalusa	6	0.00
Zachary Community	5	0.00
City of Baker	5	0.00

Table A1.37. Small School District fuzzy set scores for Louisiana parishes.

Louisiana Parish	Number of Schools	Small School District Set Score
Acadia	26	0.00
Allen	11	1.00
Ascension	21	0.40
Assumption	9	1.00
Avoyelles	13	1.00
Beauregard	12	1.00
Bienville	8	1.00
Bossier	29	0.00
Caddo	67	0.00
Calcasieu	56	0.00
Caldwell	6	1.00
Cameron	4	1.00
Catahoula	9	1.00
Claiborne	8	1.00
Concordia	10	1.00
DeSoto	12	1.00
East Baton Rouge	80	0.00
East Carroll	5	1.00
East Feliciana	7	1.00
Evangeline	11	1.00
Franklin	6	1.00
Grant	8	1.00
Iberia	30	0.00
Iberville	8	1.00
Jackson	5	1.00
Jefferson	77	0.00
Jefferson Davis	13	1.00
Lafayette	38	0.00
Lafourche	28	0.00
LaSalle	9	1.00
Lincoln	12	1.00
Livingston	39	0.00
Madison	4	1.00
Morehouse	12	1.00
Natchitoches	14	1.00
Orleans	17	0.80
Ouachita	34	0.00
Plaquemines	7	1.00
Pointe Coupee	6	1.00
Rapides	48	0.00
Red River	3	1.00
Richland	11	1.00
Sabine	10	1.00
St. Bernard	2	1.00
St. Charles	18	0.70
St. Helena	3	1.00
St. James	10	1.00
St. John the Baptist	9	1.00
St. Landry	37	0.00

St. Martin	16	0.90
St. Mary	26	0.00
St. Tammany	49	0.00
Tangipahoa	33	0.00
Tensas	3	1.00
Terrebonne	36	0.00
Union	7	1.00
Vermilion	18	0.70
Vernon	18	0.70
Washington	12	1.00
Webster	18	0.70
West Baton Rouge	10	1.00
West Carroll	6	1.00
West Feliciana	5	1.00
Winn	8	1.00
City of Monroe	18	0.70
City of Bogalusa	6	1.00
Zachary Community	5	1.00
City of Baker	5	1.00

Table A1.38. Non-Public School Enrollment fuzzy set scores for Louisiana parishes.

Louisiana Parish	Non-Public School Enrollment	Non-Public School Enrollment Set Score
Acadia	2111	1.00
Allen	0	0.00
Ascension	1781	0.89
Assumption	221	0.11
Avoyelles	1008	0.50
Beauregard	63	0.03
Bienville	0	0.00
Bossier	140	0.07
Caddo	4379	1.00
Calcasieu	3177	1.00
Caldwell	113	0.06
Cameron	0	0.00
Catahoula	0	0.00
Claiborne	333	0.17
Concordia	0	0.00
DeSoto	145	0.07
East Baton Rouge	17208	1.00
East Carroll	176	0.09
East Feliciana	424	0.21
Evangeline	785	0.39
Franklin	564	0.28
Grant	0	0.00
Iberia	2136	1.00
Iberville	814	0.41
Jackson	0	0.00
Jefferson	19622	1.00
Jefferson Davis	465	0.23
Lafayette	7975	1.00
Lafourche	2611	1.00
LaSalle	0	0.00
Lincoln	842	0.42
Livingston	243	0.12
Madison	287	0.14
Morehouse	304	0.15
Natchitoches	406	0.20
Orleans	18483	1.00
Ouachita	1494	0.75

Plaquemines	251	0.13
Pointe Coupee	1258	0.63
Rapides	2623	1.00
Red River	316	0.16
Richland	256	0.13
Sabine	0	0.00
St. Bernard	520	0.26
St. Charles	611	0.31
St. Helena	0	0.00
St. James	241	0.12
St. John the Baptist	2373	1.00
St. Landry	2818	1.00
St. Martin	1276	0.64
St. Mary	1024	0.51
St. Tammany	7325	1.00
Tangipahoa	2624	1.00
Tensas	194	0.10
Terrebonne	3138	1.00
Union	304	0.15
Vermilion	841	0.42
Vernon	131	0.07
Washington	376	0.19
Webster	574	0.29
West Baton Rouge	412	0.21
West Carroll	0	0.00
West Feliciana	0	0.00
Winn	0	0.00
Monroe City	1025	0.51
Bogalusa City	578	0.29
Zachary Community	43	0.02
City of Baker	232	0.12
Central Community	693	0.35

Table A1.39. Data sources for fuzzy set analysis.

	Source - Citation	Link
Louisiana Parish Population Statistics		
Large Population	U.S. Census Bureau - USA Counties	http://censtats.census.gov/usa/usa.shtml
Small Population	U.S. Census Bureau - USA Counties	http://censtats.census.gov/usa/usa.shtml
Emerging or Growing Parish	U.S. Census Bureau - American Fact Finder	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml
Declining or Stagnating Parish	U.S. Census Bureau - American Fact Finder	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml
Parish Demographic Information		
Parish Diversity	Geo-Data Center For Geospatial Analysis and computation - ASU.edu	http://geodacenter.asu.edu/%5Btermalias-raw%5D/diversity-and-s-0
Parish Crime Level	U.S. Census Bureau - USA Counties	http://censtats.census.gov/usa/usa.shtml
Old or Aging Parish	U.S. Census Bureau - USA Counties	http://censtats.census.gov/usa/usa.shtml
Young Parish	U.S. Census Bureau - USA Counties	http://censtats.census.gov/usa/usa.shtml
Parish Education and Income		
Wealthy Parish	U.S. Census Bureau - USA Counties	http://censtats.census.gov/usa/usa.shtml
Poor Parish	U.S. Census Bureau - USA Counties	http://censtats.census.gov/usa/usa.shtml
Educated Parish	U.S. Census Bureau - USA Counties	http://censtats.census.gov/usa/usa.shtml
Parish Location and Geographic Factors		
Urban or Rural Parish	U.S. Department of Agriculture - Economic Research Service	http://www.ers.usda.gov/Data/UrbanInfluenceCodes/
Parish with Noteworthy Natural Amenities	U.S. Department of Agriculture - Economic Research Service	http://www.ers.usda.gov/Data/NaturalAmenities/
Parish with Interstate Highway	Google Earth - Map	http://www.google.com/earth/index.html
Coastal Parish	Google Earth - Map	http://www.google.com/earth/index.html
Parish with Major Ports	American Association of Port Authorities - Seaports of the Americas Directory	http://www.seaportsoftheamericas.com/
Labor Market Resources		
Substantial Mining Employment	Regional Economic Information System - Bureau of Economic Analysis	http://ciesin.org/datasets/reis/reis-home.html
Small Business Intensive	Regional Economic Information System - Bureau of Economic	http://ciesin.org/datasets/reis/reis-home.html

	Analysis	
Large Business Presence	Regional Economic Information System - Bureau of Economic Analysis	http://ciesin.org/datasets/reis/reis-home.html
Labor Market Outcomes		
Low Unemployment	Regional Economic Information System - Bureau of Economic Analysis	http://ciesin.org/datasets/reis/reis-home.html
Job Growth	Regional Economic Information System - Bureau of Economic Analysis	http://ciesin.org/datasets/reis/reis-home.html
Competitive Per Capita Personal Income	Regional Economic Information System - Bureau of Economic Analysis	http://ciesin.org/datasets/reis/reis-home.html
Education Resources		
Competitive Teacher Salary	Southern Regional Educational Board	http://www.sreb.org/
Substantial Local Capacity	Louisiana Department of Education - Minimum Foundation Program	http://www.doe.state.la.us/divisions/edfn/mfp_admin.html
Oil and Gas Industry Influence	Louisiana Department of Education - Minimum Foundation Program	http://www.doe.state.la.us/divisions/edfn/mfp_admin.html
Focus on Instruction	Louisiana Department of Education - Minimum Foundation Program	http://www.doe.state.la.us/divisions/edfn/mfp_admin.html
Education Outcomes		
Adequate School Performance	Louisiana Department of Education - District Performance Scores	http://doe.louisiana.gov/data/district_accountability_reports.aspx
Few Low-Performing Schools	Louisiana Department of Education - District Performance Scores	http://doe.louisiana.gov/data/district_accountability_reports.aspx
District Improvement	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
First-Time Freshman	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Student Characteristics	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Percentage of At-Risk Students	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Percentage of African American Students	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html

District Processes	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Drop-Out Rate	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Number of Disciplinary Cases	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Student Retention (Grade Repeat)	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Small District	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Large District	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html
Non-public School Enrollment	LA Department of Education - State Progress Reports	http://doe.louisiana.gov/offices/infomanagement/state_progress_reports.html

APPENDIX B. LESSONS LEARNED FROM MEETINGS WITH LOCAL OFFICIALS

A.B.1. CONTEXT

As part of the cooperative agreement, we traveled to parishes identified as being impacted by OCS activity to discuss how the oil and gas industry, broadly defined, and the 2005 hurricanes have affected local capacity to provide necessary services. More specifically, within each parish we attempted to meet with:

1. The Superintendent or Chief Financial Officer of the parish school district (note, that in most cases the parish is coterminous with the school district, with the only two exceptions being East Baton Rouge and Washington Parishes)
2. The Parish President or Chief Financial officer of the Police Jury or local administrative unit

We used guided conversations with local officials, in that we began by explaining who we were and what our purposes were in meeting with them, including our desire to provide context for some of the quantitative analysis of financial statements and to learn more about the contexts surrounding financial and policy changes resulting from the 2005 hurricanes. Instead of asking specific questions, we allowed the conversations to evolve naturally, and attempted to cover a range of topics of interest. Here, we will summarize some of the lessons learned from these conversations. We do not intend for this summary to comprehensively report all the information we gleaned from our visits with local officials.

The summaries will be presented in two sections, the first reporting on our key lessons learned from meeting with education officials and the second reporting our key lessons learned from meetings with local government officials.

A.B.2. KEY LESSONS LEARNED FROM VISITS WITH EDUCATION OFFICIALS

One key topic of conversation revolved around the impact of the 2005 hurricanes. Of the 35 school districts in southern Louisiana, 4 were heavily damaged. Hurricane Katrina devastated Orleans Parish School District, Plaquemines Parish School District, and St. Bernard Parish School District and Hurricane Rita devastated Cameron Parish School District. We did not get an opportunity to meet with education officials from these four parishes. However, we do know that the number of schools in operation declined substantially [include figures Here]. The remaining districts faced less drastic, but still significant challenges after the 2005 hurricanes. First, all districts accepted displaced students into their schools in the months following the hurricanes, although the numbers of students and their lengths of stays in the host schools varied widely. Second, school districts bordering the 4 most heavily damaged districts were additionally affected in at least four significant ways: (1) they tended to get many more displaced students; (2) more displaced students in these districts stayed for a longer term or permanently; (3) many existing students within these districts were displaced to other districts; and (4) many existing students within these districts were displaced to other schools within the district. The last two trends were a result of the fact that, though not as devastating as in the worst cases, several of these border parishes districts suffered extensive damage to certain areas. Calcasieu, St. Tammany, Tangipahoa, Jefferson are examples of border parishes. Many local officials reported that the federal funding to assist with displaced students, along with increased economic activity related to recovery efforts, put many parishes on sound financial footing to deal with the ongoing challenges.

Another discussion topic involved the influence of the Oil & Gas Industry, broadly defined, on students, their families, and the school financing. The majority of the education officials we spoke with reported that the oil and gas industry was an important employer in their school district. A large number of parents of students in southern Louisiana work either directly for the Oil & Gas Industry, on the rigs in the Gulf of Mexico, or in support industries or headquarters. In addition, the onshore oil and gas industry was particularly important in a small selection of school districts such as Vermillion Parish, which generated revenues from "sixteenth section" holdings.

A third topic of discussion revolved school enrollment projects for the next several years. Most of the school districts in the western part of the state project stagnant or slightly declining enrollments, consistent with general population projects. A few districts project slight increases in enrollments, while several districts along the North Shore and between New Orleans and Baton Rouge project rapid population growth and school enrollment growth. Ascension and Tangipahoa are examples of districts projecting significant growth. The officials suggested that the trend could be seen even before 2005, but that the rate of increase accelerated after the hurricanes.

A fourth area discussed involved the challenges facing all school districts in Louisiana, and the nation, in meeting the education standards incorporated into the No Child Left Behind act. We found that education officials in Louisiana have mixed opinions about NCLB and its local implications. Many officials emphasized the importance of hiring highly qualified teachers, which can be more difficult for smaller, more rural, and more isolated parishes. All districts reported that teachers and other school personnel had pursued and earned National Board Certification, and credited the governor's office for providing financial incentives to all teachers in the state for pursuing the National Board Certification credential. Other positive reactions to the NCLB included comments that it refocused attention on insuring that all students receive a good education, that it encouraged administrators to find ways to support teachers, and it encouraged teachers to attend to the needs of all students, and that it encouraged a teachers to find ways to spend more time on task. At the same time, school officials in southern Louisiana also expressed several negative attitudes toward NCLB, including the opinion that it amounts to an unfunded mandate forcing schools to spend too much money on testing, instruction, and assessment—taking away from other important school objectives. Also, some officials expressed the view that NCLB was too narrowly focused on testing and fundamentals. Consistent with this view, several officials expressed a more holistic view of educational outcomes that included moral outcomes, civic outcomes, and a broader definition of successful students, schools, and districts.

A fifth topic covered in meeting with educational officials revolved around education financing, particularly the amount held in reserve in case of emergency, and insurance costs. Most districts held some cash reserves, so that they could continue to meet operating costs for a month, 2 months, 3 months, or longer in the case of a hurricane or similar disaster. At least two parishes tied the amount the held in reserve directly to the Standard and Poor's bond rating criteria, which emphasized the reserves. Having a good bond rating is particularly important in districts projecting significant enrollment increases (such as Ascension Parish) because the rating will influence the interest rates they will be required to pay on the loans they will need for additional construction of schools and buildings.

Sixth, we asked education officials about inequality within the parish/school district, and some noted that there was considerable intra-district inequality. In some cases, structural boundaries, such as the Mississippi River or marshlands, isolated certain towns and schools from the rest of the district exacerbating inequalities. In other cases, the school inequalities were tied directly to economic situations of families living in the communities served by the schools.

Seventh, in addition to learning about the education finance and student outcomes challenges facing parish/school districts in Louisiana, we used our visits with local education officials to vet some of the fuzzy set descriptions we had developed for the parish education profiles. We briefly explained the purpose of the fuzzy sets as grouping like parishes together in ways that are consistent with the actual practices within the system. Several education officials, for example, mentioned that tying the notion of offering a competitive teacher salary to the Southern Regional Education Board averages was consistent with actual practices.

A.B.3. Key Lessons Learned from Visits with Local Parish Government Officials

When planning to visit and discuss with local government officials in their official capacity, our original goal was to gather contextual information on their financial situations in the wake of the 2005 hurricanes. In the initial meetings in 2007, we learned about available FEMA databases that kept this information in a form that we could access and merge with the audited financial statements compiled by the undergraduate student member of our research team. Gaining knowledge of this database saved us a significant amount of time. After learning of the database, we altered our approaches to our discussions with local officials from a focused discussion on the financial aspects of recovery to a more general, and wide-ranging conversation about the challenges facing local governments in southern Louisiana.

Local governments in Louisiana's coastal parishes provide important services to their populations. Drainage, road and bridge repair and maintenance, and corrections were all mentioned as being major financial challenges for local governments. We observed a wide variety of approaches to providing these services, from more centralized to more decentralized tax and structural approaches.

Local officials are also responsible for planning for and providing needed services in the case of a hurricane, disaster, or other emergency. One key service in this respect is debris removal.

Although a few parishes maintain the equipment necessary to provide this service in-house, the majority tend to have contractual arrangements with firms in the private sector that kick into place once a disaster declaration is declared by the president or governor. Some officials expressed concern about whether the firms they contracted with would actually be able to honor the contracts, but most expressed confidence that their preparations would be adequate in all but the most extreme circumstances. For example, after the 2008 hurricanes, Gustav and Ike, one official learned that the firm they had contracted with for evacuation services could not provide the necessary number of emergency vehicles because they had also contracted with some neighboring parishes and were overextended.

Nearly all local government officials we spoke with expressed concern over the number of people currently being held in the parish prison system and the costs incurred by the local government to maintain the number of prisoners. One cost that several officials complained about involved the health care cost of detainees (apparently, health costs for prisoners are reimbursed from state and federal funds, but local governments bare these costs for detainees). Further, if the prison population exceeds the number of beds in the parish jail (as it does in many cases) then the costs per prisoner increase because the cost of sending prisoners to another parish jail is far higher than the cost of holding them in the parish.

Several officials in more rural and isolated parishes, such as Allen and Vernon, reported that it is sometimes difficult for them to retain good employees because parallel jobs in the private sector pay much more than they can afford.

With regards to disaster planning, most parish officials reported that they had developed comprehensive plans before the 2005 hurricanes, as they had learned over the years from previous hurricanes dating back to the 1960s. However, the 2005 and 2008 hurricanes led many local officials to revisit their disaster planning and preparations. For example, many parishes increased the amount of cash they had in reserves so that they could afford to pay salaries and insurance deductibles on local government properties in need of repair after major hurricanes.

Discussions regarding populations led us to observe a number of trends for the southern Louisiana region. First, parishes on the North Shore and along River Road between New Orleans and Baton Rouge are witnessing rapid population growth, while rural parishes in western-southern and central-southern regions of the state are declining. Rural parishes that are contiguous with the cities of Lake Charles, Lafayette, and Baton Rouge have witnessed an increase in inmigrants into “cottage communities” that commute to work in the city. The newly developed neighborhoods require services from the local parish government, but residents engage in most of their economic activities (work, shopping, dining out, etc.) in the larger urban city, thus contributing less in local sales taxes. Also, residents of these neighborhoods are less engaged in the parish planning and community activities. In connection with this movement, many southern Louisiana parishes are noticing a shift of the intra-parish population from older to emerging communities. In some cases, this shift was exacerbated by the 2005 and 2008 hurricanes, especially in border parishes like St. Tammany and Vermillion, and also in the North Shore and River Road parishes. But, most local officials claim that the trend was not entirely caused by hurricanes but by the loss of locally based employment opportunities and the corresponding increase in opportunities to commute to work.

APPENDIX C. OIL AND GAS DRILLING FORECASTING

A hybrid approach somewhat similar to that of Walls (1994) is used to generate forecast for oil and gas wells drilled in the deepwater Gulf of Mexico region. Formulas (AC.2), (AC.3), (AC.4), (AC.5), and (AC.6) used in this study follow formulas (14), (12), (13), (2), and (3) respectively stated in Walls (1994). All prices are adjusted for inflation using the Producer Price Index (PPI) with 2007 as the base year (PPI = 100 for 2007).

The total number of oil and gas wells drilled at period t (W_t) is as following:

$$\textbf{(AC.1)} \qquad W_t = \alpha_0 + \alpha_1 W_{t-1} + \alpha_2 V_{t-1} + \alpha_3 l_t + \alpha_4 D_t l_t + \varepsilon_t$$

where V_{t-1} is the expected discounted present value of profits per well at period $t-1$. The argument for using a lag of expected discounted present value of profits is that expected discounted present value of profits in previous year (period $t-1$) affects drilling decision at period t. W_t is the summation of exploratory wells at time t and development wells at time $t+1$. W_{t-1} is the lag value of W_t signifying that last period drilling activities might affect drilling activities at period t. Variable l_t is the weighted average number of leased tracts in the Gulf of Mexico for five consecutive periods (period $t-4$, $t-3$, $t-2$, $t-1$ and t). The weights (summing to one) for each year are as following: .5000 for period t, .2600 for period $t-1$, .1352 for period $t-2$, .0703 for period $t-3$, and .0345 for period $t-4$. Walls' study (1994) describes the weights as the impact of leasing on drilling activities that takes place over five-year period. The study mentions that half of the impact occurs in the first year. D_t is dummy variable that equals to zero prior to 1995 and equals to one otherwise. In 1995, the Deep Water Royalty Relief Act (DWRRA) was enacted to provide royalties relief to eligible leases for certain amounts of deepwater production. After its expiration in 2000, the DWRRA was then redefined and extended to promote deepwater exploration.[17] Variable $D_t l_t$ is incorporated into the model to capture any influence from the DWRRA on the deepwater drilling.

The expected present value profit per well (V_t) consists of four components: The after tax discounted present value of net operating profit for oil (in barrel) and gas (in thousand cubic feet/mcf), success ratio in finding oil or gas, expected size of new discoveries, and after tax drilling costs. The formula is given as following:

$$\textbf{(AC.2)} \qquad V_t = \pi_t^o S_t^o a_t^o + \pi_t^g (S_t^o a_t^{ag} + S_t^g a_t^{ng}) - [C_{dry} (1 - \tau_t) + C_{wet} (1 - \tau_t (exp + i (1 - exp))$$

where π_t^o and π_t^g represent discounted present value net operating profit per barrel of oil and gas, respectively. S_t^o and S_t^g represent the success ratio of finding oil or gas, respectively. C_{dry} represents exploratory and development drilling cost for dry hole per total well drilled, while C_{wet} is for the successful wells drilled. Variable i shows the delays between drilling and production while variable exp is the proportion of successful well drilling costs. Variable a_t^o represents

17 The U.S. Energy Information Administration website http://www.eia.doe.gov

additional oil discovered per successful well drilled, a_t^{ag} represents additional mcf associated-dissolved gas discovered per successful oil well drilled, and a_t^{ng} represents additional mcf non associated gas discovered per successful gas well drilled.

Associated-dissolved natural gas is natural gas that occurs in crude oil reservoirs either as free gas (associates) or as gas in solution with crude oil (dissolved gas). Non-associated natural gas is natural gas that is not in contact with significant quantities of crude oil in the reservoir.[18] Variables a_t^o, a_t^{ag}, and a_t^{ng} are defined as three-year moving averages. Additional oil discovered per successful well drilled (a_t^o) is obtained by dividing three year moving average of total discoveries with three year moving average of successful well drilled lagged one period. The same procedure is applied to compute for a_t^{ag} and a_t^{ng}.

The discounted present value net operating profit per barrel of oil (π_t^o) is obtained as following:

(AC.3) $$\pi_t^o = \beta^2\, b\, P_t^o / (1 - \beta e^{-b})$$

The discounted present value net operating profit per mcf of gas (π_t^g) is obtained as following:

(AC.4) $$\pi_t^g = \beta^2\, c\, P_t^g / (1 - \beta e^{-c})$$

where β is the discount factor ($\beta = 1/(1 + r)$; r = discount rate). Variable b is the average crude oil production decline rate obtained by dividing total production (barrel) with total reserves (barrel). Variable c is the average gas production decline rate obtained by dividing total production (mcf) with total reserves (mcf). The lag between drilling and production is also shown through the square of β. P_t^o is the net operating profit per barrel of oil. P^t_g is the net operating profit per mcf of gas.

The net operating profit per barrel of oil (P_t^o) is as following:

(AC.5) $$P_t^o = \Phi_t^o\,(1 - \tau_t\,(1 - \delta_t - \omega_t - \rho_t) - \omega_t - \rho_t) + \omega_t\, P_t^b - OC_t^o\,(1 - \tau_t)$$

where Φ_t^o is the wellhead oil price, τ_t is the corporate income tax rate, ρ_t is the royalty rate, δ_t is the depletion allowance rate, and ω_t is the windfall profits tax rate. P_t^b is the spot market price of oil (West Texas Intermediate). OC_t^o is the operating cost per barrel of oil.

The net operating profit per mcf of gas (P^t_g) is as following:

(AC.6) $$P_t^g = \Phi_t^g\,(1 - \tau_t\,(1 - \delta_t - \rho_t) - \rho_t) - OC_t^g\,(1 - \tau_t)$$

where Φ_t^g is the wellhead gas price, τ_t is the corporate income tax rate, ρ_t is the royalty rate, and δ_t is the depletion allowance rate. OC_t^g is the operating cost per mcf of gas.

18 Definitions taken from the U.S. Energy Information Administration website http://www.eia.doe.gov

An Autoregressive Distributed Lags (ADL) model is used to estimate model (1). Hill et al. (2008) describes that Autoregressive Distributed Lags model overcomes two problems found in finite distributed lag model. First is the problem of choosing how many lags to be put into the model and second is the auto correlated error problem. The inclusion of lagged values of the dependent variable eliminates this correlation. An ADL (1,1) is applied to model (1) where there are lag of both dependent and independent variables in the model. The coefficient estimates obtained shown on Table AC.1 are then used to generate forecast for the number of wells drilled.

Results from the hybrid oil and gas model are used to evaluate labor and fiscal effects of an economy. After obtaining the total numbers of wells to be drilled for future years, those numbers are fed in MAGPLAN to generate the total number of employment to fulfill that final demand. Following the block recursive nature of the COMPAS model, demand for the final product, oil and gas, generates an employment demand. In our case, final demand is the number of wells to be drilled. Given that employment drives the COMPAS model, employment generated to drill the provided number of wells would offer direct, indirect and induced impacts. This employment number is then plugged into the labor force module which ultimately fed into the fiscal module in the Louisiana Community Impact Model[19] for analyzing a specific parish (Lafayette—an example parish for this study) that are measurably impacted by deepwater oil and gas extraction.

The values for royalty rate (ρ_t), corporate income tax rate (τ_t), delays between drilling and production (i), proportion of successful well drilling costs (*exp*), windfall profit tax rate (ω_t), and the success rate for oil and gas (S_t^o and S_t^g) used in this study follow the values mentioned in the study by Walls (1994). The value for depletion rate (δ_t) used in this study refers to a publication by the Independent Petroleum Association of America (2009).

Operating costs (OC_t^o and OC_t^g) for 1984 – 1989 and 1994 – 2007 are obtained from DOE/EIA-0185 publications (*Costs and Indexes for Domestic Oil and Gas Field Equipment and Production Operations*). Operating costs (OC_t^o and OC_t^g) for 1990 – 1993 are obtained from DOE/EIA-TR-0568 publication (*Cost and Indices for Domestic Oil and Gas Field Equipment and Production Operations 1990 through 1993*). The amount of additional oil and gas discovered from new field discoveries, new reservoir discoveries in old fields, and extensions are obtained from DOE/EIA-0216 publications (*U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves Annual Report*).

The discount rate (r) is the federal funds rate obtained from Federal Reserve Statistical Release. The PPI index is obtained from the U.S. Department of Labor, Bureau of Labor Statistics. The wellhead prices for oil and gas (Φ_t^o and Φ_t^g), total oil and gas productions, total oil and gas reserves are obtained from the U.S. Energy Information Administration website. The number of tracts leased (l_t) is obtained from the U.S. Department of the Interior, Bureau of Ocean Energy Management. The number of exploratory and development wells (W_t) as well as the number for operating oil and gas wells is obtained from API Basic Petroleum Data Book (2009). The drilling costs (C_{wet} and C_{dry}) are obtained from the yearly Joint Association Survey

(JAS) publication published by API. The market spot prices of crude oil (P_t^b) based on West Texas Intermediate (WTI) are obtained through the LSU Center for Energy Studies website.

The coefficient estimate for W_{t-1} is positive implying that an increase in the number of wells drilled in the previous period ($t-1$) increases the number of wells drilled in period t. A positive coefficient on V_{t-1} implies that an increase in the previous period expected discounted present value of profit per well increases the number of wells drilled at period t. Variable l_t also has positive coefficient meaning that an increase in the number of leased tracts leads to an increase in wells drilling at period t. A positive coefficient on $D_t l_t$ implying that the 1995 DWRRA have a positive impact on the number of wells drilled. W_{t-1} was significant at the 90 percent level.

Table AC.1. Coefficient estimates of model.

Number of obs = 23
F(4,18) = 8.62
Prob >F = 0.0005
R-squared = 0.6188
Root MSE = 40.68

W_t	Coef	Robust Std. Err.	t	P > |t|	95% Conf. Interval	
W_{t-1}	0.60107	0.14468	4.15	0.001	0.2971058	0.9050445
V_{t-1}	0.000001	0.000001	1.51	0.149	-0.000000078	0.000000474
l_t	0.04336	0.05813	0.75	0.465	-0.078767	0.1655044
$D_t l_t$	0.01600	0.03048	0.52	0.606	-0.0480443	0.0800452
Constant	0.59378	38.1127	0.02	0.988	-79.47805	80.66562

A joint significance test for all the right hand side (RHS) variables is conducted with the result that they are significant at 95 percent level. The Durbin-h test statistics is conducted to test for the null hypothesis of no serial correlation in the error term. The test fails to reject the null hypothesis at 95 percent level, implying that there is no serial correlation in the error term. Figure AC.1 shows the actual compared to the fitted values for the total wells drilled.

Variables a_t^o, a_t^{ag}, and a_t^{ng} are generated with a three-year moving average as following:

$$\text{(AC.7)} \quad a_t^o = [(a_{t-1}^o + a_{t-2}^o + a_{t-3}^o)/ (a_{t-2}^o + a_{t-3}^o + a_{t-4}^o)]\, a_{t-1}^o$$
$$\text{(AC.8)} \quad a_t^{ag} = [(a_{t-1}^{ag} + a_{t-2}^{ag} + a_{t-3}^{ag})/ (a_{t-2}^{ag} + a_{t-3}^{ag} + a_{t-4}^{ag})]\, a_{t-1}^{ag}$$
$$\text{(AC.9)} \quad a_t^{ng} = [(a_{t-1}^{ng} + a_{t-2}^{ng} + a_{t-3}^{ng})/ (a_{t-2}^{ng} + a_{t-3}^{ng} + a_{t-4}^{ng})]\, a_{t-1}^{ng}$$

The success ratio for oil and gas (S_t^o and S_t^g) in the forecasting is much higher than the ones used in the model. A study published by MMS (2003) notes that due to advance technological progress in offshore drilling, this success rate has dramatically increased to about 50 percent. Forecasts for the crude oil and gas wellhead price (Φ_t^o and Φ_t^g) as well as crude oil spot market price (P_t^b) are obtained through the U.S. Energy Information Administration website (http://www.eia.doe.gov).

The number of tracts leased (l_t), exploratory and development drilling costs for dry hole as well as for successful well (C_{dry} and C_{wet}) are the average values from the sample period. The operating cost for oil and gas (OC_t^o and OC_t^g) as well as the discount factor (β) are the values at the last year of sample period (in 2007). In 2005, the congress passed the Energy Policy Act that states the windfall profit tax rate (ω_t) to be 25 percent for oil and gas production (Lazzari and Pirog, 2008).

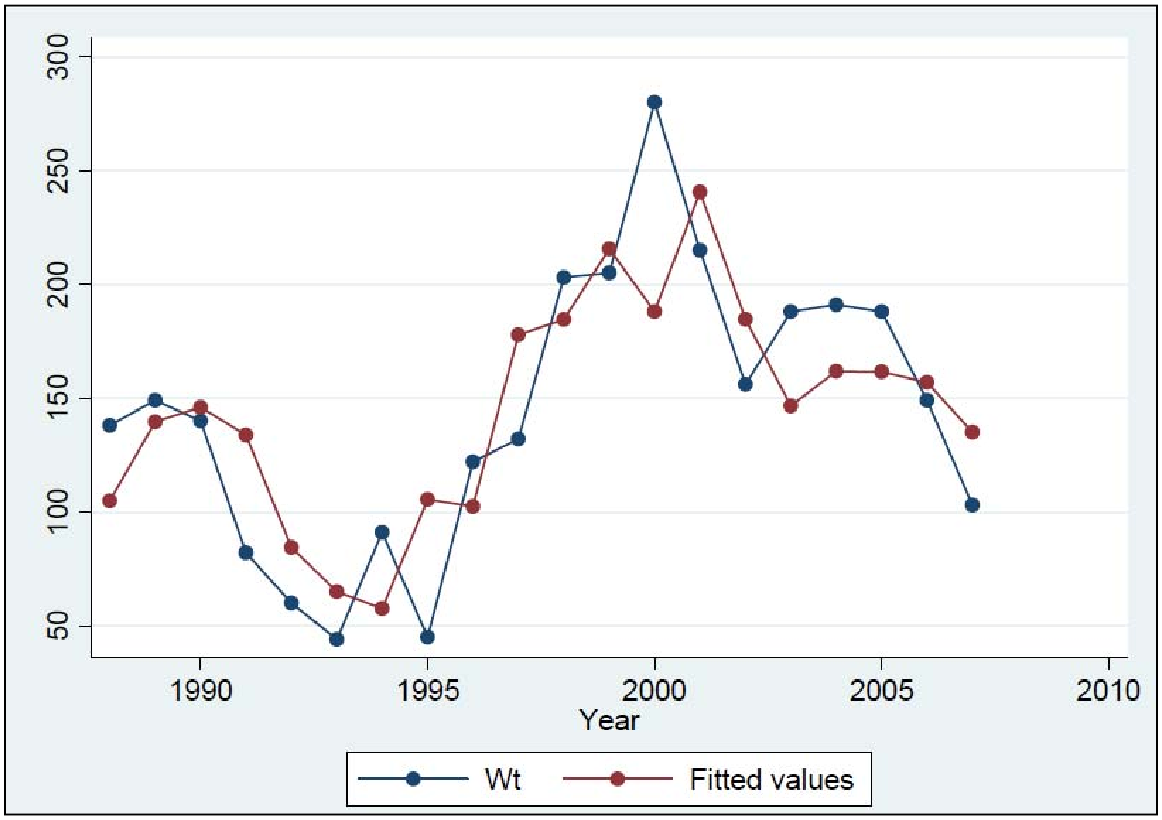

Figure AC.1. Comparison os actual compared to fitted values of total wells drilled.

The variables and parameters used for the forecasting are shown on Table AC.2. The crude oil spot market price (P_t^b) combined with the crude oil and gas wellhead price (Φ_t^o and Φ_t^g) as well as operating cost for oil and gas (OC_t^o and OC_t^g) are applied to formula (5) and (6) yielding the net operating profit per barrel of oil (P_t^o) and per mcf of gas (P^t_g), respectively. These results are then applied to formula (3) and (4) to obtain the discounted present value net operating profit per barrel of oil (π_t^o) and per mcf of gas (π_t^g), respectively. The prediction for expected present value profit per well (V_t) following formula (2) is then generated by combining the discounted present value net operating profit per barrel of oil and per mcf of gas (π_t^o and π_t^g) with the predicted three-year moving average of additional reserves (a_t^o, a_t^{ag}, and a_t^{ng}) as well as the exploratory and development drilling costs for dry hole and for successful well (C_{dry} and C_{wet})

The predicted expected present value profit per well (V_t), the number of tracts leased (l_t), and variable $D_t l_t$ to capture any influence from the DWRRA on the deepwater drilling are then combined with the coefficient estimates obtained from the regression (Table A1) to generate prediction for the number of wells drilled (W_t). The predicted number of oil and gas wells drilled to the year 2020 is shown on Table AC.3.

The discovery process components in the model (a_t^o and a_t^{ag}) are showing decreasing discovery rates, except for a_t^{ng} that increases during the forecast period. The decreasing discovery rates effects of a_t^o and a_t^{ag} are much less than the increasing discovery rates effect from a_t^{ng}. These discovery process components are built into the computation for V_t. Due to this, V_t increases over the forecast period as well. Since V_t and W_t are positively correlated, hence W_t increases over the 2008–2020 period.

Table AC.2. Variables and parameters for forecasting.

Variables	Values
τ_t	0.34
ρ_t	0.167
i	0.921
exp	0.3
ω_t	0.25
δ_t	0.15
S_t^o	0.5
S_t^g	0.5
OC_t^o	$15.32/barrel
OC_t^g	$1.48/mcf
β	0.9025
Φ_t^o	$84.18/barrel
Φ_t^g	$3.91/mcf
l_t	817 tracks
C_{wet}	$7,442,658/well
C_{dry}	$11,583,355/well
P_t^b	$86.08/barrel
D_t	1
b	0.12
c	0.18

Table AC.3. Predicted number of wells drilled.

Year	Number of Wells
2008	101
2009	110
2010	115
2011	119
2012	120
2013	121
2014	122
2015	123
2016	124
2017	124
2018	125
2019	126
2020	127

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management Mission

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.