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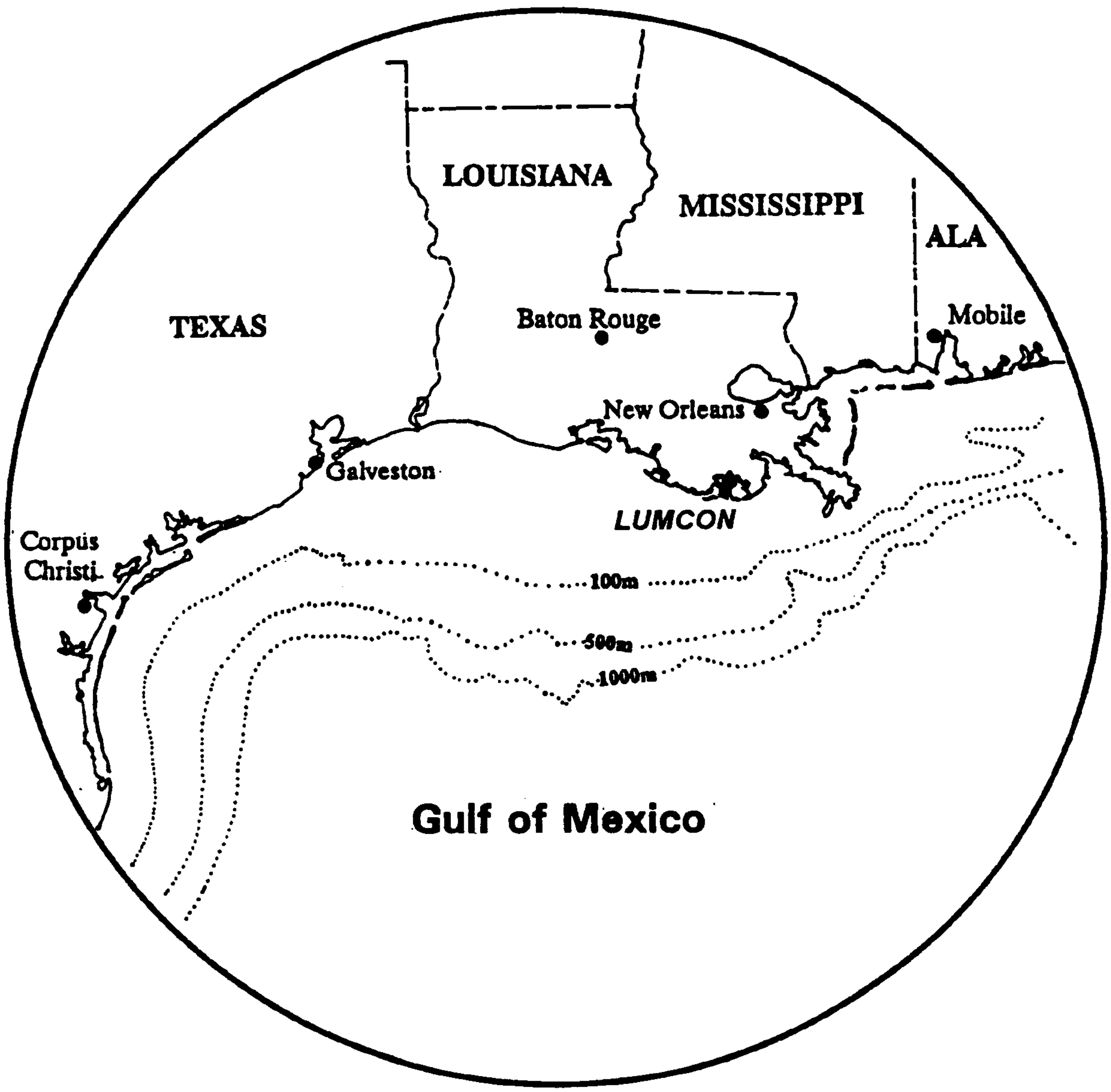
Oil and Gas Development and Coastal Income Inequality: A Comparative Analysis



U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

Cooperative Agreement
University Research Initiative
Louisiana Universities Marine Consortium

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Oil and Gas Development and Coastal Income Inequality: A Comparative Analysis

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Abstract

This research employed parish- and county-level data from the 1970, 1980, and 1990 Censuses in a comparative analysis of family income inequality. We focused on the analysis of trends in income inequality in coastal Louisiana parishes adjacent to the substantially developed Outer Continental Shelf (OCS). With a comparative analysis design, we examined inequality trends in Louisiana parishes and in coastal counties of the Florida panhandle where there has been no significant onshore or offshore development. The analysis framework enabled a temporal comparison across key decades in the recent history of the oil and gas industries. While the decade of the 1970s was one of rising oil prices, much onshore activity, and greatly expanded OCS development, the 1980s saw prices fall and industry activity generally decline.

An initial review of per capita income and median family income figures indicated lower 1970 income in Louisiana parishes than in Florida counties. By 1980, the income relationship in coastal areas was reversed with Louisiana parishes generally exhibiting higher incomes--some precipitously higher--than Florida counties. Louisiana statewide and coastal 1990 incomes, however, were well below those of Florida. After taking inflation into account, coastal 1990 median family income levels in Louisiana were actually lower than they were in 1970.

A comparative inequality analysis revealed very different patterns of income inequality for statewide and coastal areas of Florida and Louisiana. While Florida inequality primarily trended downward across time, inequality in Louisiana exhibited a great deal of volatility and, by 1990, was higher than in 1970 in several cases. The Louisiana patterns suggest a substantial impact of onshore and offshore industry activity on coastal families in the middle to upper middle portions of the income distribution.

In the modeling phase of the analysis, we attempted to account for these inequality patterns by controlling for important factors known to influence inequality. The modeling was limited due to the small number of coastal parishes and counties. At best, the models accounted for roughly half the variance in the observed inequality. Moreover, through these modeling procedures, we were unable to eliminate the differences between coastal Louisiana parishes and panhandle counties of Florida or the volatility in the Louisiana patterns. To explain the Louisiana patterns, we must therefore look beyond important variables such as education, race, industry mix, and the national economy. Louisiana inequality follows the expansion and contraction of the oil and gas industry activity despite controlling for these key factors.

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In a number of respects, this research was facilitated by the resources of the Louisiana Population Data Center at LSU. CD-ROM and other data for the project were taken from the Center's extensive archive. Maps and figures were generated in the Center's GIS lab. Books, documentation, and manuals were obtained from the Center library. We are grateful for the Center's ongoing support of socioeconomic research.

INTRODUCTION

This research is a comparative analysis of family income inequality that employs parish- and county-level data from the 1970, 1980, and 1990 Censuses. The focus of the analysis is trends in family income inequality in coastal Louisiana parishes adjacent to the substantially developed Outer Continental Shelf (OCS). The comparative analysis design permits inequality trends in Louisiana parishes to be compared to inequality trends in coastal counties of the Florida panhandle where there has been no significant onshore or offshore development. Inequality trends in the parishes and counties along the Gulf of Mexico are also compared to state-wide family income inequality in Louisiana and Florida. The analysis design permits a temporal comparison across key decades in the recent history of the oil and gas industries. While the decade of the 1970s was one of rising oil prices and greatly expanded industry development, the 1980s saw prices fall and offshore activity generally decline. This change in development patterns is an important reason to study inequality trends in the 1970-1980 and 1980-1990 periods. Following conventions of inequality analysis, trends in family income inequality are gauged with multiple measures of inequality computed with decennial census data. The multiple measures permit us to focus on inequality trends at several key points in the income distribution. The inequality is then modeled with ordinary least squares and pooled time-series, cross-sectional estimators. In these ways, the analysis is designed to gain an understanding of the effects of oil and gas industry development on income inequality in coastal areas.

An initial review of per capita income and median family income figures indicates lower 1970 income in Louisiana parishes than in Florida counties. By 1980, the income relationship in coastal areas is reversed with Louisiana parishes generally exhibiting higher incomes--some precipitously higher--than Florida counties. Louisiana statewide and coastal 1990 incomes, however, are well below those of Florida. After taking inflation into account, coastal 1990 median family income levels in Louisiana are actually lower than they were in 1970.

A comparative inequality analysis reveals very different patterns of income inequality for statewide and coastal areas of Florida and Louisiana. While Florida inequality primarily trends downward across time, inequality in Louisiana exhibits a great deal of volatility and, by 1990, is higher than in 1970 in several cases. The Louisiana patterns suggest a substantial impact of oil and gas industry development on coastal families in the middle to upper middle portions of the income distribution.

In the modeling phase of the analysis, we attempt to account for these inequality patterns by controlling for important factors known to influence inequality. While the modeling exercise is limited to some extent by the small number of coastal spatial units (eight parishes and nine counties), the results do suggest some important differences between the two states and across time in Louisiana. At best, the models account for roughly half the variance in the observed inequality. Moreover, through these modeling procedures, we are unable to eliminate the sharp differences between coastal Louisiana parishes and panhandle counties of Florida or the volatility in the Louisiana patterns. To explain the Louisiana patterns, we must therefore look beyond important variables such as education, race, industry mix, and the national economy. The Louisiana inequality patterns follow the rise and fall of onshore and offshore oil and gas industries more than they follow any factors introduced in our models.

BACKGROUND

Brief Literature Review.

The study of income inequality is a long-standing tradition in sociology, economics, and other social sciences (for reviews of studies and methodologies, see Allison, 1978; Coulter, 1989). Implicit or explicit in most income inequality research is a concern for the fundamental dimension of social stratification in industrial and post-industrial societies. Rather than focusing only on income extremes--say, the very rich and/or the very poor--those who study income inequality assess the distribution of income throughout the population. Inequality indices thus gauge the relative socioeconomic well-being of all persons.

Kuznets' classic research on inequality remains the point of departure for virtually all studies of the relationship between development and inequality (Kuznets, 1955, 1966). Using income data from developing nations, Kuznets postulated that industrialization ultimately leads to a decline in inequality. Much research has followed in the Kuznets tradition, linking the emergence of a manufacturing sector to the emergence of a upwardly mobile working class and a corresponding reduction in societal inequality. On the one hand, the Kuznets hypothesis seems applicable to the development of oil and gas resources. That is, we might hypothesize that oil and gas development would lead to a reduction in income inequality by increasing opportunities for personal wealth and earnings. On the other hand, we also know that oil and natural gas are commodities whose prices can be very volatile. It is the commodity characteristic that leads us to suspect that the Kuznets hypothesis may hold only in periods of high or rising prices. A manufacturing plant can be retooled to produce a different, but profitable product or it can be relocated to a more cost-effective location. In contrast, extraction industries can only operate where natural resources are concentrated. Thus, operators of oil and gas wells do not have the same degree of flexibility and are more likely to minimize or suspend production. The contraction of the oil and gas industry in a highly dependent area could bring about just the opposite of the Kuznets hypothesis: deindustrialization and an increase in inequality. Very little has been written about the possibility of a such a reversal probably because modernization theories tend to treat industrialization as an irreversible evolutionary process. Yet, it does not seem contradictory to Kuznets' theory to hypothesize that a cessation or contraction of development activity might bring about increasing inequality.

This study of oil and gas development and income inequality employs classic inequality measures as well as a newer class of social welfare functions (Atkinson, 1970). The power of the social welfare approach lies in the analyst's ability to focus on inequality in different parts of the income distribution (Schwartz and Winship, 1980; Braun, 1988; Coulter, 1989). In other words, we may choose to emphasize inequality in the middle range of the income distribution, inequality at or near a poverty level, or inequality elsewhere in the income distribution. This is important because it gives us more insight into the specific ranges of incomes that may be affected by oil and gas development. We do not have to assume a uniform effect across all income ranges.

There are just a few socioeconomic studies on Louisiana oil and gas development, and none has thus far focused on income inequality. In terms of employment, Gramling and Freudenberg (1990) have demonstrated that Louisiana coastal parishes are so dependent on oil and gas extraction activities that 90 percent of variance in local employment can be explained by national and international petroleum indicators (e.g., prices, rig counts). In a series of studies, researchers have focused on how families in coastal Louisiana have adapted to offshore work schedules that require week-long absences of spouses (Gramling and Forsyth, 1987; Forsyth and Gramling, 1987; Forsyth and Gauthier, 1991). Still other researchers have studied social problems associated with onshore and offshore development. Seydlitz et al. (1993) report increasing numbers of suicides and homicides associated with rapid development. The only references to income we have found are in Laska et al. (1993). They provide evidence of higher per capita income in parishes characterized by high involvement in OCS oil and gas extraction than in minimally involved parishes. By emphasizing income inequality, we add to these key findings in the socioeconomic research tradition.

Income Inequality.

An inequality analysis is essentially a study of dispersion or distribution of some valued resource. The most commonly employed statistics are measures of central tendency (e.g., mean, median, or mode). Yet a mean (or average) can be a very poor description of an income distribution. One problem is that two income distributions can have the same mean while exhibiting very different dispersions of income values about those means. On the one hand, a distribution could have income values clustered closely around the mean, indicating that individuals represented in the distribution have very similar incomes. On the other hand, the incomes could be concentrated at the extreme ends of the distribution, suggesting a great deal of inequality not reflected in a comparison of means.

Inequality measurement is therefore a longstanding concern for social scientists. As a research tradition in income inequality has developed, various inequality measures have been proposed and then scrutinized by researchers. Two excellent sources for overviews of work in this area are Allison (1978) and Coulter (1989). Both writers define desirable qualities of inequality measures and establish the extent to which commonly used measures satisfy the criteria. Because income inequality indices have different properties and strengths, it has become standard practice for researchers to analyze multiple inequality measures.

This research employs three inequality indices: the Gini coefficient, Theil's information-theoretic inequality measure, and Atkinson's social-welfare function. All three measures satisfy basic criteria established by Allison (1978) and Coulter (1989). One basic criterion is that the measure equal zero when there is no inequality (i.e., all persons have equal income shares). When the income shares are not equally distributed, an inequality measure should have a positive value that increases as inequality increases. Another property is scale invariance; that is, multiplication of all incomes by a constant does not change the extent of inequality. Scale invariant inequality measures allow researchers to compare income distributions based on different monetary systems in, say, different countries. Scale invariance also makes it unnecessary to adjust for inflation. In this research, we focus on a single currency (U.S. dollars) across a very inflationary period (1970-1990). While we will make adjustments for inflation for descriptive purposes below, we employ scale invariant measures that report the same level of inequality with or without the adjustments. A criterion of major concern to this research is Dalton's (1920) principle of transfers which holds that a transfer of income from a poorer person to a richer person should increase inequality, no matter how much money is involved and no matter how poor or rich the persons. Conversely, a transfer from a richer person to a poorer person should decrease the measured inequality. While all three measures--Gini, Theil, and Atkinson--satisfy the principle of transfers, they differ in their sensitivity to transfers at different points in the income distribution. These differences are detailed as each measure is introduced below.

Based on the Lorenz curve, the Gini coefficient has been the most widely used inequality measure. It will be employed in the proposed research as defined by Treas and Walther (1978):

$$G = \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| x_i y_i - x_j y_i \right|$$

where n = the number of income categories, x_i = the population share of the ith group, and y_i = its income share. When the Gini coefficient equals zero, all persons have equal shares of income and, hence, there is no inequality. In ordinary income distributions, the Gini measure is most sensitive to income transfers among persons in the middle portion of the income distribution. This means that the assessment of inequality focuses less on transfers from the rich to the poor and more on transfers among persons in the middle tiers of the income distribution. From a normative point of view, the sensitivity of the Gini coefficient may or may not be satisfactory. The Gini, for example, can be used to build a case that development brings about changes in middle-income inequality patterns. Because of its particular pattern of sensitivity, however, the Gini is less useful if the one wishes to claim that development brings about a redistribution of income from the rich to the poor.

The Gini coefficient reaches its upper bound at maximal inequality (i.e., one person has all income). Arithmetically, the upper bound is:

$$1 - \frac{1}{n} \quad .$$

Since the number of income intervals reported in the Census can vary from one decennial Census to the next, the Gini coefficients presented here are standardized by expressing them as a proportion of their upper bound (Allison, 1978:870). Hence, the values will range between zero (no inequality) and one (maximum inequality).

Despite its ease of computation and interpretation, the Gini coefficient's range of sensitivity should be complemented by other inequality measures (Allison, 1978; Braun, 1988; Coulter, 1989). Based in information theory, Theil's (1967) inequality measure is a widely used index that is often reported along with the Gini coefficient. The Theil measure is defined by Allison (1978:867) using natural logarithms:

$$T = \frac{1}{n} \sum_{i=1}^{n} \left(\frac{x_i}{\mu} \right) \log \left(\frac{x_i}{\mu} \right)$$

where X_i = the income value of the ith person and μ = the overall mean. Theil's measure ranges in value from zero (no inequality) to log(n) which is maximum inequality. Since the areas to be studied here vary in population size, we will standardized the Theil coefficients by expressing them as proportions of their maximum value (Allison, 1978: 870). Accordingly, the values of the measure range from zero to one.

There is some disagreement in the literature about the sensitivity of the Theil measure (Allison, 1978; Braun, 1988). The preponderance of evidence suggests, however, that the Theil measure is most sensitive to transfers among middle and upper middle income persons (Osberg, 1984). Thus, from a normative standpoint, the Theil measure is best at gauging redistribution of income in the upper middle ranges of the income distribution. For our purposes, a higher Theil value in 1980 than in 1970 would indicate greater concentration of income among the richer persons in the coastal areas under study. If this presumably unpopular scenario developed along with large-scale development efforts such as oil and gas extraction, the inequality patterns would likely doom future development efforts. On the other hand, a decrease in the Theil value would indicate less concentration in the upper ranges of the income distribution. Presumably, this more equitable arrangement would be a welcome outcome of any development effort.

The Gini and Theil measures are widely used in socioeconomic studies. Though they are not without their problems, we use them here to preserve comparability with previous work in several disciplines. As Schwartz and Winship (1980) and Braun (1988) contend, however, both measures are occasionally problematic when different populations are compared. Technically speaking, they yield incomparable results when the Lorenz curves for the compared areas intersect. A Lorenz curve is a graphic depiction of an income distribution. When the curves for two areas cross, the shape of their income distributions differs in some fundamental way. In this comparative analysis of parishes and counties, it is essential that we also include an inequality measure which permits comparisons of geographic areas, even if the income distributions are very different.

Schwartz and Winship (1980) and Coulter (1989), among others, advocate the use of Atkinson's inequality measure for several reasons. First, the researcher is required to make *a priori* assumptions about what would constitute a more equal distribution. This is done by specifying a parameter that controls the sensitivity range of the measure. The Atkinson measure is in a class of inequality indices usually characterized as social-welfare measures because, by definition, they require a normative assumption on the part of the research about what constitutes an equitable socioeconomic order.

As we introduced the Gini and Theil measures above, we made efforts to outline the normative implications of their use. These measures are often employed, however, without discussion of their differences in sensitivity to transfers. The Atkinson measure makes the sensitivity issue an explicit part of inequality analysis. A third feature of the Atkinson measure is its incorporation of the notion of declining utility of transfers as incomes increase.

> . . . the effect of a transfer to one person from one person whose income is a fixed proportion higher (say double) diminishes as the absolute level of their incomes increases. For example, a small transfer to a person with $7,500 from someone with $15,000 is more effective in reducing inequality (or increasing social welfare) than a transfer of the same size to a person with $15,000 from someone with $30,000. (Schwartz and Winship, 1980:29)

Thus, the Atkinson measure permits comparisons across geographic areas, makes explicit the type of transfers that are to be emphasized, and takes declining utility into account.

Allison (1978) gives the following computational formula for Atkinson's (1970) measure:

$$A = 1 - \frac{n}{1}\left[\sum_{i=1}^{n}\left(\frac{x_i}{\mu}\right)^{1-\epsilon}\right]^{\frac{1}{1-\epsilon}}$$

where μ = the grand mean and ϵ = the "inequality aversiveness" of the inequality coefficient. By manipulating ϵ, the researcher targets sensitivity to transfers in different portions of the income distribution. As ϵ increases, increasing emphasis is placed on the share of income held by the low-income portion of the population. Lower values of ϵ emphasize the upper portion of the income distribution (as theoretically represented in a Lorenz curve). The ability to fix ϵ is a very advantageous aspect of the Atkinson measure. But, as Coulter (1989:125) quite correctly notes: "Setting ϵ is a distinctively normative decision and should be based on the investigator's preference about the relative important of different portions of the Lorenz curve in an inequality index or on how different types of transfers should affect the index value."

Our approach in this research on oil and gas development is less normative than descriptive. That is, we do not explicitly test any particular income redistribution hypothesis. We are more intent on describing at what point an income distribution corresponds temporally to the rise and decline of a dominant industry. In situations like these, researchers are apt to specify several values of ϵ in assessing inequality in a distribution (Schwartz and Winship, 1980; Braun, 1988).

Results for Atkinson measures in some cases will approximate those obtained for the Gini coefficient and the Theil measure. Coulter (1989) notes that values of ϵ approaching zero will yield results similar to the Theil measure. Atkinson (1970) found results similar to the Gini coefficient using ϵ between 0.5 and 1.0. Following others in the literature (e.g., Schwartz and Winship, 1980; Braun, 1988), we will report Atkinson inequality measures with ϵ = 0.5, 1.0, 1.5, 2.0, and 2.5. This range of ϵ values will permit us to assess inequality at a number of key points in the income distribution.

The Atkinson measures range from 0 to 1 with one indicating maximal inequality. By definition, the Atkinson measure is relative and does not require standardization for different numbers of cases or income intervals (Coulter, 1989). Using these multiple measures of income inequality, we will gain a more complete understanding of the patterns of inequality in coastal Louisiana and the processes that generate those patterns.

COMPARATIVE RESEARCH DESIGN

Our rationale for conducting a comparative analysis along the central Gulf of Mexico rests on comparisons and contrasts of two key areas. Louisiana is of interest because of the degree of statewide oil and gas activity and the extent of OCS development off its shores. Florida is chosen for comparative purposes because it has a lengthy Gulf coastline and has seen minimal onshore or offshore activity. The comparisons are made at three points in time. For reasons outlined below, it is essential that decennial Census data be used for the income inequality analysis. The temporal comparisons are much more than mere conveniences, however, as they correspond reasonably well to periods of expansion (1970-1980) and contraction (1980-1990) in oil and gas industry activity. Figure 1 indicates the extent to which the growth and decline of Louisiana oil and gas industry employment corresponds to the decennial Census years. The figure also shows that employment was tied to the international price of oil through the mid-1980s. In the sections that follow, we detail elements of this comparative research design based on decennial Census year data points.

Decennial Census Data.

Decennial Census data are available in a variety of forms including printed reports and machine-readable data files. The printed reports typically do not provide the geographic detail required here to make comparisons of parishes and counties. Machine-readable data are generally of two types: data summarized by geographic area and sample data on individual respondents. For confidentiality reasons, it is not possible to obtain individual-level data for most of the geographic areas of interest in this study. In 1970, the smallest areas identified on public-use samples of individual-level Census data had at least 250,000 persons. The population criterion for 1980 and 1990 was 100,000 persons. This leaves us with geographic summary data as our only source of high quality and readily available data on family income. All of the analyses that follow are based on summary-level data issued by the Bureau of the Census for parishes and counties. Our data have been drawn from the extensive archival holdings of the Louisiana Population Data Center at Louisiana State University. The files were originally produced by the U.S. Bureau of the Census or one of its contractors (U.S. Bureau of the Census, 1973, 1983, 1991).

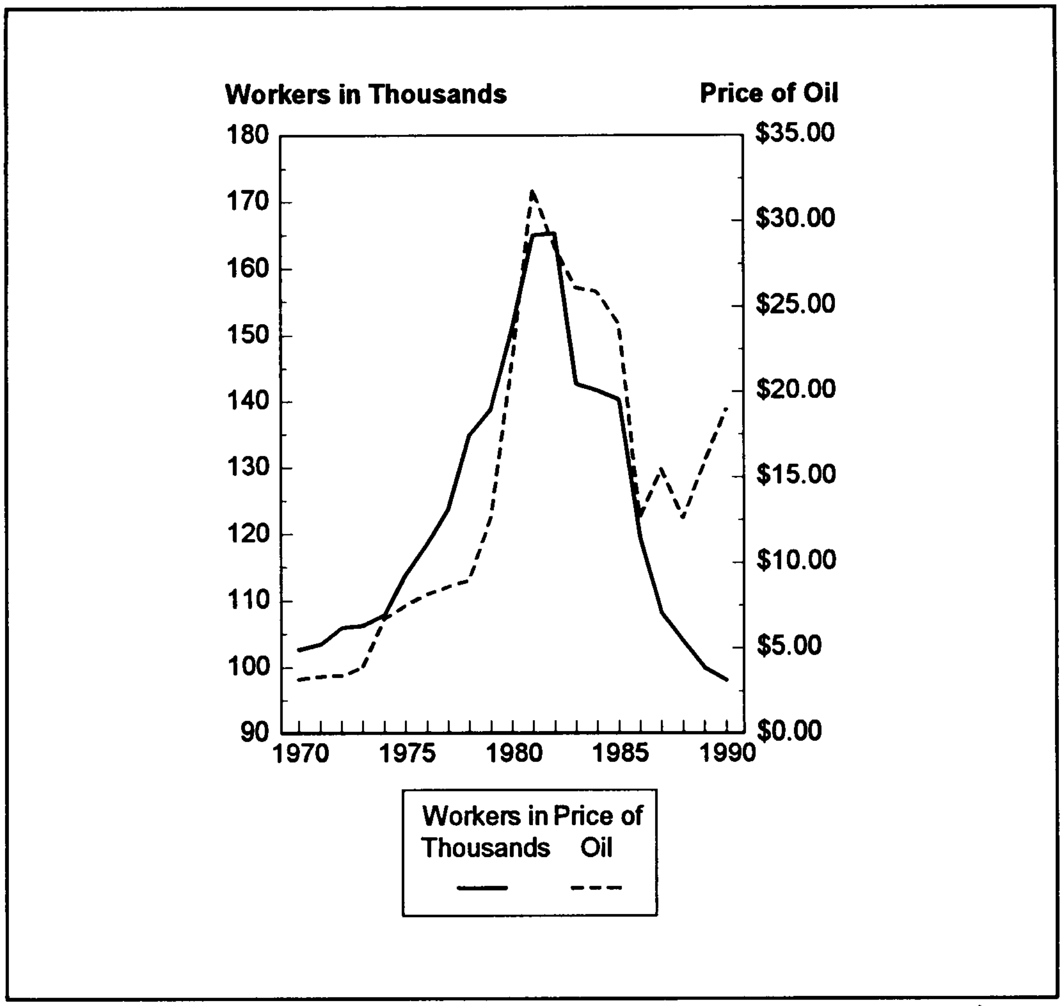

Figure 1. Louisiana Oil and Gas Workers and the Price of Oil. Source: *Louisiana Almanac* (Calhoun, 1992)

Family income data for each parish and county are contained in the summary-level files. The income information is presented as frequency distributions for specified income intervals. The income intervals change across time and are listed in Table 1. In the inequality analyses that follow, we use standardized or relative measures to avoid problems associated with different numbers of income categories in the three Censuses. The income values that are actually employed in our computations are the midpoints of the intervals listed in the table. By convention, the raw income data were transformed in two important ways. First, a value was estimated for the open-ended interval representing the highest income category. This involved the computation of a Pareto mean estimate (Shryock and Siegel, 1975:366). Second, for presentation purposes, the midpoints of the income intervals were adjusted for inflation using the Consumer Price Index. This latter adjustment will be apparent when we present mean and median income values below. Since the inequality measures are scale invariant, the inflation adjustment has no effect on them.

Table 1. Family Income Intervals in Decennial Census Data

Interval	1970 Census		1980 Census		1990 Census	
1	Less than 1000		Less than 2500		Less than 5000	
2	1000	1999	2500	4999	5000	9999
3	2000	2999	5000	7499	10000	12499
4	3000	3999	7500	9999	12500	14999
5	4000	4999	10000	12499	15000	17499
6	5000	5999	12500	14999	17500	19999
7	6000	6999	15000	17499	20000	22499
8	7000	7999	17500	19999	22500	24999
9	8000	8999	20000	22499	25000	27499
10	9000	9999	22500	24999	27500	29999
11	10000	11999	25000	27499	30000	32499
12	12000	14999	27500	29999	32500	34999
13	15000	24999	30000	34999	35000	37499
14	25000	49999	35000	39999	37500	39999
15	50000 or more		40000	49999	40000	42499
16			50000	74999	42500	44999
17			75000 or more		45000	47499
18					47500	49999
19					50000	54999
20					55000	59999
21					60000	74999
22					75000	99999
23					100000	124999
24					125000	149999
25					150000 or more	

Bases for Comparisons.

In the comparative analysis that follows, we will first report Louisiana and Florida inequality measures on a statewide basis. One rationale for the statewide comparisons is to gauge the extent to which coastal patterns follow those of the state as

Figure 2. Louisiana Coastal Parish Study Area

whole. Another reason is to assess the extent of statewide volatility in Louisiana coinciding with oil and gas development in comparison to Florida. To be sure, the Louisiana and Florida of the 1990s are very different in demographic and socioeconomic respects. These differences, however, were less exaggerated in our baseline year (1970) than they are now. At the same time, the natural resources of the two states were very different. By 1970, Louisiana had a well developed onshore oil and gas industry. Expansion offshore was facilitated by familiarity with the onshore industry and by access through sparsely populated coastal wetlands (Freudenberg and Gramling, 1994). Florida had very little in the way of oil and gas development. Moreover, beaches, tourism, and recreation areas promised to make offshore access and development more difficult. Not surprisingly, the states took different routes to the development of natural resources. Thus, the statewide comparisons provide interesting insight into the socioeconomic consequences of development policies tied to different natural resources.

After reporting on statewide inequality results, we turn to comparisons of gulf coastal areas adjacent to the OCS. The coastal parishes of Louisiana are mapped in Figure 2, and the panhandle counties of Florida appear in Figure 3. Two major urban areas are omitted from our comparative inequality analysis:

Jefferson Parish (part of the New Orleans metropolitan statistical area) and Escambia County (Pensacola). These are the most populated and most urban areas along the northern Gulf coasts of both states. They have complex local economies that are less likely to reflect the activities of a single industry sector such as oil and gas extraction. In a number of preliminary analyses, we found results for both Jefferson and Escambia very different from their neighboring, smaller parishes

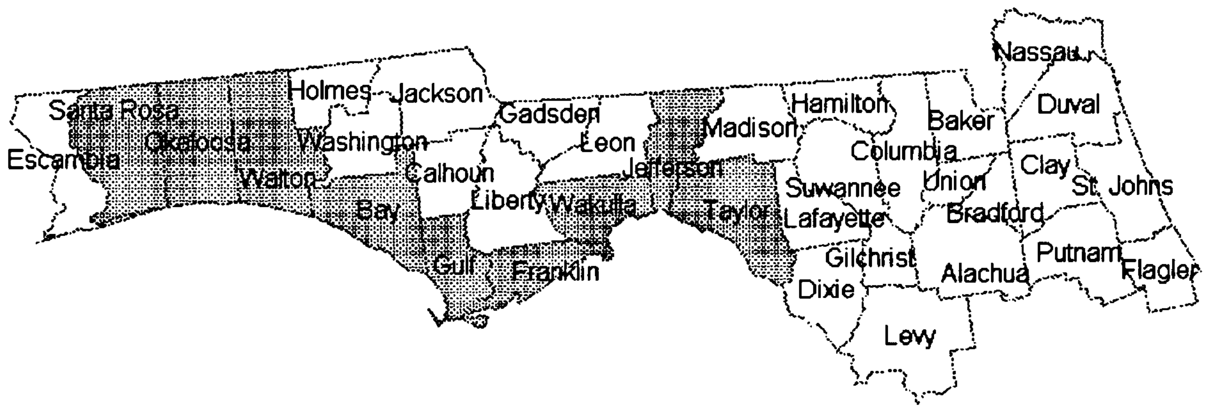

Figure 3. Florida Panhandle Coastal County Study Area

and counties. In the inequality analyses below, data for all other parishes and counties adjacent to the northern Gulf are included. The final basis for our comparative analysis is the comparison of closely matched pairs of counties and parishes. Methods used to pair the areas are outlined in the following section.

Matched Pairs of Parishes and Counties.

Since 1970 serves as our baseline year (i.e., before the oil and gas industry expansion), we assembled basic demographic, industrial, and occupational data for the coastal parishes of Louisiana and the panhandle counties of Florida. The 1970 demographic data included basic factors such as parish population and migration (measured as percent new residents). To measure racial composition a percent black variable was employed. The demographic indicators also included socioeconomic variables (median household income, percent of households on public assistance, and unemployment rate). The last demographic factor was percent high school graduates, a measure of local human capital levels.

The 1970 industry indicators consisted of standard Census items measuring percentage employment in nine industry groups. The industry groups were manufacturing, transportation, public administration, agriculture and mining, construction, communications and utilities, wholesale and retail trade, finance and retail trade, and other services. The 1970 occupational indicators consisted of standard Census items measuring percentage employment in nine occupation groups. The occupation groups were executive or managerial, professional or technical, sales, clerical, service, farming or fishing, precision production, operative, and laborer.

To identify very similar parishes and counties, the three sets of indicators--demographic, industrial, and occupational--were each analyzed with a hierarchical cluster analysis algorithm. This analytical strategy permitted us to compare all counties and parishes on all variables in each of the sets of indicators. The algorithm joins the most strongly related counties or parishes first and then joins other counties, parishes, and clusters in subsequent order of relationship until there is one cluster that contains all elements. The results thus permit us to identify those counties and parishes that are most similar in terms of the demographic, industrial, and occupational variables.

Table 2 presents the results for a cluster analysis of the coastal parishes and counties on the demographic variables. The clustering algorithm generates a distance (or dissimilarity) coefficient listed in the rightmost column of the table. The lower the distance coefficient, the stronger the relationship between the items being clustered. The strongest relationship (most similarity) evident in the demographic variables is between Santa Rosa County of Florida and LaFourche Parish of Louisiana . Two other pairs of Florida and Louisiana areas (clusters 17 and 16) also cluster early on. Cluster 17 pairs Walton of Florida with Vermilion of Louisiana, while cluster 16 joins St. Mary of Louisiana with Taylor of Florida. Thus, the cluster analysis provides us with three very similar pairs of counties and parishes matched on demographic factors.

Table 2. Cluster Analysis Results for 1970 Demographic Variables

Number of Clusters	Clusters Joined		Frequency of New Cluster	Normalized RMS Distance
19	Santa Rosa, FL	LaFourche, LA	2	0.036
18	Jefferson, FL	Levy, FL	2	0.037
17	Walton, FL	Vermilion, LA	2	0.054
16	St. Mary, LA	Taylor, FL	2	0.056
15	Cameron, LA	Iberia, LA	2	0.087
14	Bay, Fl	Cluster 19	3	0.097
13	Plaquemines, LA	Terrebonne, LA	2	0.103
12	Dixie, FL	Wakulla, FL	2	0.103
11	Okaloosa, FL	Cluster 16	3	0.106

As the results in Tables 3 and 4 indicate, the counties and parishes are not as similar on these dimensions as they are on demographic factors. The distances shown in Tables 3 and 4 tend to be greater than those in Table 2. Still, the cluster results of industrial and occupational composition each yield one strongly related pair consisting of one Florida county and one Louisiana parish. In terms of industrial characteristics, Jefferson of Florida and Vermilion of Louisiana are reasonably similar (in 1970). The occupational factors pair Walton of Florida with St. Mary of Louisiana. Taken together, the three cluster analyses provide us with five closely matched pairs of counties and parishes that can be used for comparative purposes. It is important to bear in mind that these pairings are based on 1970 parish and county characteristics. Along with statewide and coastal areas, the parishes and counties matched as pairs serve as yet another basis for our comparative analysis that follows.

Table 3. Cluster Analysis Results for 1970 Industrial Variables

Number of Clusters	Clusters Joined		Frequency of New Cluster	Normalized RMS Distance
19	LaFourche, LA	St. Mary, LA	2	0.161
18	Iberia, LA	Terrebonne, LA	2	0.276
17	Dixie, FL	Gulf, FL	2	0.287
16	Jefferson, FL	Vermilion, LA	2	0.295
15	Cluster 17	Taylor, FL	3	0.326
14	Cluster 18	Cluster 19	4	0.345
13	Bay, FL	Escambia, FL	2	0.349
12	Wakulla, FL	Walton, FL	2	0.358
11	Cameron, LA	Plaquemines, LA	2	0.358

Table 4. Cluster Analysis Results for 1970 Occupational Variables

Number of Clusters	Clusters Joined		Frequency of New Cluster	Normalized RMS Distance
19	LaFourche, LA	Terrebonne, LA	2	0.215
18	Walton, FL	St. Mary, LA	2	0.333
17	Iberia, La	Cluster 19	3	0.360
16	Escambia, FL	Santa Rosa, FL	2	0.419
15	Gulf, FL	Cluster 18	3	0.430
14	Taylor, FL	Cluster 17	4	0.440
13	Dixie, FL	Plaquemines, LA	2	0.440
12	Cluster 15	Cluster 14	7	0.504
11	Levy, FL	Vermilion, LA	2	0.504

COMPARATIVE INCOME INEQUALITY ANALYSIS

Measures of Central Tendency.

This analysis of income inequality necessarily focuses on dispersion in income distributions. To anchor the inequality analysis that follows, however, it is useful to review the central tendency or typical income figures associated with Louisiana and Florida. The central tendency data are drawn from the 1970, 1980, and 1990 Censuses. To avoid confounding the data with the effects of inflation, the income figures are expressed in 1990 dollars as calculated with the Consumer Price Index. We use 1990 dollars in this section for descriptive purposes as they are more meaningful by today's standards than are 1970 or 1980 dollars.

Per Capita Income. The most common measure of central tendency is the arithmetic mean or average of a distribution. In income distributions for persons, the average is known as per capita income. Per capita income figures for the 1970, 1980, and 1990 Censuses are presented in Figure 4. The statewide data in the upper panel of the figure indicate that Florida income increases steadily across time while Louisiana declines slightly after 1980. Data for coastal areas only appears in the lower panel of Figure 4. Those data show Florida per capita income increasing steadily, not unlike the statewide figures above. During the oil and gas industry activity peak period (circa 1980), Louisiana per capita income increases sharply to a point higher than that of Florida. The 1990 coastal Louisiana figures show per capita income for 1990 falling below that of 1980, but above 1970.

Figure 5 presents per capita income information for pairs of counties and parishes matched on demographic factors. The three panels show Louisiana even or slightly below Florida in 70, higher in 80, and lower in 90. Like the statewide and coastal parish data in Figure 4, the data in Figure 5 show 1980 Louisiana gains erased by 1990. Figure 6 presents per capita income for parishes and counties matched on industry and occupation characteristics. Both panels show Louisiana almost even in 1970, higher in 1980, and well below Florida by 1990.

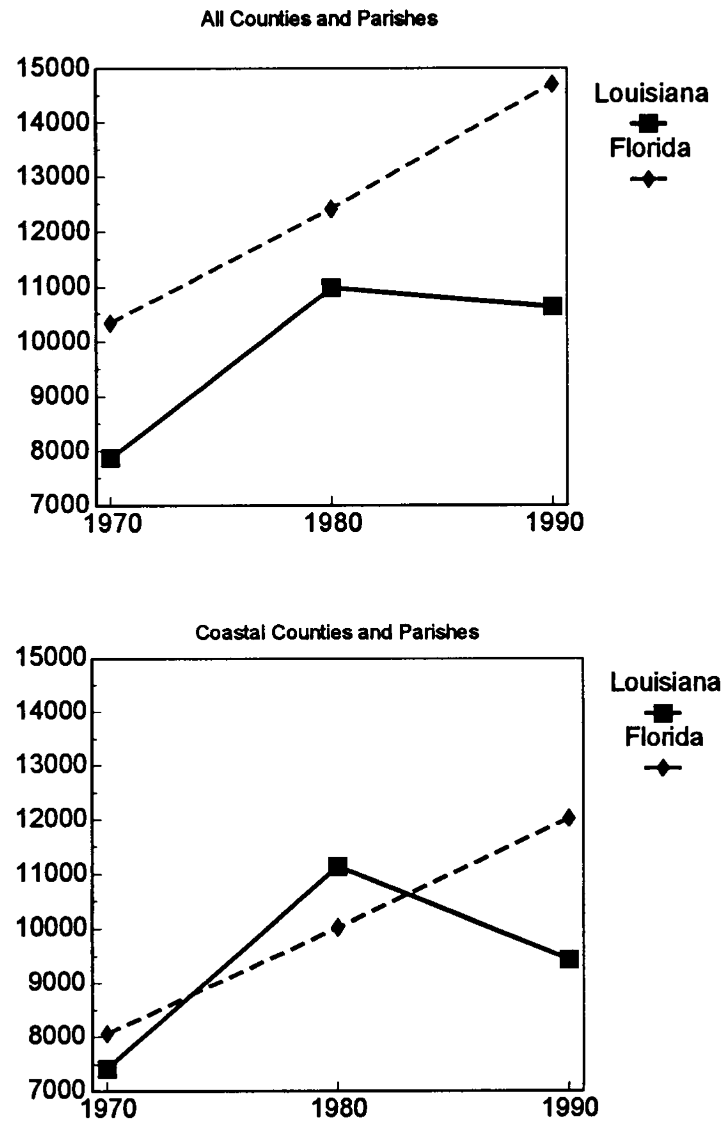

Figure 4. Statewide and Coastal Per Capita Income: 1970, 1980, 1990 (1990 Dollars)

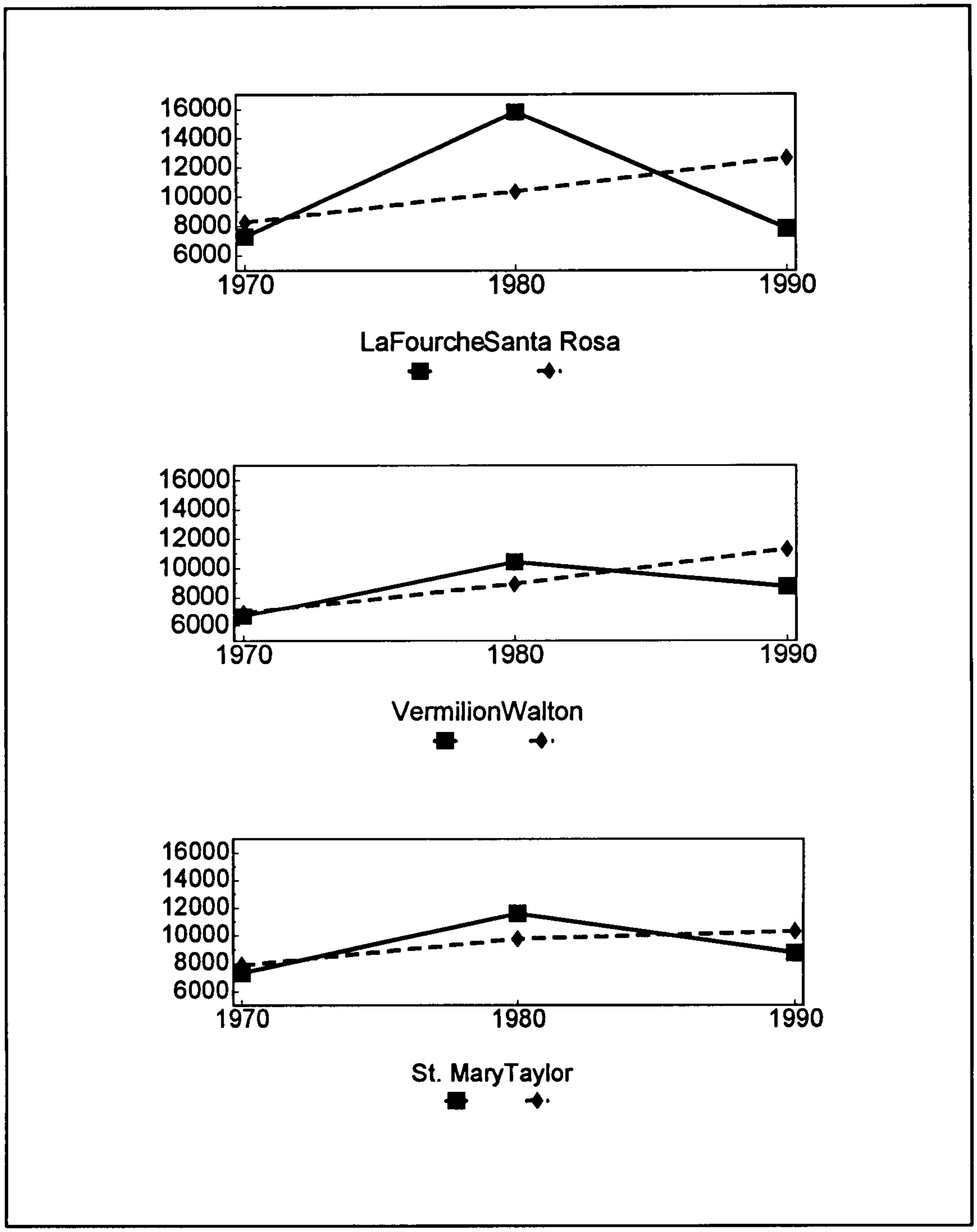

Figure 5. Parishes and Counties Matched on Demographic Factors: Per Capita Income (1990 Dollars)

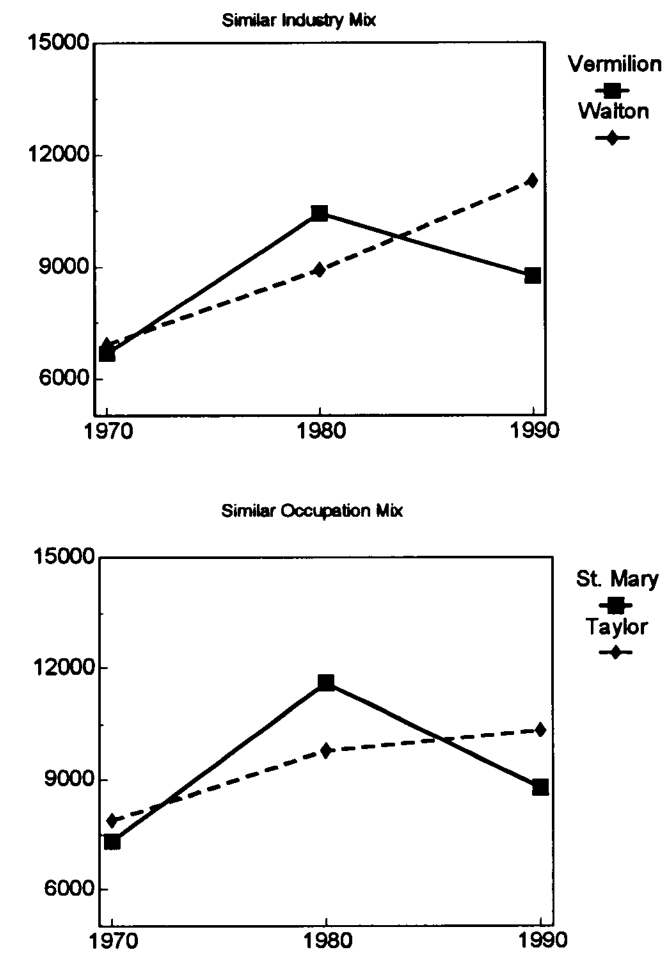

Figure 6. Parishes and Counties Matched on Industry and Occupation: Per Capita Income in 1990 Dollars

To summarize the per capita income data, the information indicates that Louisiana starts slightly lower than Florida, approaches or exceeds Florida in 1980, and is well below Florida again by 1990. Relative to Florida, there is clearly an improvement in Louisiana per capita income that corresponds to increased oil and gas production. And, there is a subsequent decline that coincides with industry decline. Though an analysis based on averages has a great deal of intuitive appeal, it should be noted that measures of per capita income exhibit the same weakness associated with all arithmetic means. That weakness is a sensitivity to extreme values. In this case, our findings in Figures 4-6 might be products of a few extreme income figures. A handful of coastal families involved with oil and/or gas might exhibit sharp 1970 to 1980 increases in household income and skew the results. Thus, the apparent increase in Louisiana statewide and coastal per capita income could be an artifact of a few outliers. In the section that follows, we report on the median, a measure of central tendency that is far less sensitive to extreme scores.

Median Family Income. The median of a distribution is that point which divides it exactly in half (the 50th percentile). One half of the cases fall below the median and one half fall above. As such, extreme values will not distort the median as they will a mean. In highly skewed distributions such as income, it is very advisable to analyze medians as well as means. We do so here by drawing median family income figures from the 1970, 1980, and 1990 Censuses. Readers should note the shift here to family income as opposed to individual (per capita) income in the previous section. For descriptive purposes, dollar amounts are again expressed in 1990 terms.

The statewide data for median family income are contained in the upper panel of Figure 7. Florida exhibits steady, modest increases across time in median income. Louisiana, on the other hand, begins lower than Florida, slightly exceeds Florida in 1980, and returns to roughly 1970 levels in 1990. This is a level well below comparable income in Florida for 1990.

The income data in the lower panel of Figure 7 show Florida coastal income is slightly lower than the corresponding statewide income. The pattern of modest family income growth across time in Florida coastal areas is very similar to the statewide data. Louisiana coastal median family income in 1970 is higher than Florida coastal income and is precipitously higher than the coastal panhandle of Florida in 1980. However, by 1990, median income in coastal Louisiana is well below that of coastal Florida. In fact, once inflation is taken into account, median family income in the coastal parishes of Louisiana is actually less in 1990 than it was in 1970.

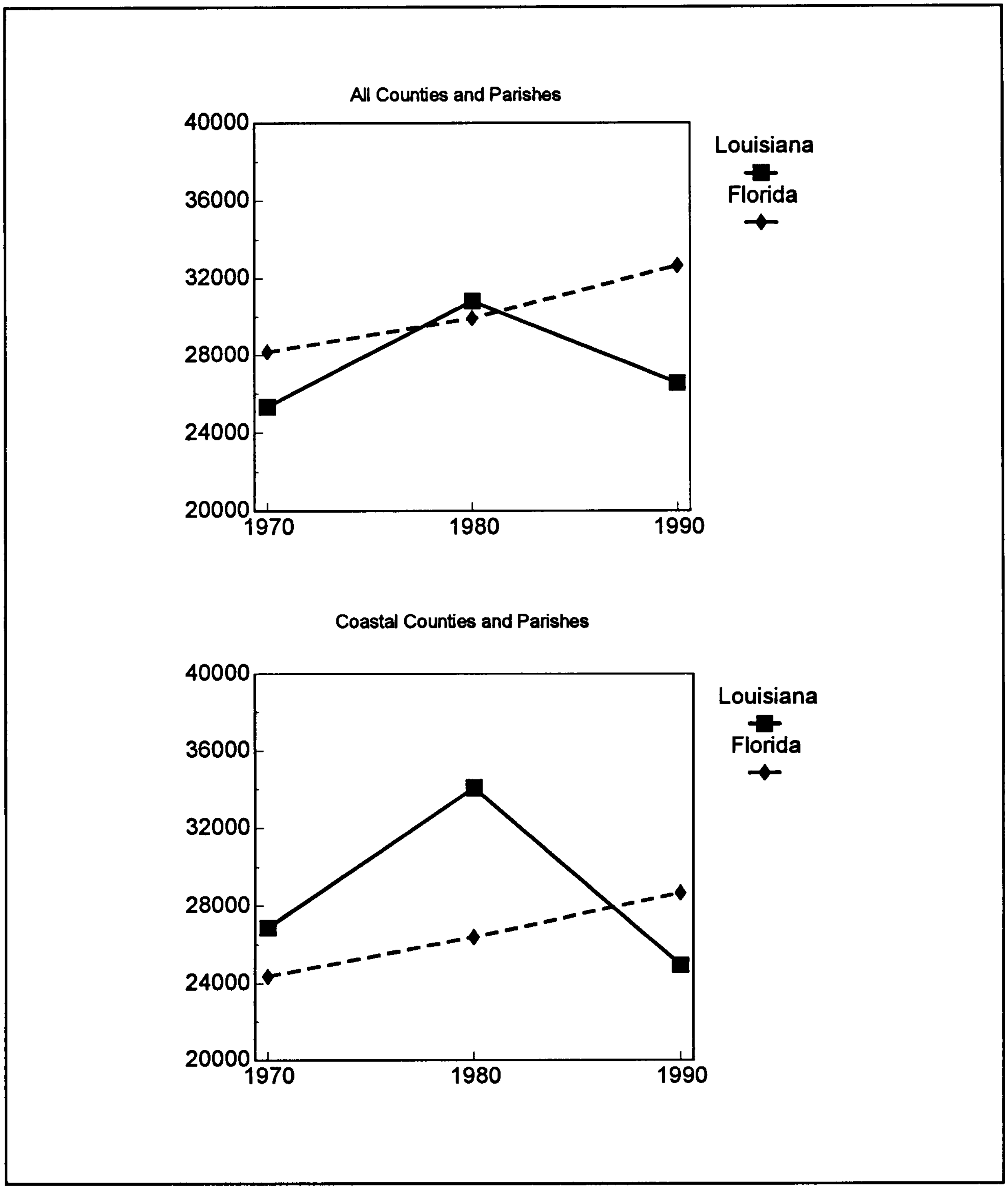

Figure 7. Statewide and Coastal Median Family Income: 1970, 1980, 1990 (1990 Dollars)

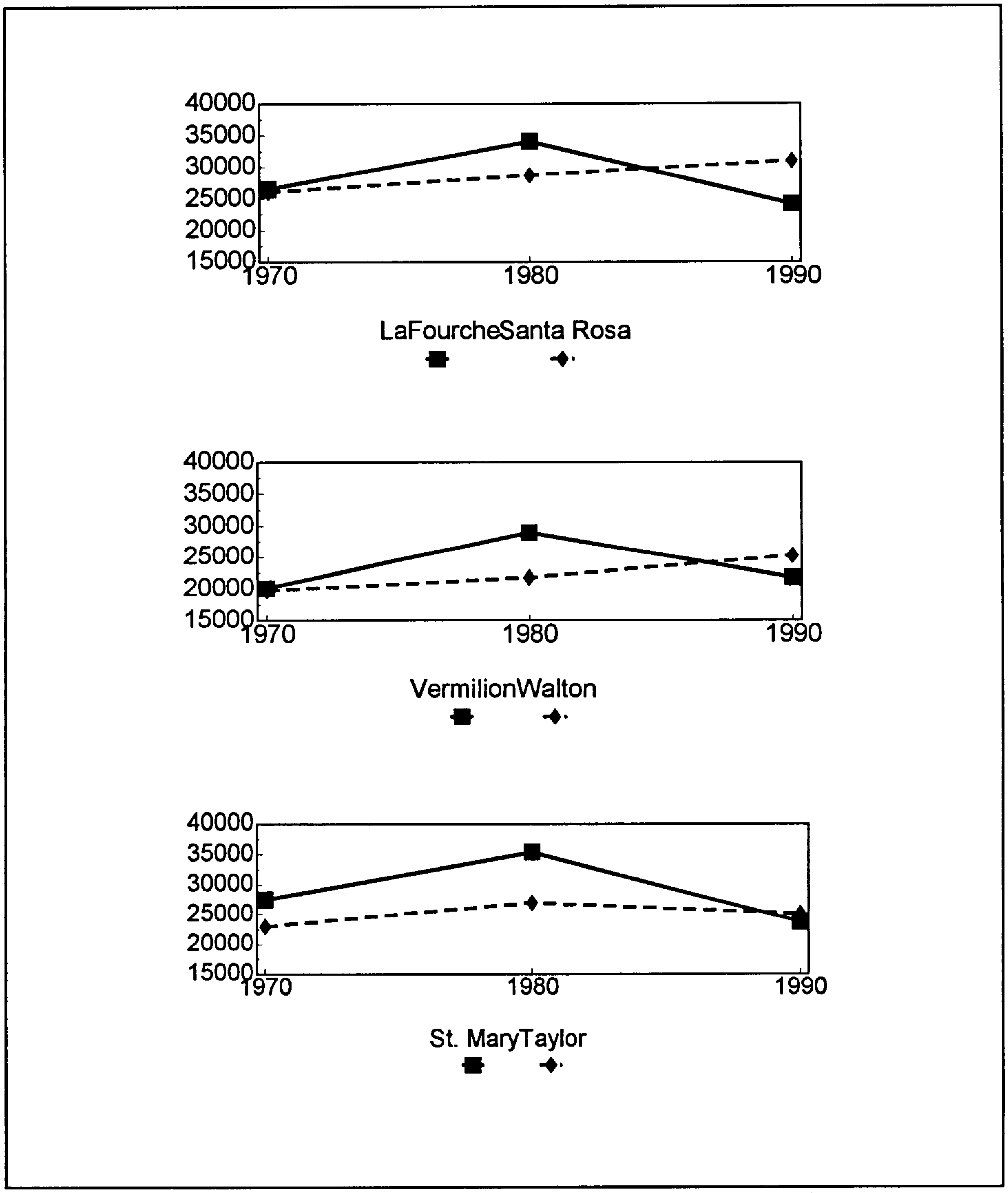

Figure 8. Parishes and Counties Matched on Demographic Factors: Median Family Income (1990 Dollars)

Median income data for counties and parishes matched on demographic factors appear in Figure 8. These comparisons are fairly consistent in showing a modest increase in median income for Florida and a sharp increase for Louisiana followed by an equal or greater decrease for Louisiana by 1990. In two of the three cases, the Louisiana median income figures are less in 1990 than they were in 1970. The areas paired on industry and occupational features in Figure 9 both show Louisiana higher than Florida at the outset, much higher during the expansion of oil and gas industry activity, and lower after the industry contraction. St. Mary Parish exhibits a 1990 median family income lower than in 1970.

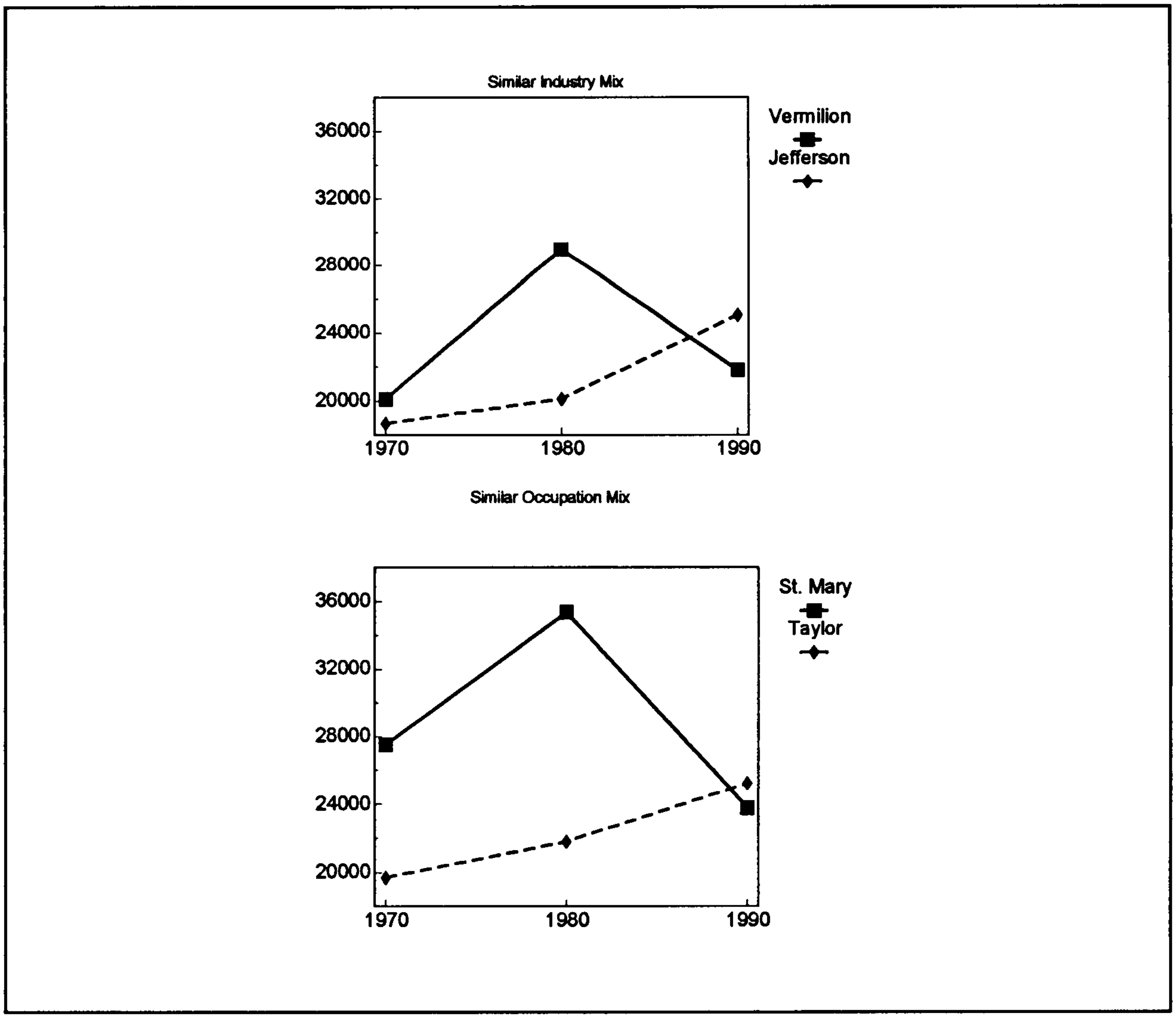

Figure 9. Parishes and Counties Matched on Industry and Occupation: Median Family Income in 1990 Dollars

Like the per capita income figures, the median family income data show Louisiana close to Florida before the expansion of oil and gas industry activity, generally higher than Florida as the expansion peaks around 1980, and lower to much lower than Florida after the major decline in oil and gas activities of the 1980s. Unlike the per capita income figures, the median income data for the Louisiana parishes exhibit lower income in 1990 than they do in 1970. Taken together, these measures of the central tendency of the income distribution reveal profound and potentially far-reaching changes in Louisiana average and median incomes over the period of oil and gas activity expansion and contraction. The central tendency measures suggest how typical Louisiana persons and families fared across these important two decades in the history of onshore and offshore development. Yet, the mean and median measures tell us little about the dispersion of income or how it is distributed among Louisiana families and households. For that analysis, we now turn to several measures of income inequality and further compare Louisiana and Florida from 1970 to 1990.

Measures of Inequality.

Gini Coefficient. We begin with our description of 1970, 1980, and 1990 Louisiana and Florida income inequality by examining the most familiar measure: the Gini coefficient. Readers are reminded that the Gini coefficient is most sensitive to transfers around the middle portion of the income distribution. The upper panel of Figure 10 presents Gini coefficients for the states and for coastal parishes and counties. The coefficients indicate that statewide family income inequality in Louisiana was higher at all points in time. Both states exhibit a decline in inequality for the 1970 to 1980 period. Louisiana's inequality then increases sharply while Florida posts a modest increase from 1980 to 1990.

The evidence in the lower panel of Figure 10 for coastal parishes and panhandle counties is somewhat different. The absolute levels of inequality for the coastal areas of both states are lower than the overall state levels displayed in the upper panel of the figure. Some of this difference is no doubt due to the relative homogeneity of coastal parishes and counties versus more heterogeneous statewide groupings. The inequality results here generally show higher statewide inequality when compared to more localized coastal areas. Inequality in Florida is initially higher than in Louisiana, but Florida income inequality declines steadily across the decennial time points. The patterns reverse themselves in 1990 as coastal inequality is highest in Louisiana (and higher than either of the earlier points).

The trend among coastal areas for Louisiana to have higher 1990 income inequality than Florida is borne out in the data for pairs of parishes and counties matched on demographic factors. In all three panels of Figure 11, panhandle Florida inequality is initially higher, but is eclipsed by Louisiana inequality in 1990. Two of the three paired areas show 1990 inequality in Louisiana to be much higher than at any previous point. Figure 12 depicts Gini coefficient income inequality for pairs of

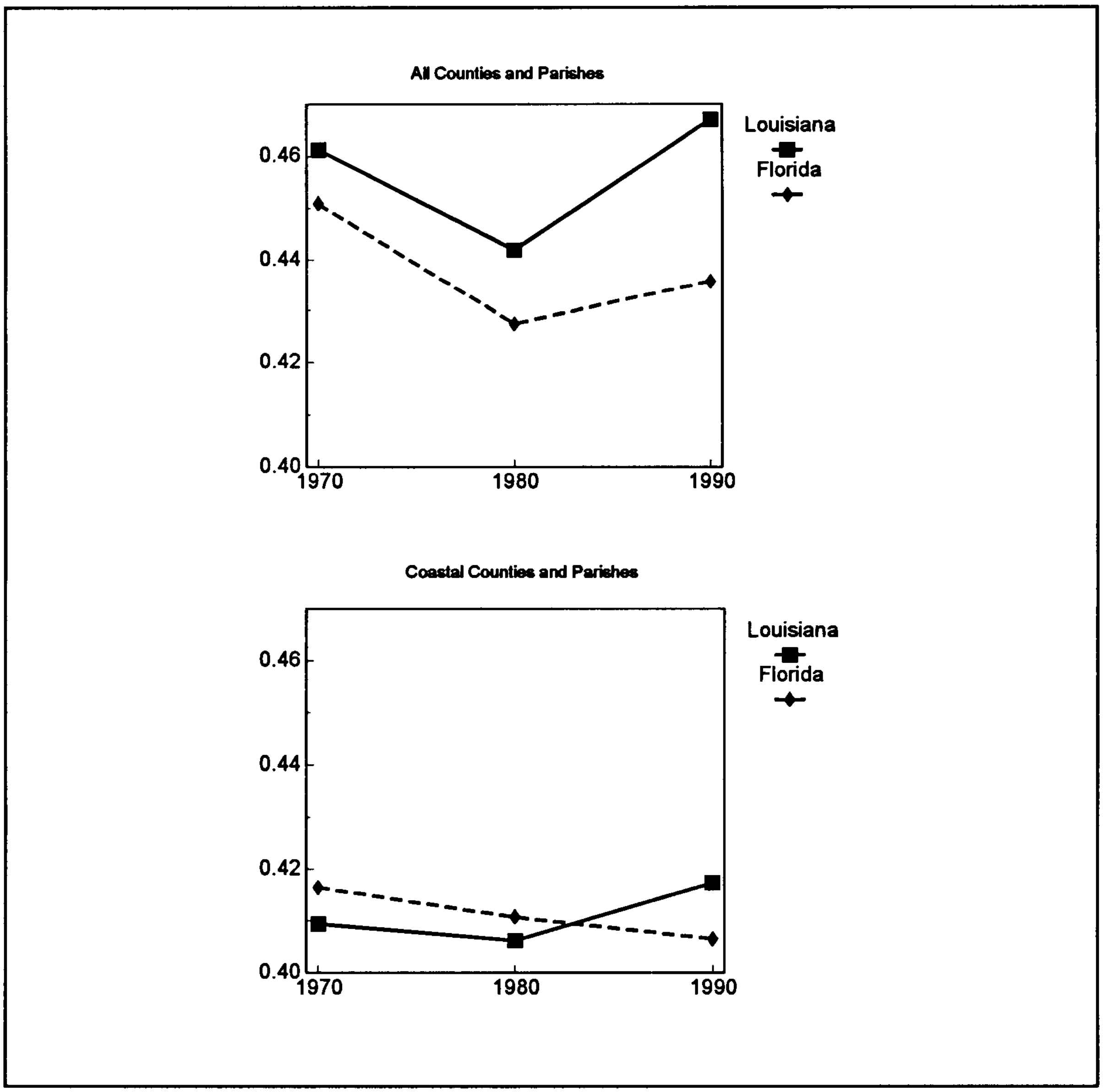

Figure 10. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Gini Coefficient.

coastal parishes and counties matched on industry (upper panel) and occupational characteristics (lower panel). The data in the figure further corroborate the trend apparent in earlier figures in which Louisiana income inequality is initially lower than Florida, but higher as of 1990.

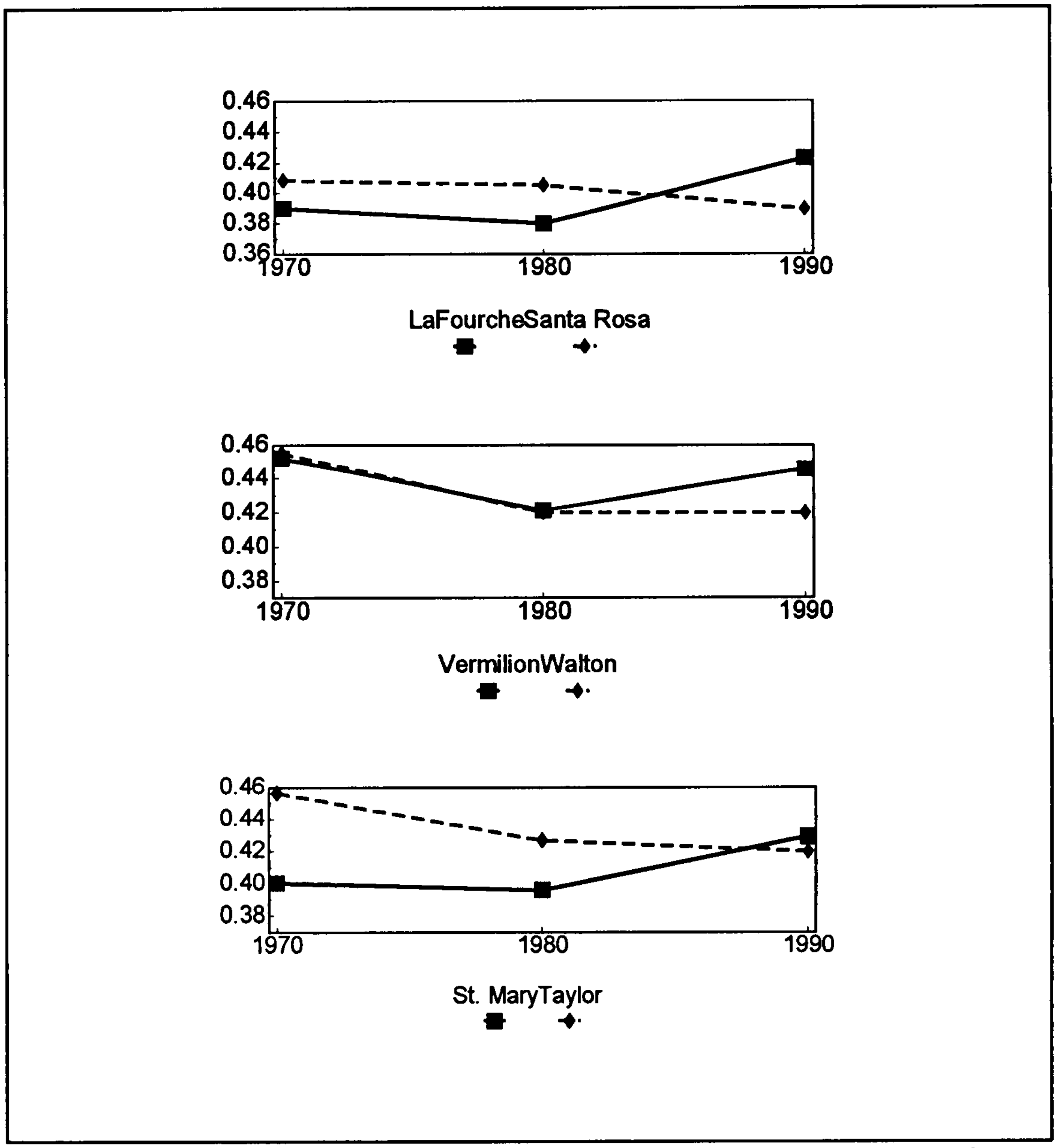

Figure 11. Parishes and Counties Matched on Demographic Factors: Gini Coefficient

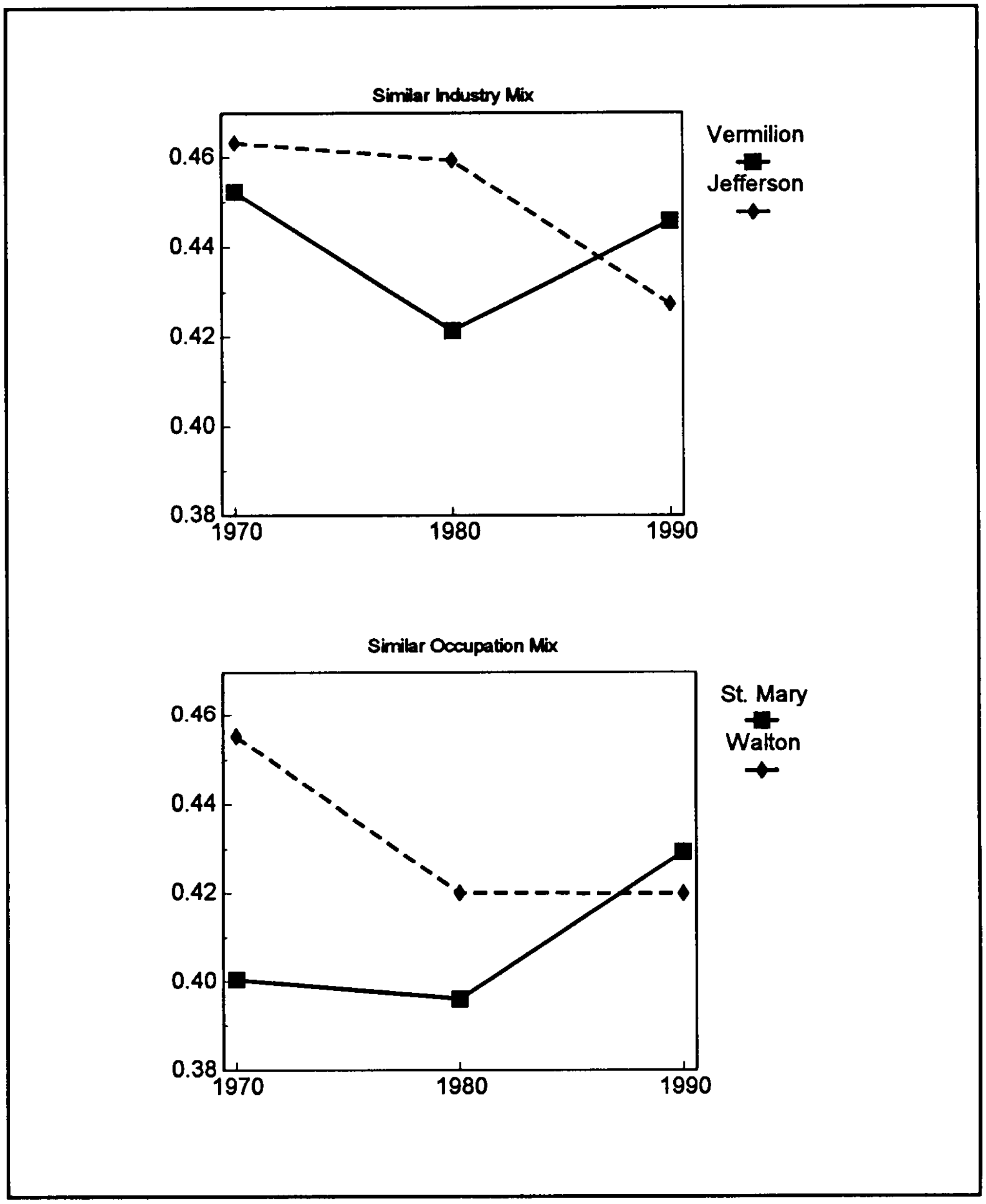

Figure 12. Parishes and Counties Matched on Industrial and Occupational Mix: Gini Coefficient

To summarize our findings for the widely employed Gini coefficient of income inequality, the data indicate higher 1990 inequality in Louisiana than in Florida for statewide and coastal area comparisons. By 1990, a time reasonably sufficient to capture the socioeconomic effects of declining onshore and offshore activity across the 1980s, Louisiana income inequality is higher than that of Florida and higher than either of the earlier time points for Louisiana. Since the Gini coefficient is

most sensitive to income transfers in the middle of the income distribution, these findings should be interpreted with that sensitivity in mind. For the 1970-1980 period of oil and gas industry expansion, middle-income inequality patterns for Louisiana do exhibit a decline that corresponds to the development activity. Inequality levels increase, however, during the 1980-1990 period of industry contraction.
In the section that follows, we turn to an inequality measure that is regarded by most researchers as sensitive to transfers in the middle and upper portions of the income distribution.

Theil Measure. Statewide family income inequality comparisons utilizing Theil's information-theoretic inequality measure are made in the upper panel of Figure 13. The data for Florida indicate a steady decline in income inequality across the period of interest. In contrast, the Louisiana data are far more volatile, exhibiting a precipitous decline in inequality from 1970 to 1980 followed by a substantial increase from 1980 to 1990. These sharp differences are coupled with an intriguing convergence of 1980 inequality levels for the two states. Like the Gini coefficients in Figure 10, however, these Theil inequality measures show much higher 1990 income inequality in Louisiana than in Florida.

The coastal area Theil measures displayed in the lower panel of Figure 13 indicate a steady decline for coastal areas of Florida that parallels the statewide Florida data in the upper panel. The Louisiana coastal data, however, exhibit even sharper declines and increases than are evident for Louisiana statewide. Also, unlike the Louisiana state data, the coastal parishes exhibit a 1980 inequality level that is much below their Florida panhandle counterparts. Though the coastal Theil measures show a much more exaggerated pattern, they do parallel the Gini coefficients in depicting less 1970 and 1980 inequality in Louisiana than in Florida. And, also like the Gini findings, the Theil results exhibit a reverse in the patterns by 1990 in which there is significantly more income inequality in Louisiana coastal areas than in the Florida panhandle.

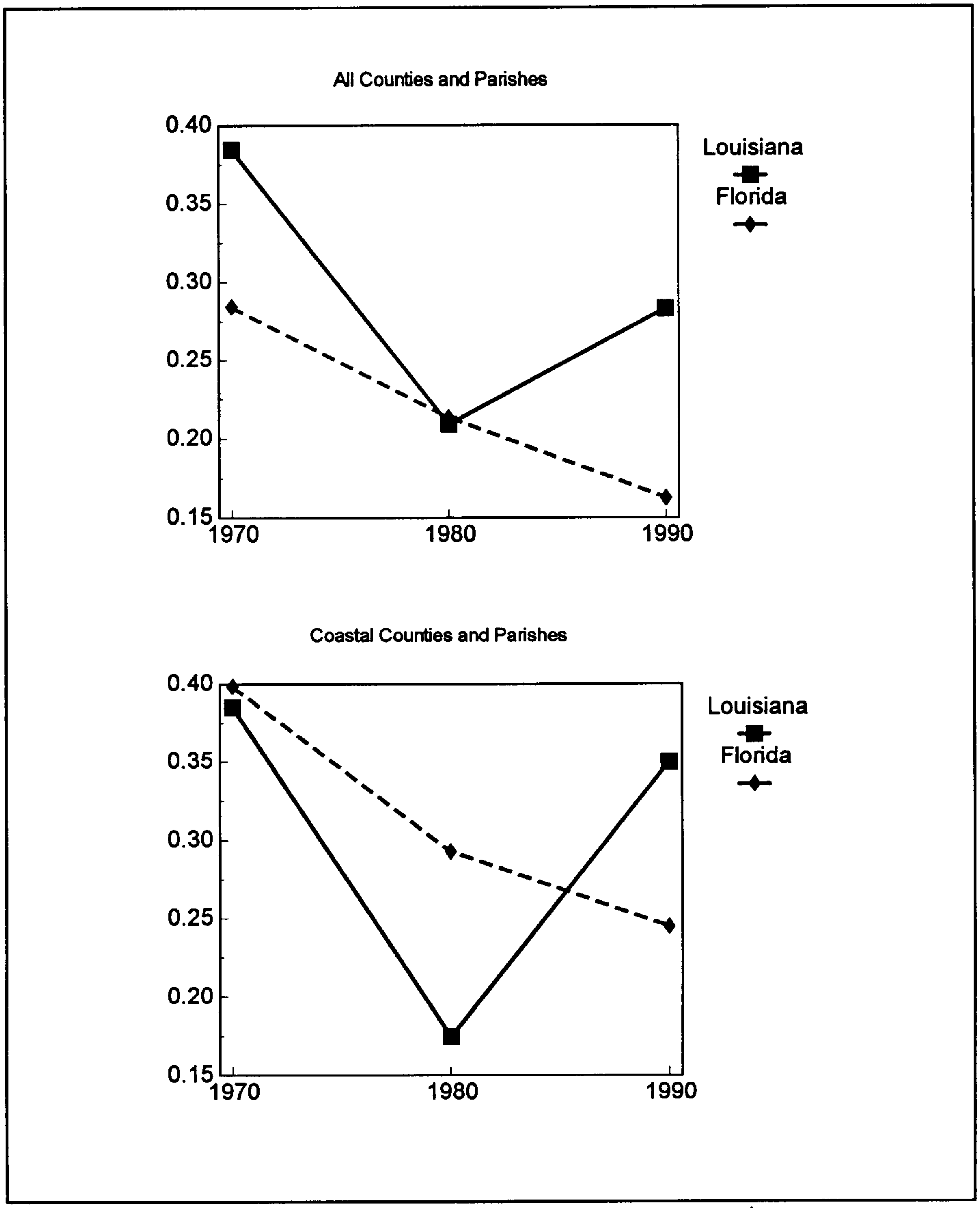

Figure 13. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Theil Measure

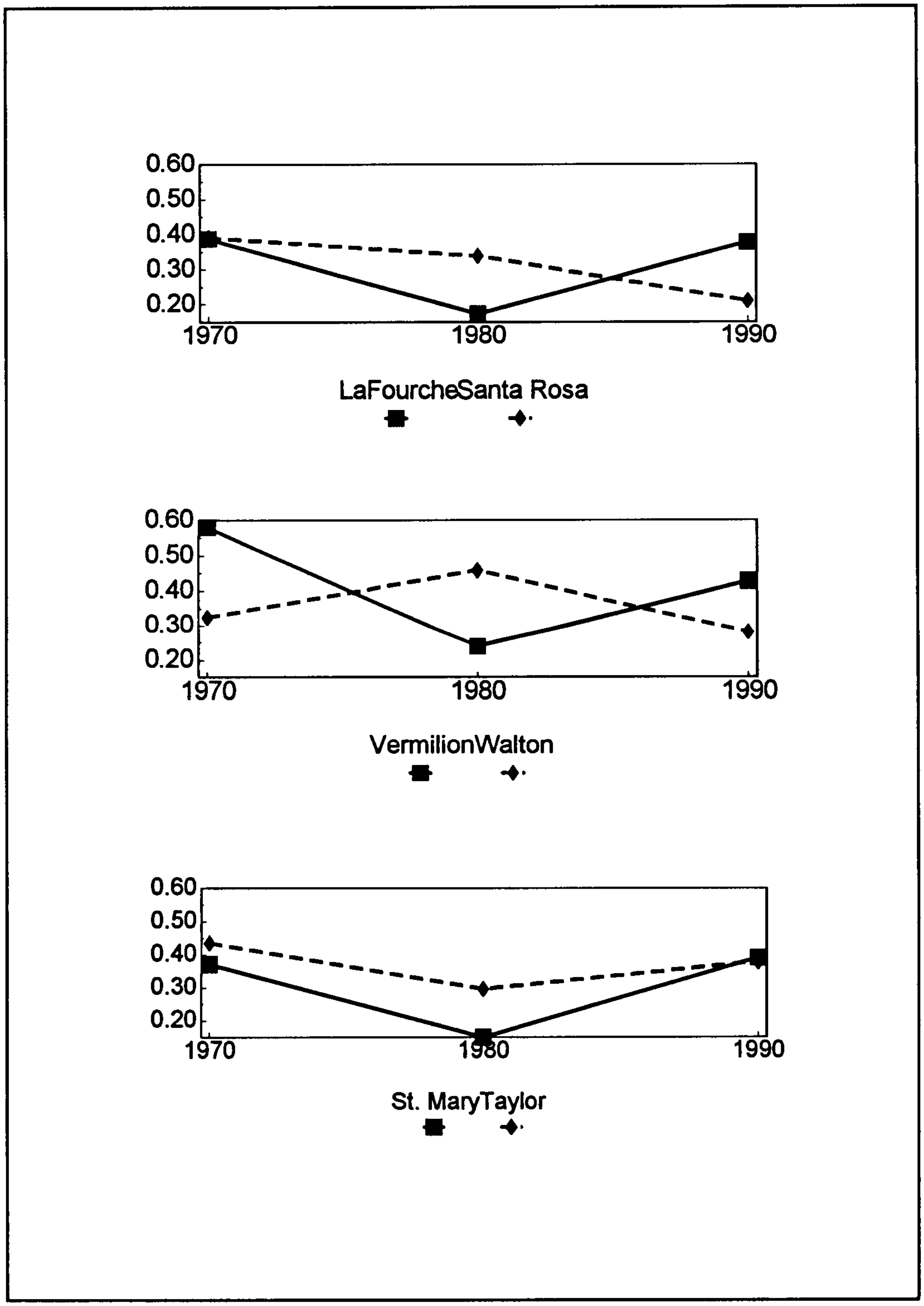

Figure 14. Parishes and Counties Matched on Demographic Factors: Theil Coefficient

Data on matched pairs of parishes and counties in two of the three panels of Figure 14 correspond closely with the overall data in Figure 12. The Theil coefficients indicate sharper 1980 to 1990 increases in income inequality for Louisiana than for Florida. Inequality is greater in each of the coastal parishes than in the coastal counties. Similarly, the industry and occupation matched areas in Figure 15 show Louisiana income inequality to be more volatile across the period and higher than Florida by 1990.

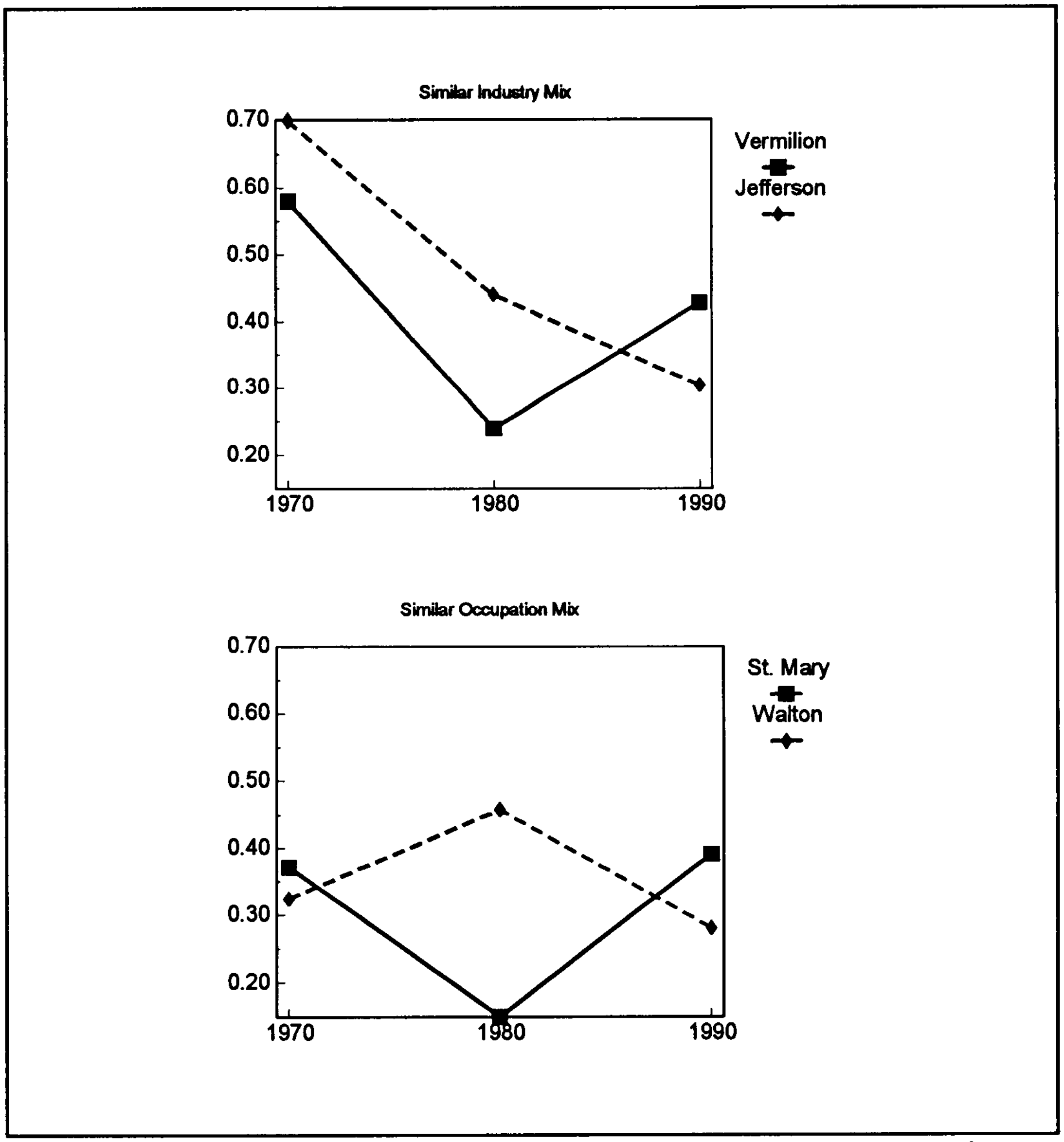

Figure 15. Parishes and Counties Matched on Industrial and Occupational Mix: Theil Coefficient

The Theil coefficients in Figures 13-15 indicate strong swings in Louisiana middle and upper income inequality levels associated with key periods of expansion and contraction of oil and gas industrial activity. Though very different from the steady decline of income inequality exhibited in most areas of Florida, the Louisiana inequality as measured by the Theil coefficient does not return to pre-boom levels. This contrasts with the Gini results which show inequality to be greater in Louisiana in 1990 than in 1970. These different outcomes are no doubt due to the differential sensitivities of the Gini and Theil measures. A comparison of the Theil and Gini results suggests that families in the upper income ranges weathered the oil and gas industry contraction better than middle-income families. We speculate that middle-income families fortunes were more directly tied to the oil and gas industry primarily through employment of one or more household members. This would be an interesting hypothesis to test with individual-level survey data.
In the section that follows, we employ the Atkinson inequality measures that permit the researcher to gauge the level of sensitivity and precisely compare results for various levels (in addition to other advantages outlined above).

Atkinson Measures. We first present findings for the Atkinson inequality measure with $\epsilon = 0.50$. At this level, we expect the results to be most similar to those for the Gini coefficient in that the focus is on the middle portion of the income distribution. Indeed, though the basic calibrations of the measures differ by definition, the Atkinson measures in Figure 16 do exhibit a pattern similar to the Gini coefficients in Figure 10. The statewide 0.50 Atkinson measures show lower inequality in Florida for all three time points. Though both states exhibit parallel rates of decline in income inequality for 1970-1980, they diverge sharply between 1980 and 1990 with Louisiana inequality higher than it was in 1970. The coastal parish and panhandle county comparison in the lower panel of Figure 16 also shows sharply higher 1990 income inequality in Louisiana. Unlike the statewide figures, however, the coastal data indicate lower inequality in Louisiana than in Florida for 1970 and 1980. The same pattern is borne out in two of the three panels of Figure 17 where parishes and counties are paired on demographic factors. Louisiana 1990 income inequality is also higher than that in Florida in the comparisons of industrial and occupational matches in Figure 18.

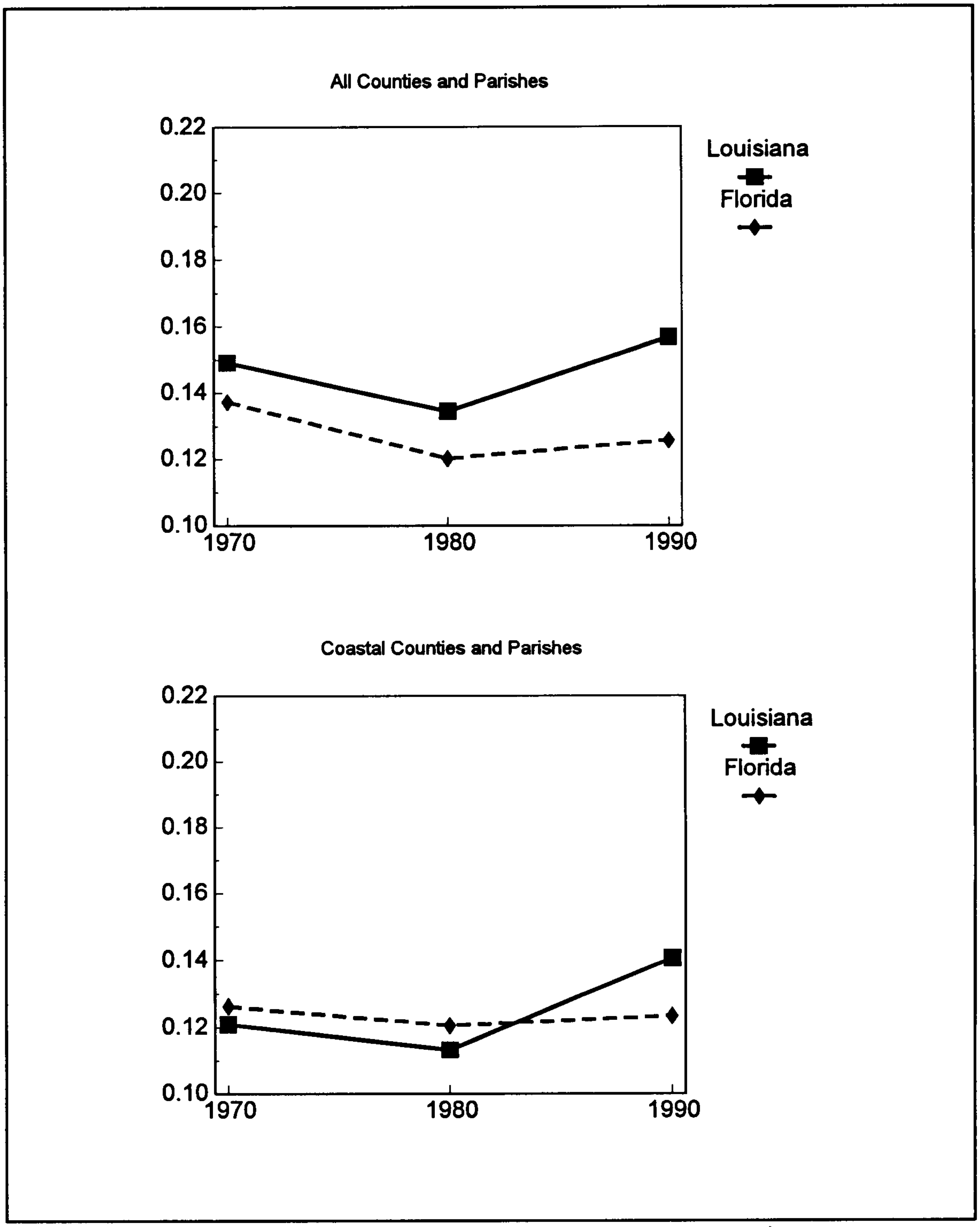

Figure 16. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Atkinson Measure (0.50)

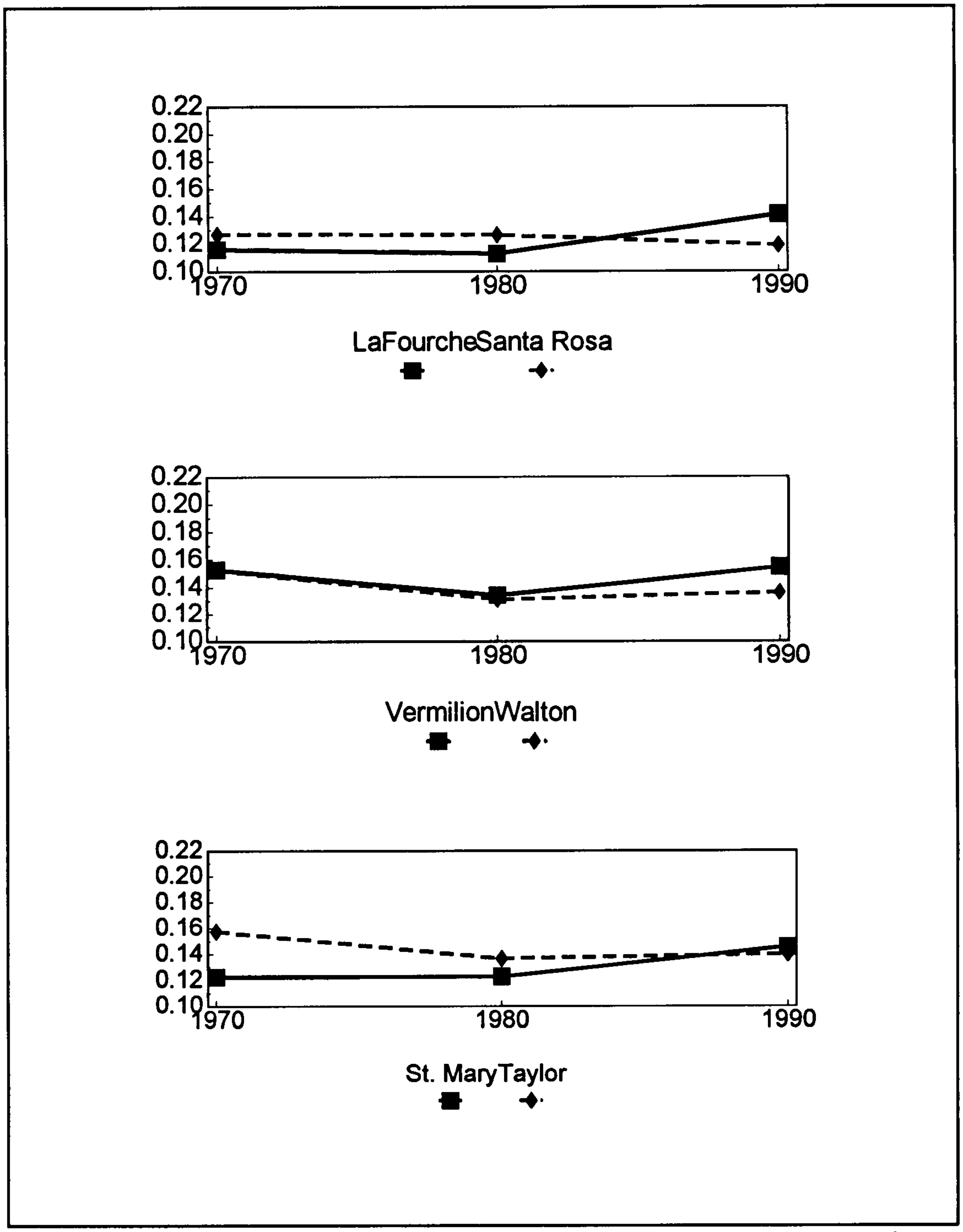

Figure 17. Parishes and Counties Matched on Demographic Factors: Atkinson Inequality Measure (0.50)

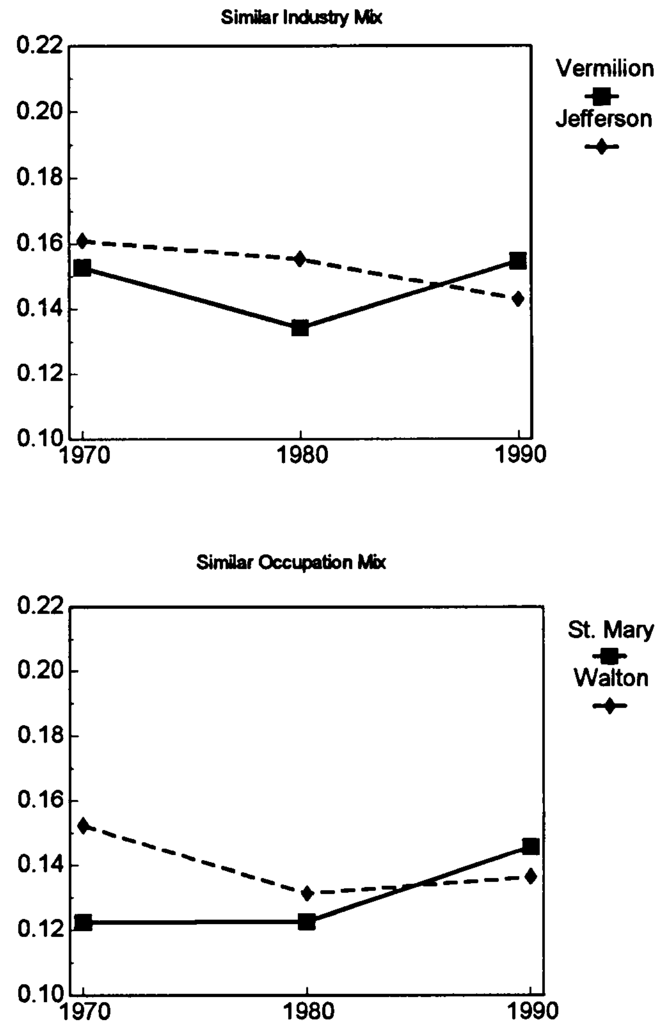

Figure 18. Counties and Parishes Matched on Industrial and Occupational Mix: Atkinson Measure (0.50)

Statewide Atkinson measures with $\epsilon = 1.0$ are displayed in the upper panel of Figure 19. These data show the now familiar pattern in which Louisiana inequality declines from 1970 to 1980 and increases sharply from 1980 to 1990. Another frequent pattern evident in the lower panel of the figure is the propensity for 1970 and 1980 Louisiana coastal inequality to be lower than the coastal Florida panhandle but much higher by 1990. The data for matched pairs of counties and parishes in Figures 20 and 21 also closely resemble those for the Gini coefficient and for Atkinson $\epsilon = 0.50$.

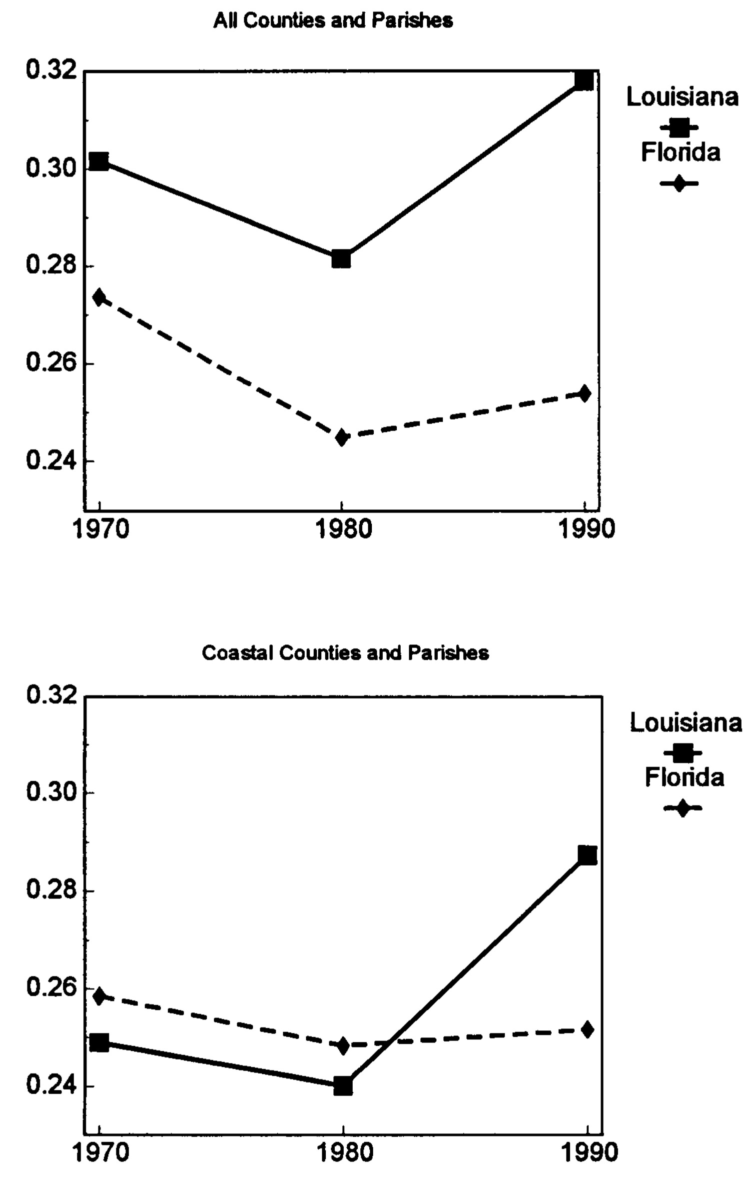

Figure 19. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Atkinson Measure (1.0)

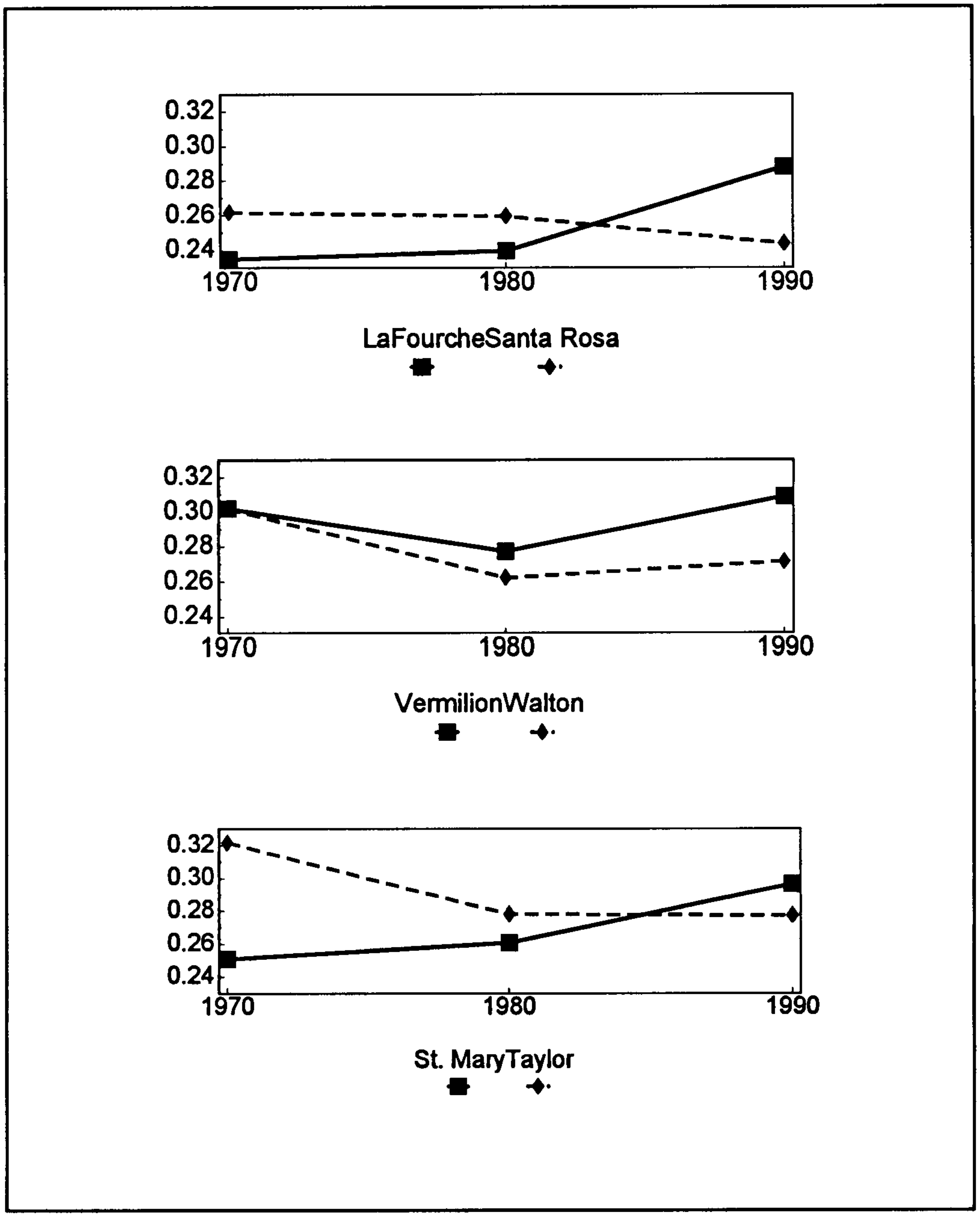

Figure 20. Parishes and Counties Matched on Demographic Factors: Atkinson Inequality Measure (1.0)

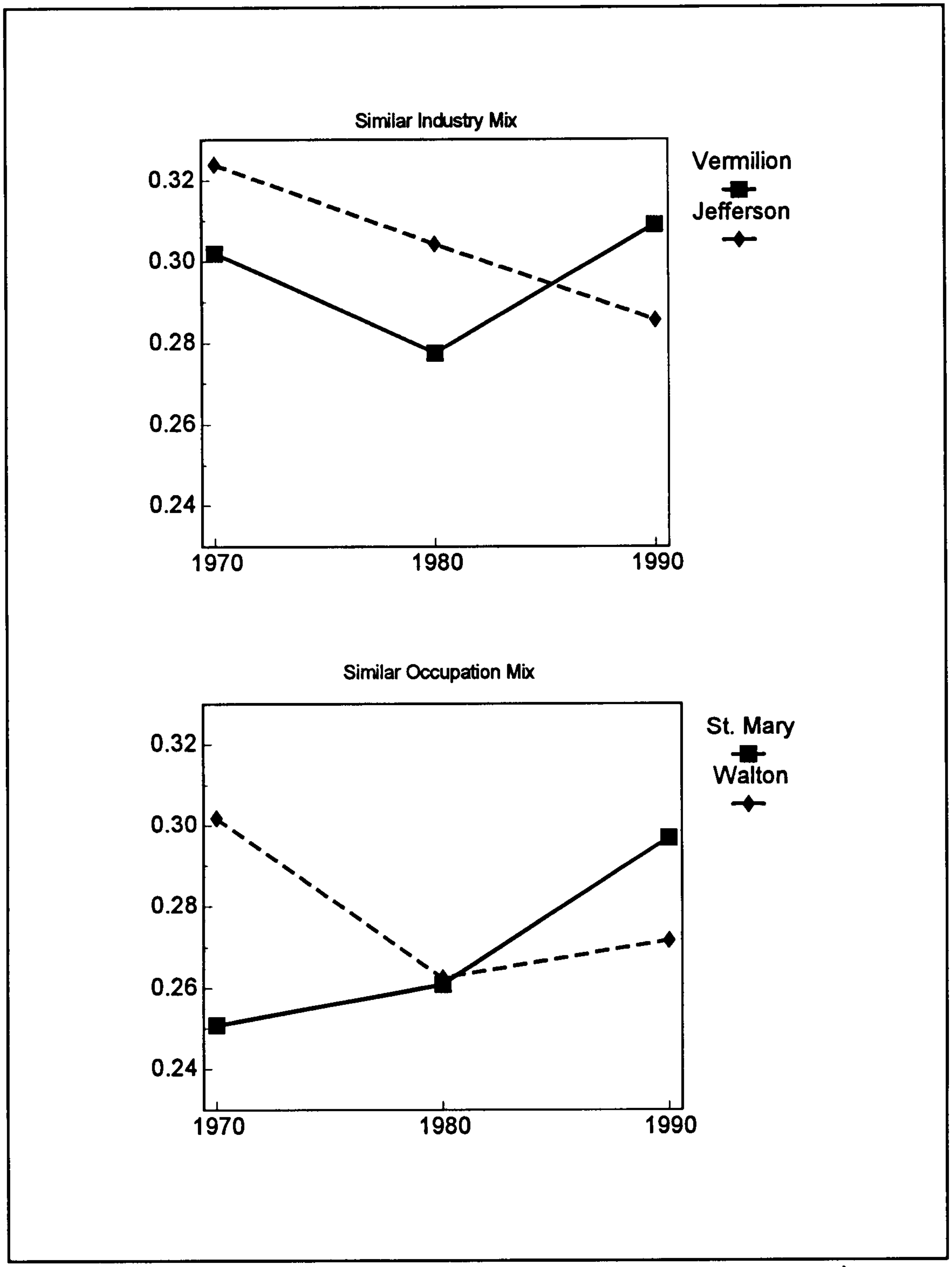

Figure 21. Counties and Parishes Matched on Industrial and Occupational Mix: Atkinson Measure (1.0)

The inequality patterns for $\epsilon = 1.5$ are displayed in Figures 22, 23, and 24. Though the general trends follow the previous figures ($\epsilon = 0.5$ and 1.0), the increase in Louisiana income inequality after 1980 is not as pronounced. Nonetheless, like all of the inequality measures we have reviewed thus far, the Atkinson 1.5 measures show inequality initially lower and then higher during the decline in offshore activity. Moreover, the patterns show little similarity to those of the state of Florida or even the coastal panhandle counties of Florida.

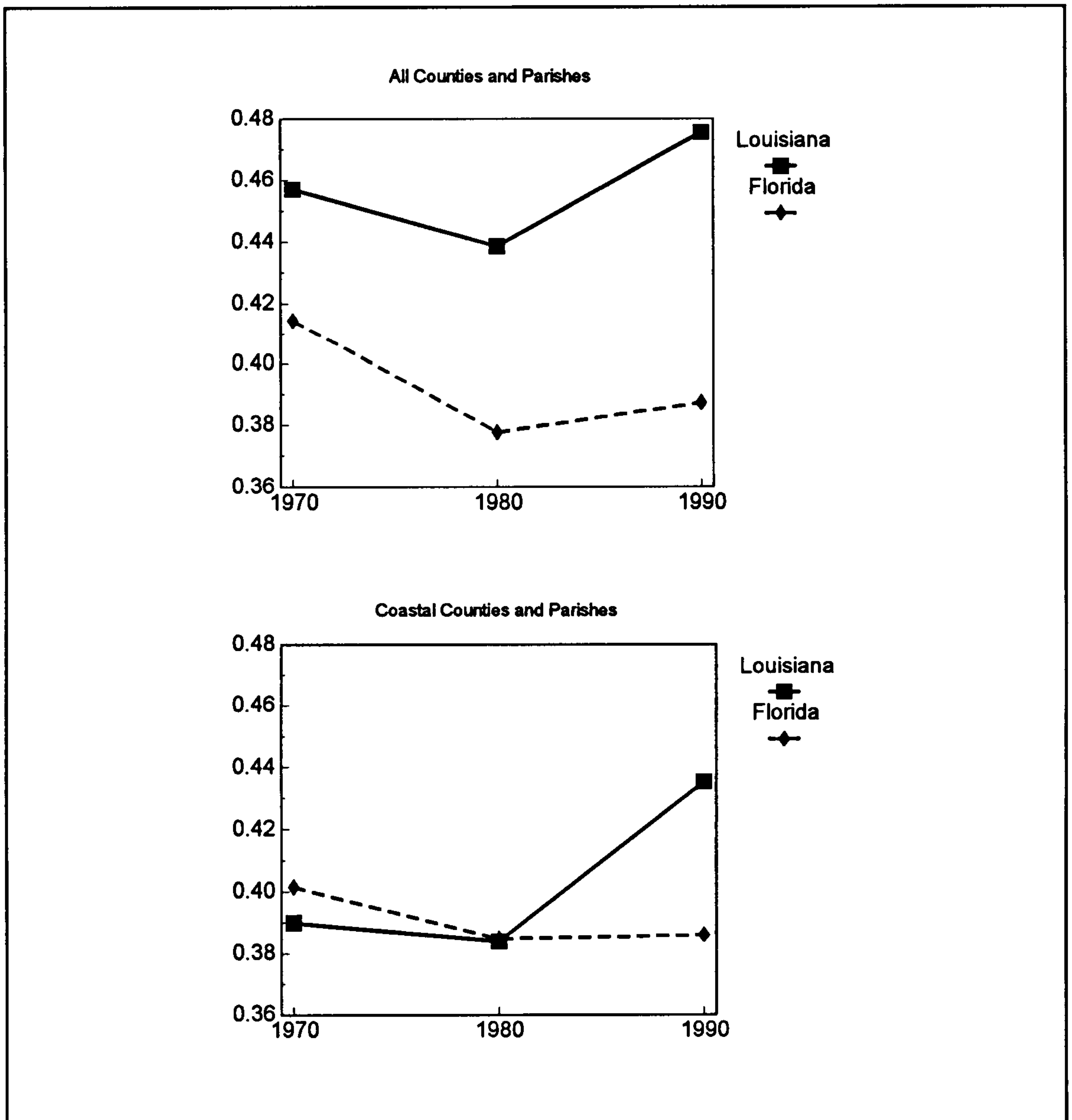

Figure 22. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Atkinson Measure (1.5)

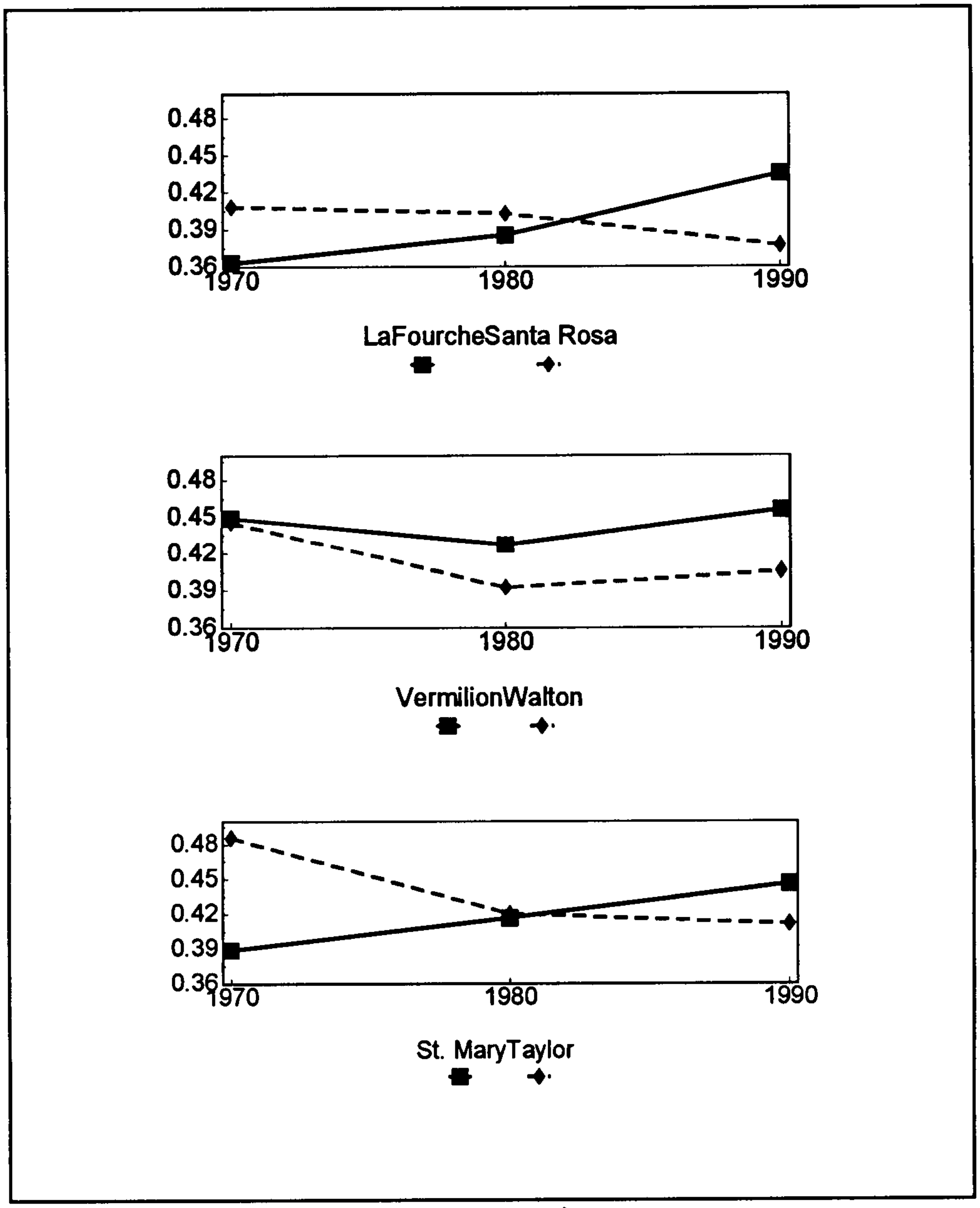

Figure 23. Parishes and Counties Matched on Demographic Factors: Atkinson Inequality Measure (1.5)

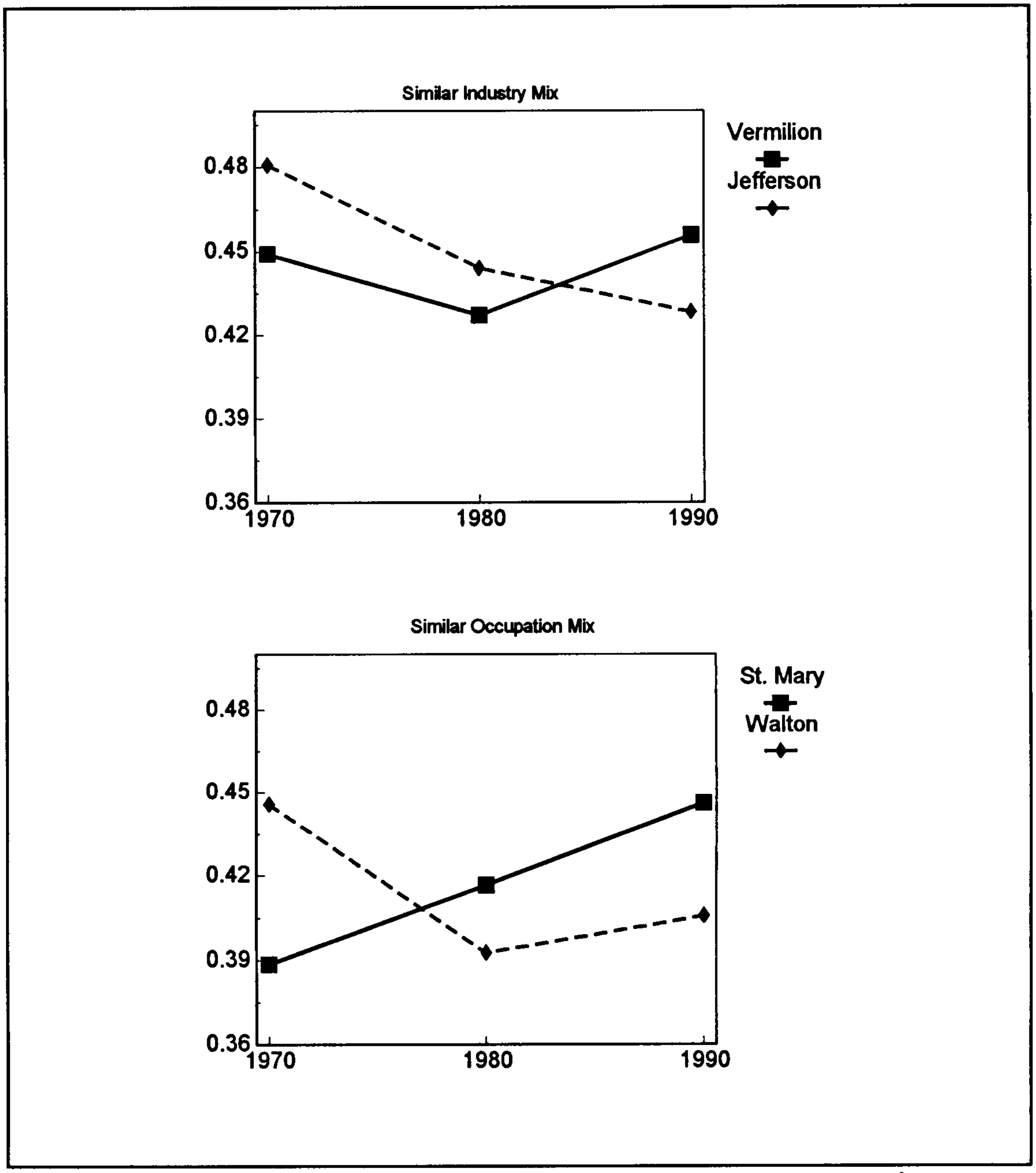

Figure 24. Counties and Parishes Matched on Industrial and Occupational Mix: Atkinson Measure (1.5)

Like the Gini and Theil results, the Atkinson measures presented thus far (ϵ = 0.5, 1.0, and 1.5) show a decrease in Louisiana family income inequality around the peak of oil and gas activity followed by a sharp increase in inequality as offshore work declines. This trend is distinct from those of Florida as a whole and from coastal panhandle counties of Florida even when parishes and counties are closely matched on 1970 demographic, industrial, and occupational factors. Since the Atkinson 0.5, 1.0, and 1.5 measures target the upper middle through lower middle portions of the income distribution, we expect the results to resemble most closely those of the Gini and Theil measures. The Atkinson results presented below focus increasingly on the lower tail of the income distribution and, as such, provide important evidence of the impact of oil and gas development among lower income families.

Statewide and coastal area Atkinson measures with ϵ = 2.0 are presented in Figure 25. The state and coastal patterns therein are somewhat different from those observed for lower values of ϵ. To be sure, statewide inequality in Louisiana exhibits a decrease from 1970 to 1980 followed by an increase that leaves inequality higher by 1990. And, Florida statewide income inequality declines from 1970 to 1980 and remains much lower than Louisiana. Though these are familiar patterns, it is important to note that the decrease and subsequent increase in Louisiana inequality are not as pronounced as in Figures 16, 19, or 22. The data for coastal areas in the lower panel also show a modest divergence from the Atkinson results above. Like the statewide Louisiana data, the coastal Louisiana data do not exhibit quite so sharp an upward trend in inequality from 1980 to 1990 as we observed for lower levels of ϵ. Also unlike some of the earlier figures, coastal Louisiana inequality in Figure 25 is greater in 1980 than in Florida. Heretofore we have typically found Louisiana inequality to be less than that of Florida in 1980.

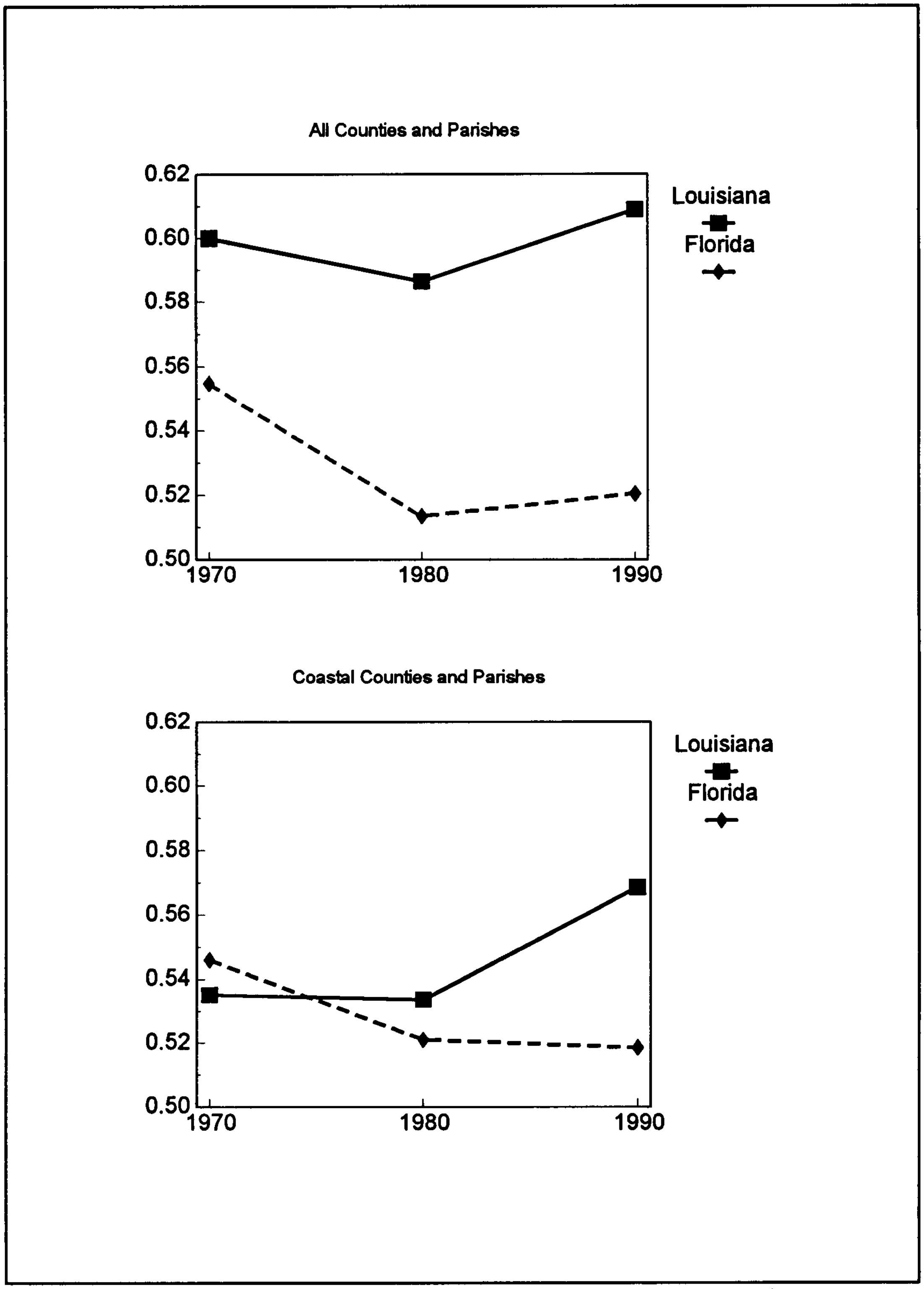

Figure 25. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Atkinson Measure (2.0)

The data for pairs of counties and parishes matched on demographic factors in Figure 26 show this difference in the rate of change more clearly. LaFourche Parish, for example, exhibits

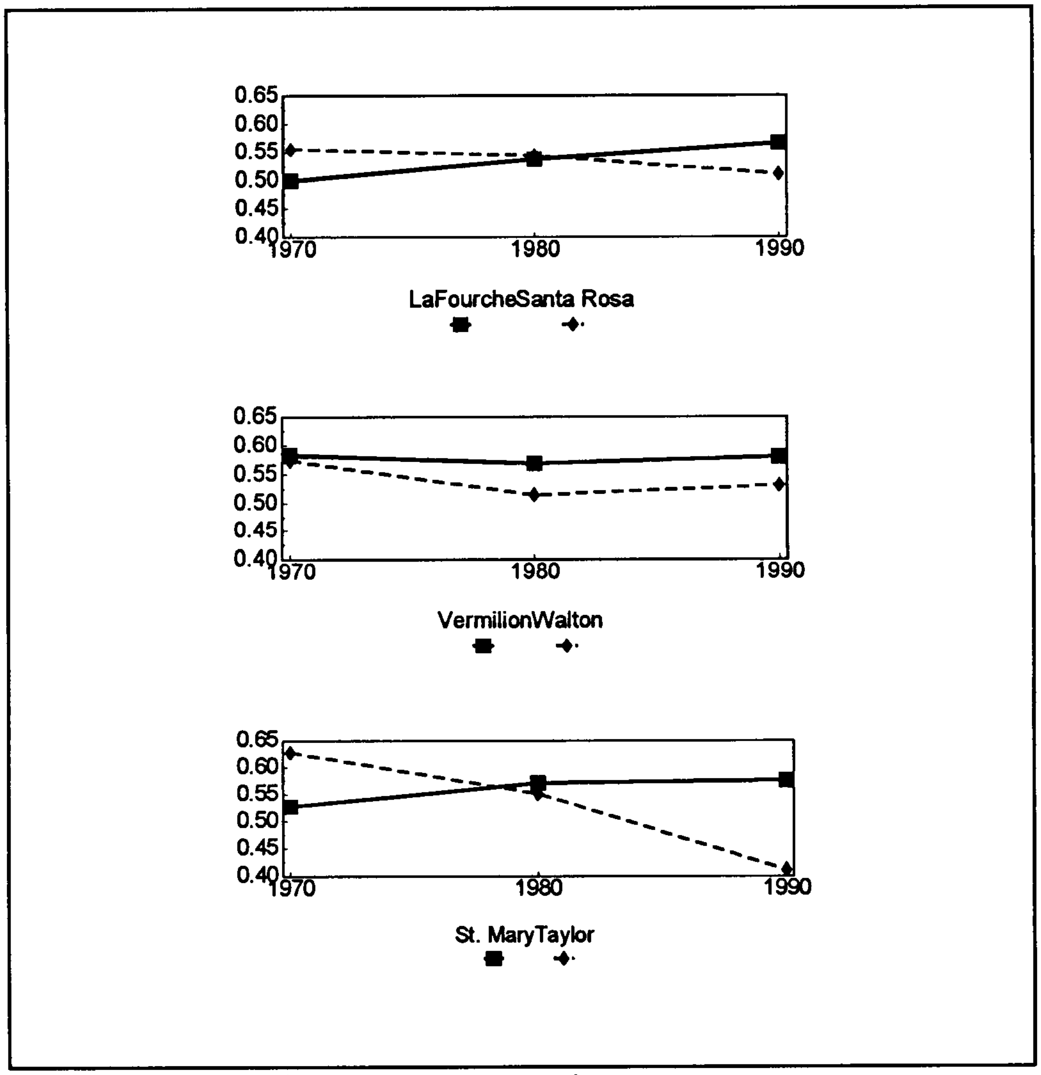

Figure 26. Parishes and Counties Matched on Demographic Factors: Atkinson Inequality Measure (2.0)

a steady, but modest increase in income inequality (compare to the much sharper increase evident Figure 20). Moreover, the increases in income inequality for Vermilion and St. Mary Parishes are very slight in Figures 26 and 27. The 2.0 Atkinson measures suggest a modest, but clear lessening of change over time periods that correspond to increases and decreases in OCS activity.

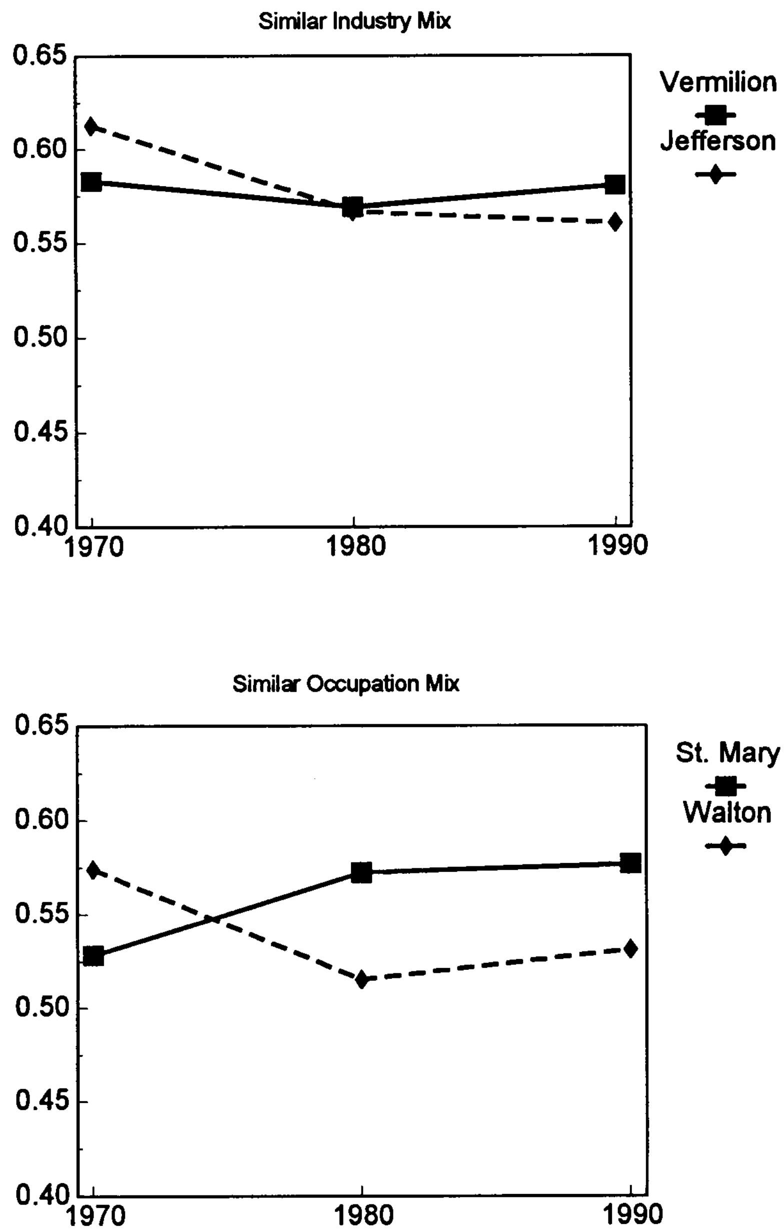

Figure 27. Parishes and Counties Matched on Demographic Factors: Atkinson Inequality Measure (2.0)

Setting $\epsilon = 2.5$ permits us to focus directly on the lowermost portion of the income distribution. The inequality data in Figure 28 depart substantially from our previous results. Though statewide Louisiana income inequality is higher than Florida, the state inequality difference is not as great as some of the other figures. More importantly, the statewide Atkinson data for $\epsilon = 2.5$ show more change in Florida income inequality over time than change in Louisiana inequality. This pattern is a sharp contrast to the volatility of Louisiana income inequality evident in other figures.

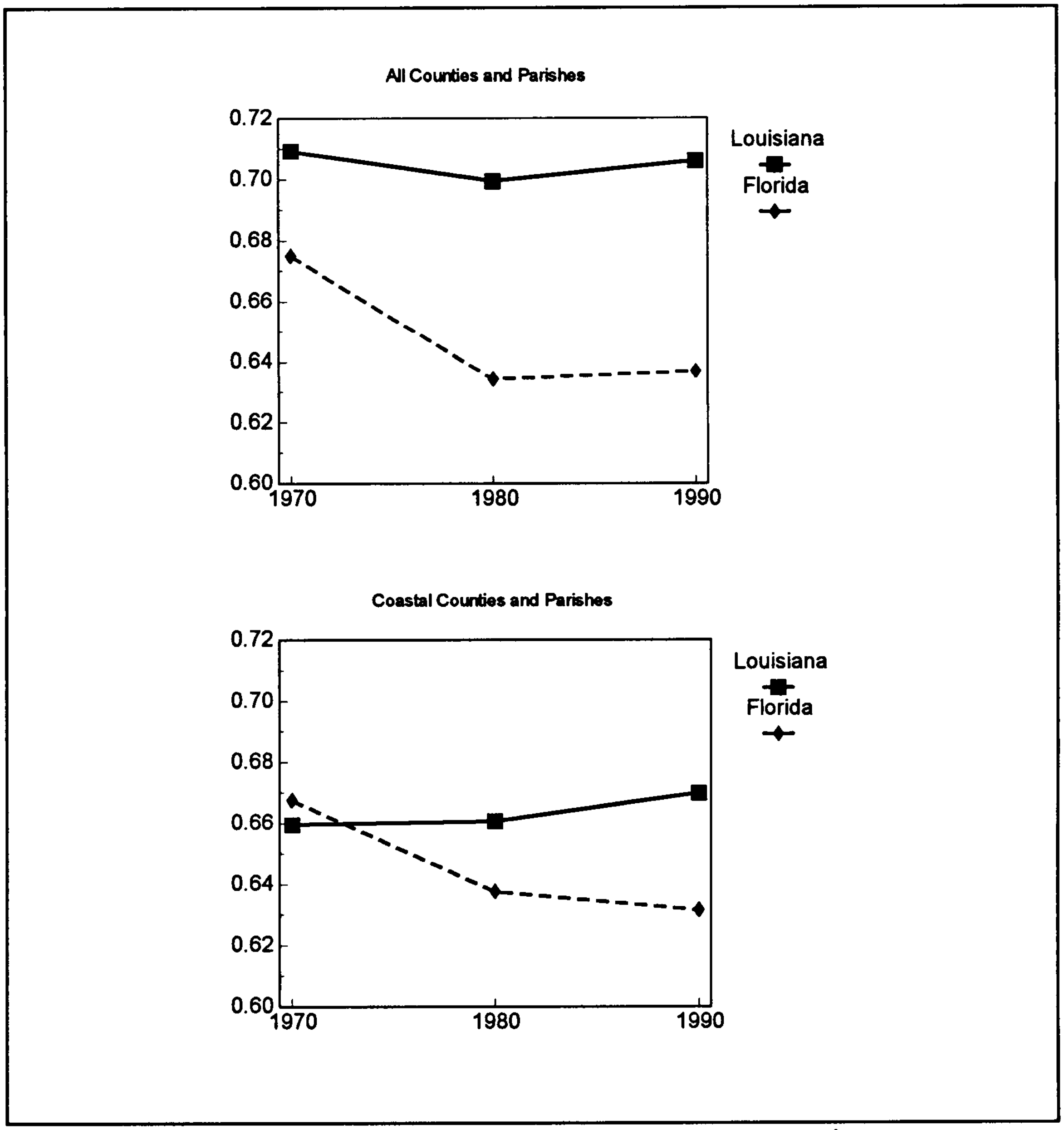

Figure 28. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Atkinson Measure (2.5)

Similarly, the Atkinson 2.5 data for Louisiana coastal areas in the lower panel of Figure 28 exhibit much more stability than corresponding data for other levels of ϵ. The coastal inequality

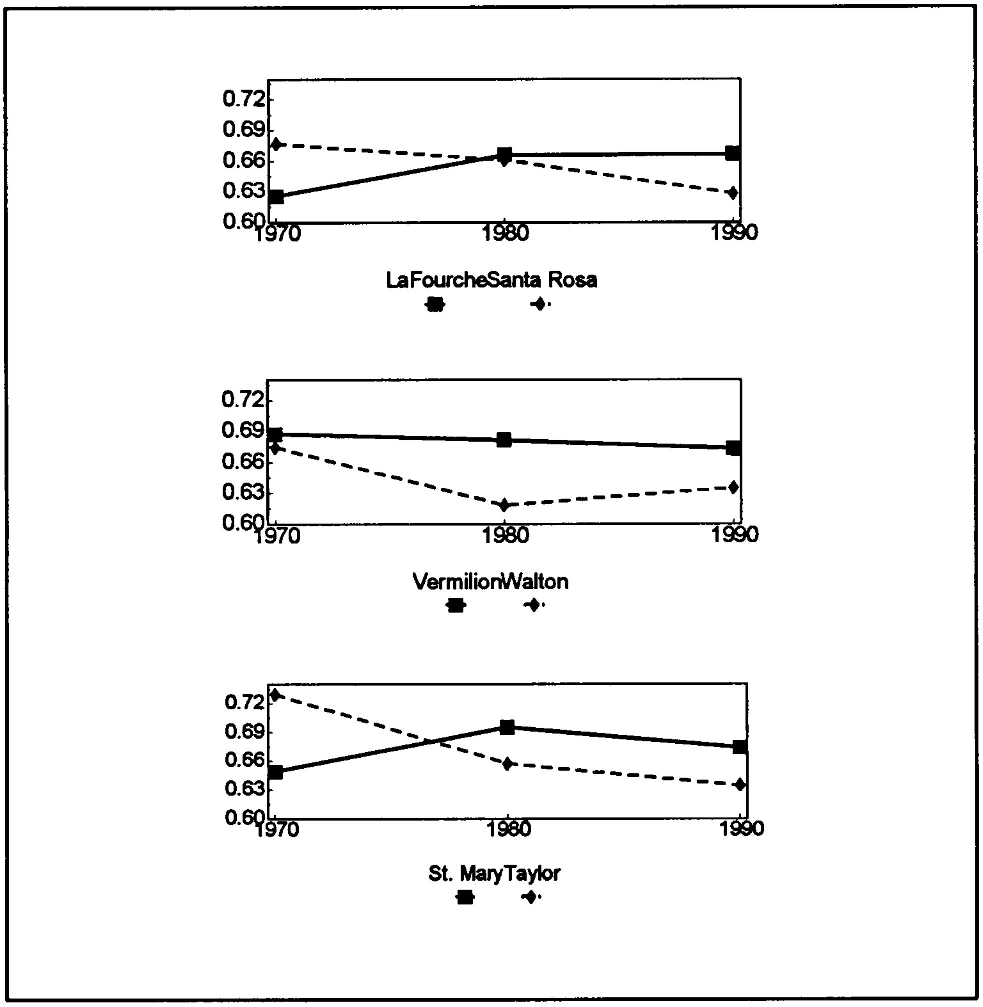

Figure 29. Parishes and Counties Matched on Demographic Factors: Atkinson Inequality Measure (2.5)

measures are also consistent with the statewide 2.5 results in showing less departure from the Florida patterns. The data for matched pairs of counties in Figures 28 and 29 are our first indications of steady or decreasing inequality in Louisiana from 1980 to 1990. Clearly, income inequality in the lowermost portions of the Louisiana income distribution does not exhibit the same volatility that we observed for the middle and upper portions. In the section that follows, we summarize and interpret these descriptive results.

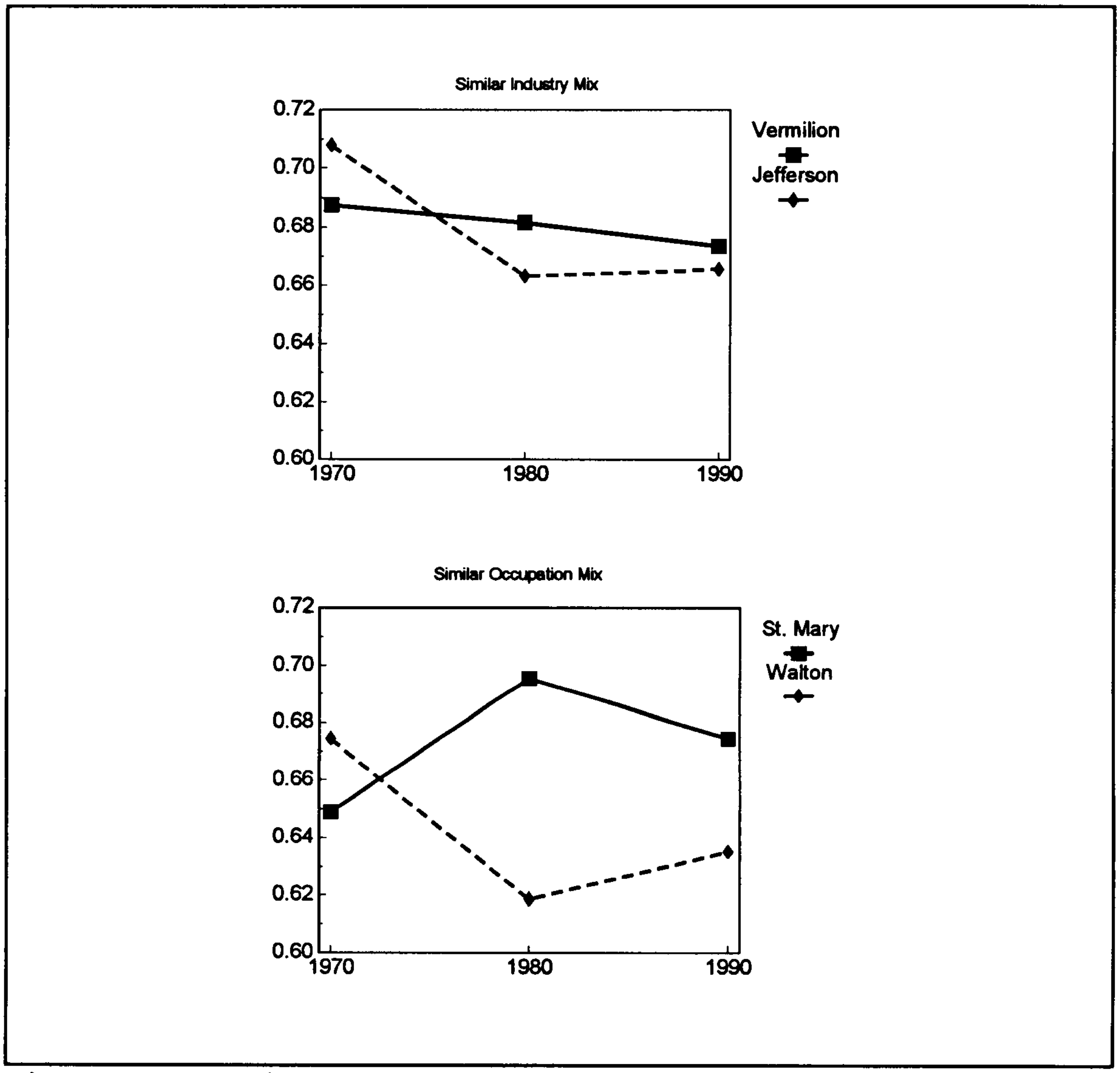

Figure 30. Parishes and Counties Matched on Industrial and Occupational Mix: Atkinson Measure (2.5)

Summary and Discussion.

The descriptive phase of this analysis was designed to compare Louisiana and Florida family income inequality at times of higher and lower oil and gas industry activity corresponding to decennial Census years 1970, 1980, and 1990. Using a variety of inequality measures that focus on the upper and middle portions of the income distribution, we find pronounced differences in statewide and coastal inequality patterns between Florida and Louisiana. Income inequality in Louisiana is highly volatile with substantial decreases between 1970 and 1980 and sharp increases from 1980 to 1990. Florida inequality shows a modest decline across the same period. The volatility in coastal Louisiana income inequality is such that inequality is higher in 1990 than in 1970. This suggests a substantial impact of oil and gas development on coastal families in the middle to upper middle portions of the income distribution.

During the 1970-1980 expansion period, the income distribution of coastal Louisiana became more equal. This suggests an expanding socioeconomic opportunity structure that provided genuine avenues for upward mobility for middle class families. Factors likely contributing to this enhanced socioeconomic standing include better paying jobs and appreciating personal assets. The labor force participation and household net worth that characterizes middle income families was not a sufficient to buffer coastal residents from the effects of the 1980-1990 oil and gas industry contraction. The inequality measures presented here indicate that the middle of the income distribution experienced a substantial increase in inequality. Without individual-level survey data, we can only surmise from aggregate trends that this increase in inequality was due in part to declining employment prospects and falling asset values (land values, personal property).

Paradoxically, when we focus on the lower end of the income distribution we find that statewide and coastal Louisiana income inequality exhibits much less volatility. When we focus on matched pairs of Louisiana parishes and Florida panhandle counties we find evidence of decreasing income inequality at the lowermost end of the income distribution. We clearly cannot infer a consistent impact--positive or negative--of OCS development on families with incomes in the lower ranges. Detailed individual and/or household data would be required to explain the apparent lack of effect on low income families. One speculative explanation is that--even in times of major economic boom episodes--low-income households depend less on formal labor force participation and more on informal economic behavior (subsistence activities such as hunting, fishing, and off-the-books employment) and on transfer payments (welfare, disability, and the like). Another reason for an absence of an effect of oil and gas development may be that the same social, cultural, and economic barriers that prevented full labor force participation by low-income households before and after the oil and gas industry expansion also prevailed during the boom period. Testing these hypotheses would require detailed data collection at the household level.

The Atkinson results for coastal Louisiana parishes are summarized in Figure 31. Changes are most pronounced for the $\epsilon = 1.0$ and 1.5 measures, again suggesting impact on the middle of the income distribution.

In this comparative analysis, we have demonstrated the correspondence of Louisiana income inequality to key time periods in the development of onshore and offshore oil and gas resources. We have also specified the portion of the income distribution that most reflects the impact of oil and gas development. In terms of the Kuznets hypothesis that development leads to a decline in inequality, our findings for the expansion period fit the theory well. As oil and gas industry activity expanded, 1970-1980 income inequality declined in Louisiana. During the subsequent industry contraction, income inequality increases in Louisiana.

Still, our findings could be attributed to a wide range of other factors, including education/human capital differences, racial composition, industrial differences, and the national business cycle. In the section that follows, we use modeling techniques to control for factors such as these.

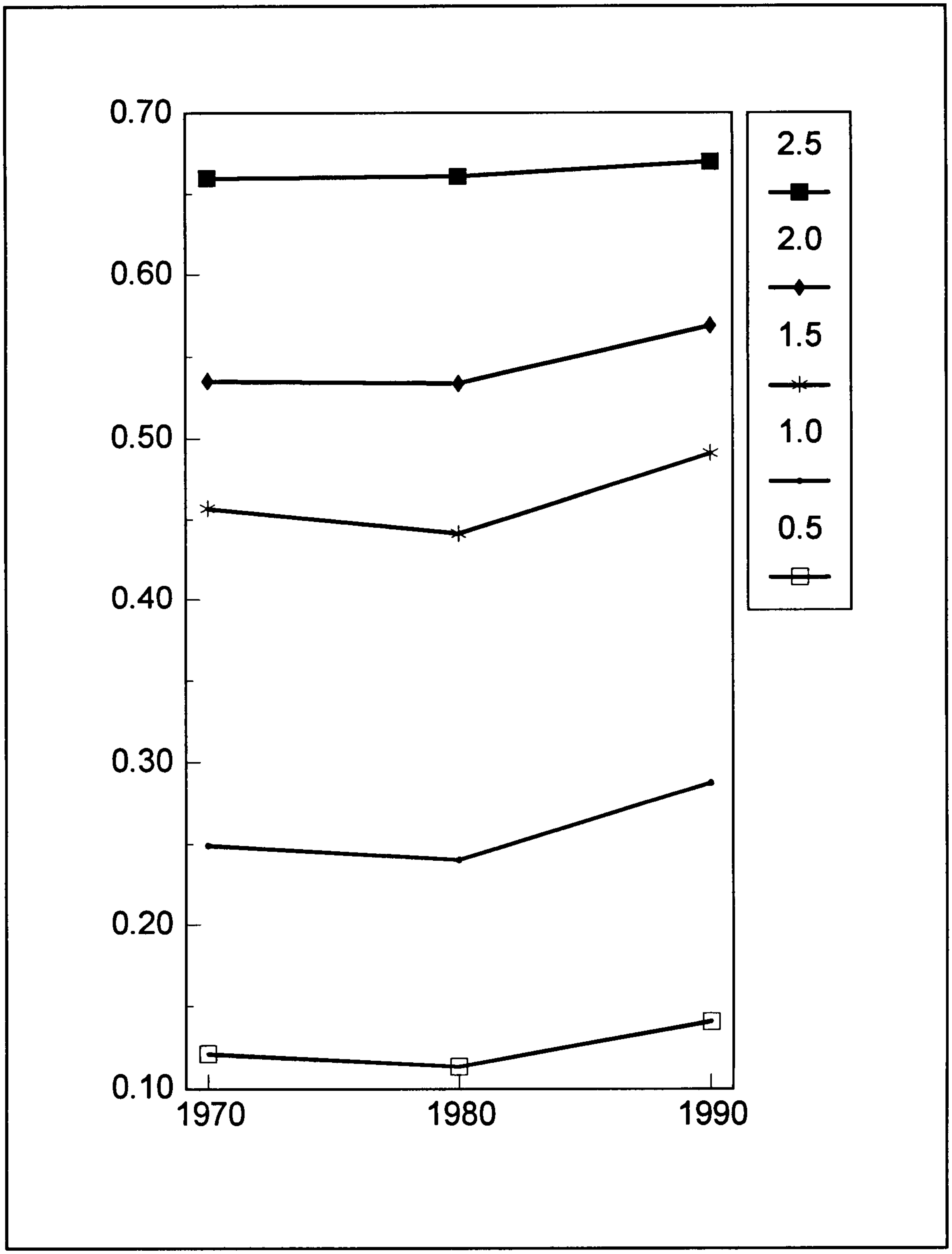

Figure 31. Atkinson Inequality Measures for Coastal Louisiana Parishes

MODELING OF INCOME INEQUALITY

Overview of Modeling Procedures.

Our data consist of characteristics of 64 Louisiana parishes and 67 Florida counties measured at three points in time. When entire states are our focus, we thus have 192 data points for Louisiana and 201 for Florida. When we focus on coastal areas, we have 24 and 36 data points for Louisiana and Florida, respectively. Especially in the latter case, our models are based on very few parishes and cases. Consequently, the results should be viewed as tentative and suggestive of issues that need further research with larger numbers of cases. The issues are important nonetheless because the differences we have observed within Louisiana over time and between Louisiana and Florida could otherwise be dismissed as products of other, well-known factors. If the inequality patterns persist after we have controlled for fundamental human capital, economic, and demographic factors, then further research with more detailed data would clearly be in order.

Models were designed so that separate estimates could be obtained for the Louisiana coastal parishes and the Florida panhandle counties. This permits comparisons of some key sources of income inequality in the two areas and reveal how those sources have changed since 1970. Statewide models were also estimated to ensure that any distinctive local inequality patterns are not a result of state-based factors.

Since these data are structured by time (1970, 1980, 1990) and by space (parishes and counties), they can be modeled with pooled time-series, cross-sectional estimators that permit the error structures to vary across time and/or spatial units. The TSCS variance components approach in SAS was initially used to analyze the inequality data (SAS Institute Incorportated, 1992). We found repeated instances, however, in which the variance component associated with time was very near zero or rounded to zero. That suggests that, with only three time points, a less complex estimation process will yield essentially similar results. The analyses were replicated with ordinary least squares (OLS) estimators and did indeed produce very similar outcomes. Accordingly, we present the OLS modeling results below.

Exogenous Variables.

Due to small sample sizes (especially for coastal models), we are limited in the number of exogenous variables that can be included in any particular model. Accordingly, a handful of variables were chosen that are most likely to account for the inequality patterns we have observed. Inequality is often linked to lower levels of human capital among populations. Analysts ordinarily include a measure of local education levels to control for differences in schooling from one area to another. In this case, the inequality patterns and trends could be claimed to be products of educational differences between Louisiana and Florida or changes in education levels over time in Louisiana.

The models presented here include as an education indicator a variable defined as percentage of parish population 25 years or older that has completed 12 years of schooling. We expect to find a negative relationship between the education variable and inequality. That is, as local education levels increase, we expect local inequality levels to decrease.

Many of the counties and parishes studied here are part of or adjacent to a larger area referred to by social scientists as the "Black Belt." This is a broad, underdeveloped, traditionally agricultural region stretching from Louisiana to North Carolina in which parishes and counties have proportionately larger African American populations (Falk et al., 1993). Perhaps the most famous subarea of the Black Belt is the Delta area of Mississippi, Arkansas, and Louisiana. There is considerable evidence to suggest that the Black Belt fosters historically unique social and economic traditions that are closely linked to income inequality. Thus, our models include a variable that measures the percent black in a county or parish. We expect to find a positive relationship between percent black and inequality such that as percent black increases, so does income inequality in an area.

The relationship between industrialization, economic development, and declining income inequality is well established (Kuznets, 1955; Lenski, 1966). Industrialization in the U.S. South is most evident in the establishment of branch manufacturing plants (Cobb, 1982; Falk and Lyson, 1988). Thus, it is important in our modeling to control for a manufacturing presence in a parish or county economy. We do so by including a variable representing the percent of the local labor force employed in manufacturing. We expect to observe a negative relationship between percent manufacturing and inequality. That is, we expect increases in manufacturing employment to be associated with decreases in local inequality levels.

There can be little doubt that some of the differences in inequality patterns we have observed are due to national economic trends that manifest themselves in the business cycle. Moreover, oil and gas industry activity has closely aligned with the business cycle in recent years (Louisiana Almanac, 1992). It is therefore important to control for major cyclical swings in the national economy. We do so by including a measure of percentage change over the last five years in the U.S. gross domestic product. Though not reported here, we also employed a measure that summarized changes in oil prices over a five year period. The correlation between the price and GDP variables is so high ($r = 0.92$) that they are essentially redundant. Thus, we opted to include the change in GDP variable.

Modeling Results.

Since the Atkinson inequality measures cover a wide spectrum of the income distribution, we focus our attention on models that estimate predicted Atkinson inequality values based on the five exogenous variables noted above. Table 5 summarizes the results of 20 OLS regression equations that model Atkinson inequality at various levels of ϵ. The upper panel displays statewide results, and the lower panel presents estimates for coastal areas.

Statewide Models. The statewide results indicated that education levels are associated with decreasing inequality in both states and at all levels except the lowest income levels in Louisiana ($\epsilon = 2.5$). Interestingly though, the effects of education are from two to three times larger in Florida than in Louisiana. This suggests that there is more to income inequality in Louisiana than low education levels. This finding is consistent with Laska and colleagues (1993) who report a lack of emphasis on education during periods of peak oil and gas activity.

In the statewide models, percent black is positively associated with inequality in both Louisiana and Florida for all levels of the Atkinson measure. This outcome is consistent with other findings in the Black Belt research tradition (see, e.g., Falk and Rankin, 1992). In most cases, the effect of percent black on inequality is larger for Louisiana than for Florida. This is not surprising since the Black Belt encompasses much more of Louisiana than Florida.

The manufacturing variable produces a sharp difference by state. There is no effect of manufacturing employment on inequality in Florida. In contrast, the estimates for Louisiana show the expected negative effect on inequality. In the parishes, increased manufacturing employment is associated with decreasing income inequality. This is not the case in Florida where the service and agricultural sectors have long dominated employment. In sum, these findings suggest that policies promoting the development of manufacturing enterprises will reduce Louisiana income inequality.

Table 5. Ordinary Least Squares Estimates of Statewide Inequality Measures for Louisiana and Florida

	Endogenous Variable	Exogenous Variables: Intercept	Education	Percent Black	Percent Manufacturing	Change in GDP	Adjusted R-Square
Statewide Florida	Atkinson 0.5	0.163*	-0.002*	0.000*	0.000	0.001	0.373
	Atkinson 1.0	0.305*	-0.003*	0.001*	0.000	0.002	0.413
	Atkinson 1.5	0.431*	-0.003*	0.001*	0.001	0.003	0.429
	Atkinson 2.0	0.545*	-0.003*	0.002*	0.001	0.005*	0.396
	Atkinson 2.5	0.642*	-0.003*	0.001*	0.000	0.005*	0.325
Statewide Louisiana	Atkinson 0.5	0.211*	-0.001*	0.001*	-0.001*	-0.005*	0.573
	Atkinson 1.0	0.377*	-0.001*	0.002*	-0.001*	-0.007*	0.572
	Atkinson 1.5	0.497*	-0.001*	0.002*	-0.002*	-0.006*	0.549
	Atkinson 2.0	0.577*	-0.001*	0.002*	-0.001*	-0.001	0.485
	Atkinson 2.5	0.637*	-0.001	0.001*	-0.001*	0.003	0.367
Coastal Florida	Atkinson 0.5	0.146*	-0.001*	0.000	0.000	0.001	0.258
	Atkinson 1.0	0.277*	-0.002*	0.001*	0.001	0.002	0.314
	Atkinson 1.5	0.398*	-0.002*	0.001*	0.001	0.003	0.345
	Atkinson 2.0	0.506*	-0.002	0.001*	0.001*	0.005	0.314
	Atkinson 2.5	0.599*	-0.001	0.001	0.001	0.005	0.228
Coastal Louisiana	Atkinson 0.5	0.204*	0.000	0.001*	-0.002*	-0.007*	0.463
	Atkinson 1.0	0.379*	0.001	0.002*	-0.004*	-0.011*	0.507
	Atkinson 1.5	0.519*	0.001	0.002*	-0.006*	-0.010*	0.546
	Atkinson 2.0	0.613*	0.001	0.002*	-0.006*	-0.005	0.563
	Atkinson 2.5	0.670*	0.000	0.002*	-0.004*	0.001	0.539

*coefficient at least twice its standard error ($p < 0.05$)

Estimates of the effect of the five-year change in gross domestic product variable also produce substantially different results by state. In Florida, the GDP variable is positive and only significant for the lowest income levels. At those low income levels, then, Florida income inequality levels increase with positive change in GDP and decrease as GDP goes down. In Louisiana, the results are just the reverse. Income inequality in the middle and higher income levels moves in a pattern opposite to GDP changes. This suggests that inequality in Louisiana is countercyclical; i.e., inequality does not follow national economic trends in the same way that it does in Florida. Since several key 1970-1990 shifts in GDP were related to oil shocks and other effects of energy crises, the atypical reaction of the state to national GDP changes is likely due to Louisiana's status as a major oil and gas producer.

The final column of statewide results provides a measure of the goodness of fit for each model. The R-square coefficient can be interpreted as the proportion of variance explained by the model. Generally, the Louisiana models fit the data better than the Florida models. At best, however, the models account for just over half of the variance in inequality scores. We discuss the fit of models further after reviewing the estimates derived from models based on coastal parishes and counties only.

Coastal Models. Estimates for Florida and Louisiana coastal counties and parishes appear in the lower panel of Table 5. The reader is cautioned to bear in mind the small numbers of cases on which these models are based. The statistical tests are heuristic at best. Nonetheless, the results tend to parallel the statewide findings that are based on sufficient numbers of cases. And, the models provide us with further descriptive evidence of processes that generate income inequality in coastal areas.

With respect to education, three of the Florida models show the expected negative effect. In contrast, none of the Louisiana models exhibits a statistically significant effect of education on income inequality. These results parallel the statewide results in suggesting that, compared to Florida counties, income inequality in the coastal parishes of Louisiana is not strongly related to education levels.

The results for the percent black variable are also generally consistent with the statewide findings in the upper panel of the table. Coastal areas in both states exhibit a positive association between percent black and income inequality. And, the relationship is stronger for Louisiana than it is for Florida panhandle counties.

The coastal results for the manufacturing variable also parallel the statewide results. There is little or no association between manufacturing and income inequality in the Florida coastal counties. In Louisiana, however, there is a negative relationship at all levels of the Atkinson inequality measure. In the coastal parishes, the effects are much larger than elsewhere in Louisiana. This is further evidence that a manufacturing presence in a local economy can lead to reduced income inequality. To be sure, at least some of the manufacturing establishments in coastal areas are directly tied to oil and gas activities. As industry development proceeds, attention should continue to be given to developing manufacturing enterprises in tandem with the oil and gas facilities. The results here suggest that such a joint development strategy might buffer the volatile income effects of oil and gas development.

Results for the GDP change variable are mostly consistent with the statewide findings in the upper panel. The lower income levels of coastal Louisiana parishes show a countercyclical sensitivity to changes in GDP. The coastal estimates for Louisiana are larger than the statewide estimates, indicating greater effects on coastal rather than inland parishes. The coastal counties of the Florida panhandle show no association with changes in GDP. This set of findings shows the two coastal areas to be very different in processes that generate income inequality.

Lastly, the R-square coefficients show less goodness of fit for the Florida coastal models than is apparent for the statewide models. The fit of the coastal Louisiana models is roughly the same as the corresponding statewide models. The best fit is just over half of variance explained. Thus, we have accounted for some but clearly not all of the variance in parish and county income inequality. Of course, given the limited number of data points, our objective was not (and should not have been) to develop a fully specified model of income inequality. Examples of elaborated models can be found in Braun (1988), and those models could serve as points of departure for subsequent research on larger numbers of spatial units. In the final analysis section that follows, we use the modeling results to revisit the descriptive inequality patterns presented at the outset.

Descriptive and Modeling Results Compared.

In the descriptive analysis presented above, we illustrated very different patterns of income inequality for statewide and coastal areas of Florida and Louisiana between 1970 and 1990. While Florida inequality primarily trends downward across time, inequality in Louisiana exhibits a great deal of volatility and, by 1990, is higher than in 1970 in several cases. In the modeling phase of the analysis, we attempted to account for these inequality patterns by controlling for important factors known to influence inequality. In this final section, we derive estimates of inequality based on the models and compare them to the inequality coefficients presented earlier. The purpose here is to discern the extent to which controlling for these key variables lessens the differences between states. It is possible, for example, that the estimated Louisiana inequality will show less volatility. Similarly, we may find that patterns for the two states converge. That would suggest that inequality differences can be reduced to state differences in factors such as education, racial composition, industry mix, and the national economy. If patterns for the states remain divergent, we would have evidence of a substantial effect of OCS development.

To make these comparisons, we need statewide and coastal summary inequality estimates for a single point in time for each state. We derived these estimates by first computing predicted values for each of the model equations (see Table 5). That resulted in a predicted value for each parish or county for each of the three time points. We then computed weighted means of the predicted values within each year over all parishes and counties (for statewide estimates) and over coastal parishes and counties (for coastal estimates). Parish or county population was used to weight the mean computations. This resulted in a single inequality estimate for each state corresponding to each decennial census year. These estimates are compared to the actual computed inequality measures in Figures 32-36.

Figure 32 details statewide and coastal Atkinson inequality ($\epsilon = 0.5$). The thicker lines repeat the inequality patterns first displayed in Figure 16. The thinner lines indicate the inequality levels estimated by our models of Atkinson with $\epsilon = 0.5$. The Louisiana inequality patterns are slightly overestimated for 1970 and 1980. The estimated and actual patterns are roughly the same by 1990. Our model at first underestimates statewide inequality in Florida and then slightly overestimates it by 1990. Similar results are indicated for the coastal counties and parishes. What is most important, however, is that the modeled inequality estimates still exhibit a volatility that corresponds to the boom and bust periods of OCS activity. The volatility remains evident even after we take into account important exogenous factors such as education, race, industry mix, and the national business cycle. In Florida, the modeled estimates appear to smooth the inequality trend somewhat.

Results for other levels of the Atkinson inequality measure are presented in Figures 33-36. Income inequality in Louisiana and Florida tends to be underestimated as we focus on increasingly lower portions of the income distribution. The degree of underestimation, however, is greater for Louisiana than Florida. There is little indication of a lessening of Louisiana volatility until $\epsilon = 2.0$ and 2.5. In Figures 35 and 36, we do observe estimated statewide inequality coefficients that exhibit less volatility than the actual measures. Readers are reminded, however, that the lower levels of the income distribution did not exhibit the same boom and bust sensitivity as middle and upper income levels.

Coastal results appear in the lower panels of Figures 32-36. Over time, the Louisiana coastal results are increasingly underestimated for all values of ϵ. Conversely, Florida coastal results are underestimated more early on. By 1990, the Florida estimates are fairly close to the actual Atkinson inequality values. Again, what is most notable is the fact that the estimated inequality values for Louisiana exhibit essentially the same boom and bust volatility as the actual values. The coastal results reinforce the statewide outcomes in suggesting that we must therefore look beyond important variables such as education, race, industry mix, and the national economy to explain the volatility in Louisiana income. The Louisiana inequality patterns clearly follow the expansion and contraction of oil and gas industry activity more than they follow any factors introduced in our models.

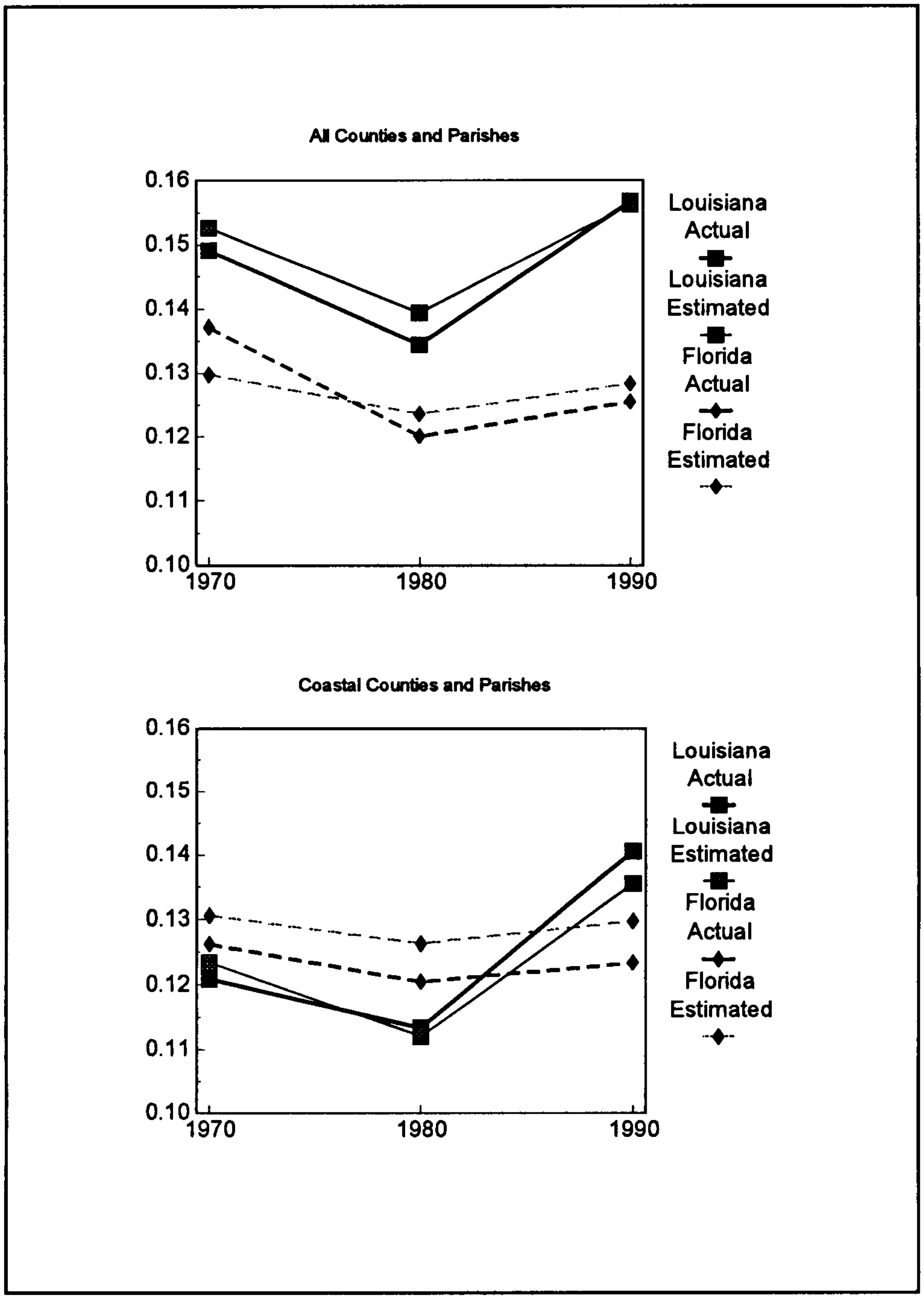

Figure 32. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Actual and Estimated Atkinson Measures (0.50)

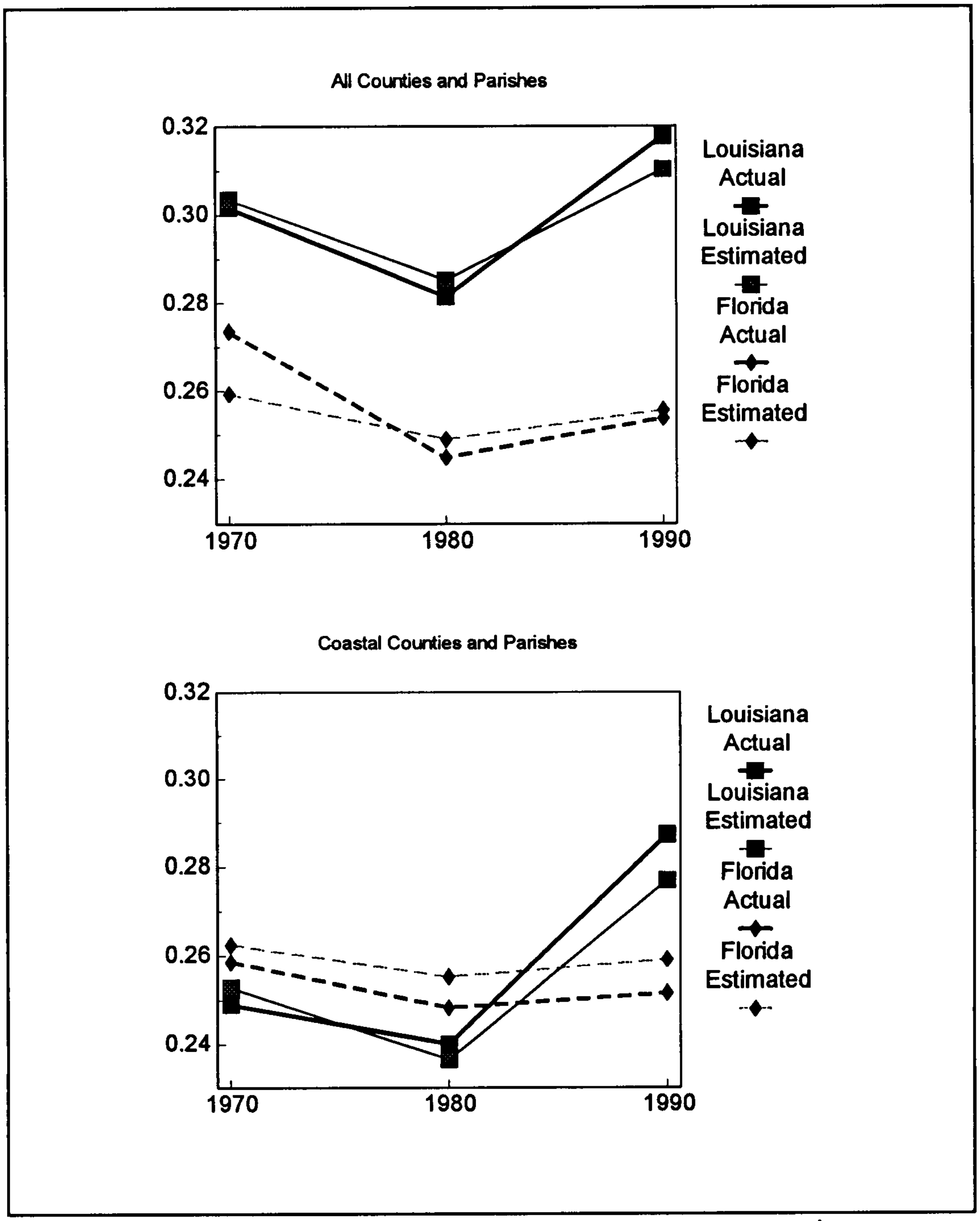

Figure 33. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Actual and Predicted Atkinson Measure (1.0)

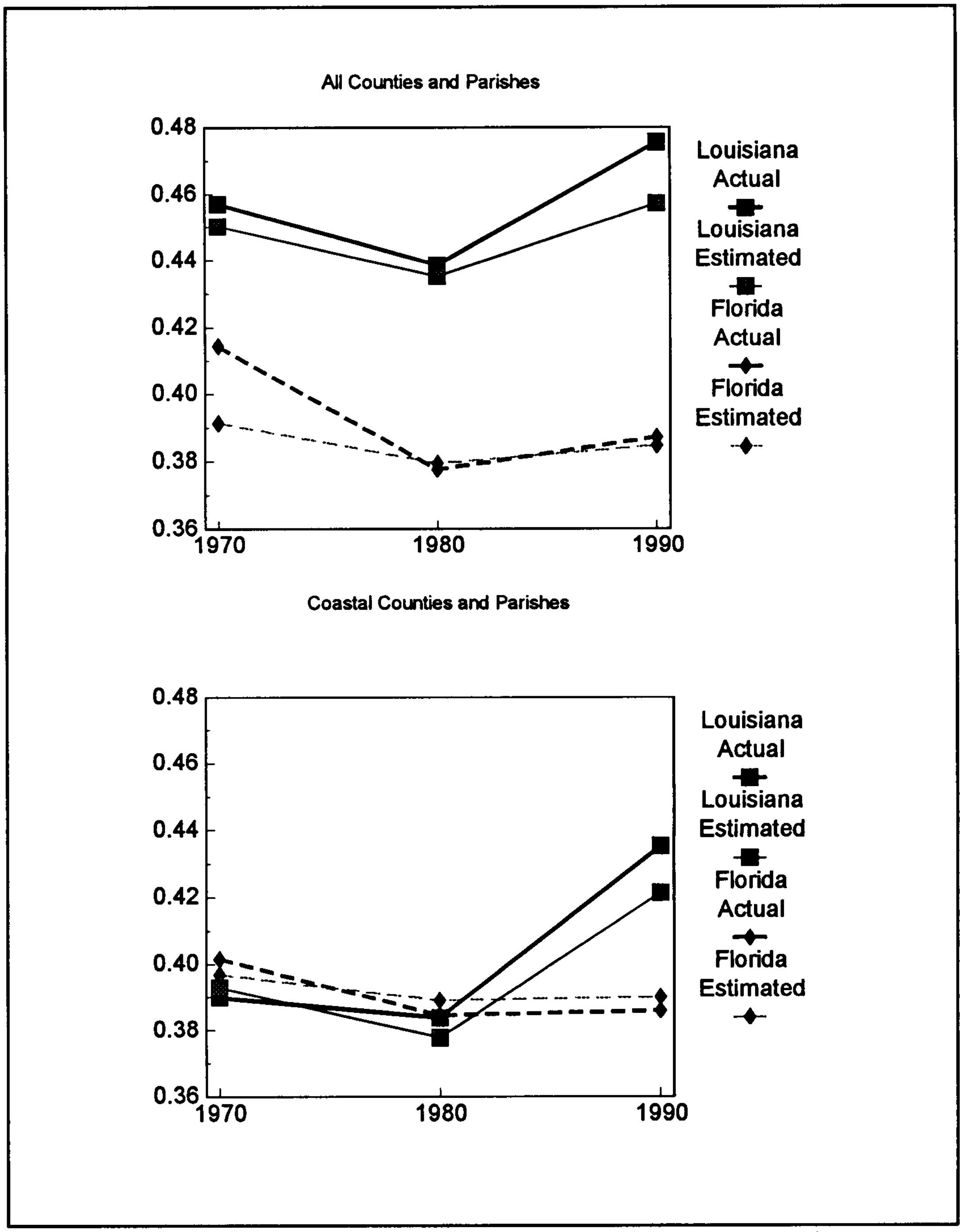

Figure 34. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Atkinson Measure (1.5)

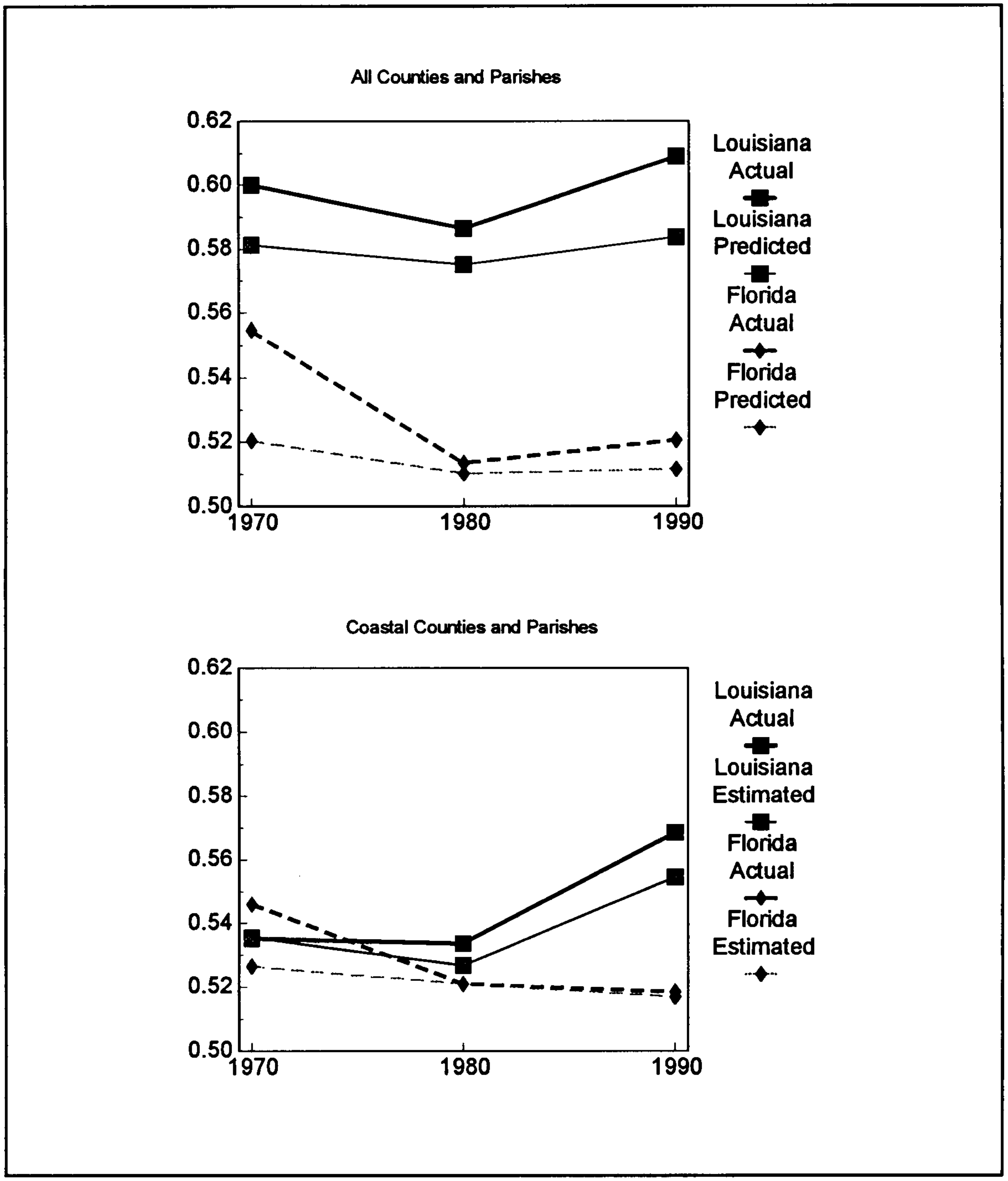

Figure 35. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Atkinson Measure (2.0)

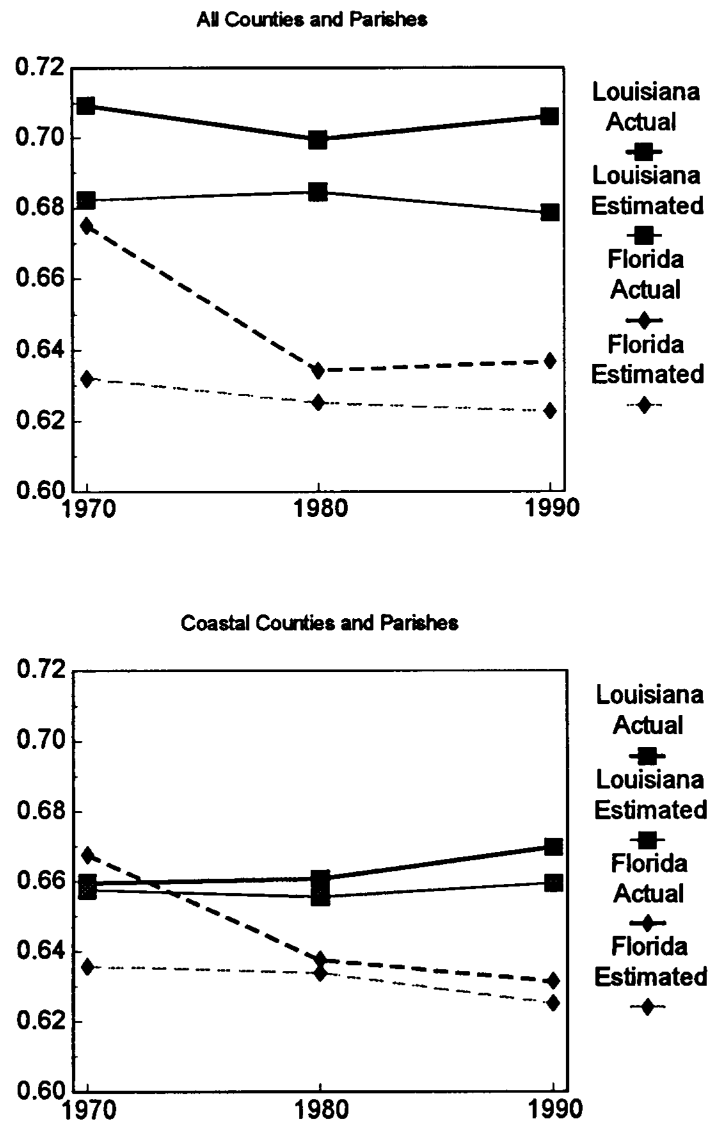

Figure 36. Statewide and Coastal Income Inequality: 1970, 1980, 1990. Actual and Estimated Atkinson Measure (2.5)

CONCLUSIONS

Overview of Key Findings.

This research employed parish- and county-level data from the 1970, 1980, and 1990 Censuses in a comparative analysis of family income inequality. We focused on the analysis of trends in family income inequality in coastal Louisiana parishes adjacent to the substantially developed Outer Continental Shelf (OCS). With a comparative analysis design, we examined inequality trends in Louisiana parishes and in coastal counties of the Florida panhandle where there has been no significant onshore or offshore development of oil and gas resources. Inequality trends in the parishes and counties along the Gulf of Mexico were also compared to state-wide family income inequality in Louisiana and Florida.

The analysis framework enabled a temporal comparison across key decades in the recent history of the oil and gas industries. While the decade of the 1970s was one of rising oil prices and greatly expanded oil and gas development, the 1980s saw prices fall and industry activity generally decline. Income inequality was gauged with multiple measures of inequality computed with decennial census data.

An initial review of per capita income and median family income figures indicated lower 1970 income in Louisiana parishes than in Florida counties. By 1980, the income relationship in coastal areas was reversed with Louisiana parishes generally exhibiting higher incomes--some precipitously higher--than Florida counties. Louisiana statewide and coastal 1990 incomes, however, were well below those of Florida. After taking inflation into account, coastal 1990 median family income levels in Louisiana were actually lower than they were in 1970.

A comparative inequality analysis revealed very different patterns of income inequality for statewide and coastal areas of Florida and Louisiana. While Florida inequality primarily trended downward across time, inequality in Louisiana exhibited a great deal of volatility and, by 1990, was higher than in 1970 in several cases. The Louisiana patterns suggest a substantial impact of oil and gas development on coastal families in the middle to upper middle portions of the income distribution. The inequality patterns suggest that the Kuznets hypothesis does hold for the decennial Census years 1970-1980 that approximate the oil and gas industry expansion period. At the state level and in the coastal parishes, Louisiana income inequality declined. Though Kuznets did not focus on the case of a decline in development, the contraction of the oil and gas industry brought about a corresponding increase in inequality.

In the modeling phase of the analysis, we attempted to account for these inequality patterns by controlling for important factors known to influence inequality. At best, the models accounted for roughly half the variance in the observed inequality. Moreover, through these modeling procedures, we were unable to eliminate the sharp differences between coastal Louisiana parishes and panhandle counties of Florida or the volatility in the Louisiana patterns. Education, race, industry mix, and the national economy simply do not account for the volatility or trends in Louisiana inequality patterns. When we control for these factors, a boom and bust pattern that corresponds to the expansion and contraction of the oil and gas industry is still evident.

Critical Assessment.

To be sure, this analysis is not without its drawbacks. Most importantly, the temporal claims are based on three time points. Yet, we have seen evidence here that the decennial Census years do indeed correspond to important conjunctures in the history of oil and gas industry in Louisiana. In this case, the temporal comparisons--limited in number as they may be--offer clear and parsimonious vantage points.

Louisiana and Florida are surely very different states, especially in terms of natural resources. Yet, we were able to establish reasonably strong similarity, especially on the demographic dimension, between key coastal parishes and counties. Moreover, the inequality trends exhibited by these matched pairs of coastal parishes and counties are very similar to other coastal areas and--within reason--similar to the states overall. It is unlikely that our findings are artifacts of poorly contrived comparisons. Another concern is the small number of cases in our models for coastal areas. Comparable results for statewide models, however, suggest that the coastal results are robust enough to serve as a basis for subsequent research with greater geographic detail.

Lastly, the performance of the Atkinson inequality measures is reassuring. The measures produce results that correspond to the better known Gini and Theil measures at appropriate levels of the income distribution. More importantly, the Atkinson measures provided key insights into the portions of the income distribution where the impact of oil and gas development was most apparent. These measures are highly recommended in further work in this area.

Suggestions for Subsequent Research.

The findings here suggest a number of avenues for further research. One important strategy would be to broaden the comparative focus to other Gulf areas. It would be interesting, for example, to compare the Louisiana experience to that of Texas or Alabama. While the parish- or county-level research design can clearly provide an interesting perspective, a more detailed geographic focus could be very fruitful. The parishes and counties studied here are large and diverse. The parish/county framework may mask important variation within the spatial units. The use of Census places (urbanized areas of 2500 or more) could introduce considerably more geographic detail and provide large sample sizes for statistical purposes. For example, in the eight Louisiana coastal parishes studied here, there are 48 1990 Census places. Another way to build the inequality data base would be to include 1960 decennial Census data.

At several points, we noted that it is impossible to test some of our speculations without person or household survey data. For example, labor force participation data in the decennial Census data are limited to current jobs. We cannot follow individual respondents through a series of jobs or through episodes of employment and unemployment. To gain a better understanding of the labor force experiences of coastal residents, detailed work history data are required. Data of this sort are collected as a part of several national surveys, but the number of coastal Louisiana residents responding to these survey is extremely small. A primary data collection effort targeted at coastal households could produce a rich history of labor force experiences before, during, and after the oil and gas industry development. Work history data would be invaluable in explaining the aggregate inequality patterns observed here. Without them, we can only surmise how household labor force behavior may have produced the observed inequality patterns.

A final suggestion for further research goes beyond methodological issues. In presenting preliminary findings to a variety of professional and industry audiences, we have been repeatedly asked about the uniqueness of the offshore oil and gas industry. Are there other development regimes that would lead to similar results? For example, are the findings here all that different from those we would expect when the main plant in a factory town closes? Or, are the results different from the impact of a major construction project such as a dam or power plant? Answers to these sorts of questions should be a high priority for subsequent socioeconomic research on onshore and offshore oil and gas development.

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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 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 territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.