Geographical Features of U.S. Crop Production in the 1990s

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Introduction

The continued sprawl of urban America toward, around, and in formerly agricultural areas is well documented (Audirac 1999; Bryant and Johnston 1992; Fuguitt et al. 1988; Hart 1998; Lockeretz 1987). For decades, researchers have studied the structure of agricultural production in the United States in relation to other social structures and conditions (Goldschmidt 1978; Lobao 1990; Reif 1987; Wimberley 1987, 1993). While some focused mainly on metropolitan and nonmetropolitan population growth patterns (Elliot and Perry 1996; Fuguitt et al. 1988; Johnson 1989, Johnson and Beale 1994), other researchers investigated inter-relationships between commodity production and its proximity to urbanized areas (Audirac 1999; Barnard and Lucier 1998; Bradshaw and Muller 1998; Otte 1974; Butler and Maronek 2002; Thomas and Howell 2003; Heimlich and Anderson 2001; Vesterby and Krupa 1993). Hart (1998) described, for example, the metropolitan influence on agriculture as a bow wave. He contended there is a constantly transforming zone of "intensely cultivated, high-priced agricultural land" that remains in front of the moving bow wave of urban population growth (Hart 1998: 328). This bow wave influences farmers to adapt their management and production practices to improve operational efficiencies and profitability as land and other resource costs escalate. Vesterby and Krupa (1993) found that crop sales for the 29 fastest growing U.S. counties increased by over a billion dollars from 1950 to 1987. This increase indicated that producers in these high-growth areas had shifted to higher value commodity production. Thomas and Howell (2003) find nearly one-third of all crop sales for 1997 were due to production in the ever expanding metropolitan fringe. They and others (Albrecht 1998; Heimlich and Barnard 1997) concluded that such areas with large and scattered urbanized populations also accommodate intense, high yield production agricultural operations with large sales revenues.

In our study, we attempt to answer the following questions: (1) What was the structure of U.S. agricultural production (i.e., *agristructure*) in 1992 and had this structure changed by 1997? (2) What was the relationship between *metropolitan proximity* and U.S. agristructure and its changes from 1992 to 1997 at the county level? (3) What was the relationship between U.S. *production regions* and change in U.S. agristructure from 1992 to 1997? and (4) Are agristructure, metropolitan proximity, and production regions associated with commodity production and have these relationships changed during the 1990s?

Concepts, Measurements, and Findings

After we define and discuss the measurement of key concepts (see italics above) used in this analysis, we summarize the findings presented in supporting tables and figures. We then proceed to a discussion of the next concept and finally present concluding remarks.

Agristructure

The development of the agristructure measure involved variables used by Thomas et al. (1996) in their analysis of multiple indicators of agristructure from 1982 to 1992. The results of their multi-step process were values that indicated the predominate sizes of agristructural systems of U.S. counties. We added data from the 1997 Census of Agriculture to extend the their analysis of the dimensions of U.S. agristructure to the latter half of the decade. Data were acquired from the 1992 and 1997 Censuses of Agriculture conducted by the U.S. Department of Agriculture's National Agricultural Statistics Service.

The Census of Agriculture years of 1992 and 1997 were chosen for three reasons. First, using only these census years assured a constant metropolitan definition and avoided operationalization issues associated with changes in the definition (Butler and Beale 1994). Second, the data served as a snapshot of the existence of agristructure in the 1990s relative to changes in sizes of population and differences production regions across the nation. The 1990s

were the post-crisis decade during which time the nation was recovering from recession and farm crises of the 1980s. This same time period saw significant growth of metropolitan areas along with economic prosperity and increasing globalization (Flora 1990). Finally, agricultural policy also changed drastically in 1996. Prior to the Federal Agriculture Improvement and Reform Act (FAIR), producer price supports were governed by supply management via acreage limits and storage programs. The 1996 legislation provided for greater market orientation levers in deciding government transfers to farmers (Economic Research Service 2002). This significant policy change contributed additional strain on U.S. agricultural systems and economies which were still adjusting from the tribulations of the previous decade.

We selected 18 variables from 1992 and 1997 Censuses of Agriculture and grouped them into five descriptive categories: scale, ownership, operation, operation characteristics, and labor resources. Table 1 reports the list of variables and their descriptive statistics. Each variable is defined in Appendix A and is measured in the same manner for both census years. Any data reported in dollars for 1992 data were standardized to 1997 dollars using the current Consumer Price Index methods (1983-84 = 100, base). Overall, the study was based on 3,034 counties and 3,042 counties in 1992 and 1997, respectively.[1]

The comparison of 1992 and 1997 results provide a meaningful picture of the status of agriculture during the 1990s. As seen in Table 1, 10 of the 18 agristructural variables had means and standard deviations that decreased in the 1990s. Nine variables had means and standard deviations that increased, which indicated greater variation in these structural characteristics. While average number of farms, mean farm size and average percent of farmland in counties declined during the decade, the number of small farms and real estate values increased. The average number of farms per county decreased from 632 farms to 636 farms. Average percent of farmland in county declined slightly from 52 percent to 51.4 percent. Likewise, mean farm size

decreased from 765.4 acres to 710.8 acres. In contrast, the number of small farms increased from 138.5 to 162 farms per county. Farm real estate value also increased by twenty million dollars from 1992 to 1997. These changes indicated that despite fewer and smaller farms, the value of land used for farming had become more valuable.

Operator dynamics changed during the 1990s as well. The average number of full owners increased from 365 to 375 per county. The number of part owner and tenant operations

Table 1. Original Means and Standard Deviations for Agristructural Variables in 1992 and 1997

	1992[a]		1997[b]	
Variables	Means[c]	Standard Deviations	Means	Standard Deviations
Scale				
Farms (N)	632.23	487.35	625.94	480.12
Land in farms (% in county)	52.0	30.4	51.4	30.5
Mean farm size (acres)	765.4	2,236.3	710.8	1,563.1
Small farms (N<$2,500 sales)	138.5	142.3	162.4	150.9
Farm real estate value ($000)	257,389.7	301,445.6	280,623.9	311,542.9
Operation				
Full owner (N)	365.0	334.2	375.5	333.7
Part owner (N)	196.3	140.3	188.3	135.8
Tenant (N)	70.9	68.9	62.2	60.5
Operator Characteristics				
Off farm work 200 days+ (N)	218.7	188.2	232.4	194.7
Farm resident (N)	453.0	361.0	446.1	357.1
Mean age (yrs.)	53.6	2.5	54.6	2.3
Ownership				
Individual/family (N)	543.0	417.0	538.1	415.6
Partnership (N)	61.4	59.6	55.5	53.4
Corporate (N)	27.8	35.4	32.3	39.0
Labor Resources				
Hired farm labor (N)	227.7	214.4	213.1	197.2
Hired workers (N)	1,221.9	4,342.6	1,095.9	2,969.3
Contract labor expenses ($000)	866.6	6,128.7	964.6	7,388.1
Custom work expenses ($000)	960.2	2,703.3	1,047.7	3,172.2
Machine/equipment ($000)	35,070.5	33,957.2	36,140.6	34,003.1

[a] N = 3,034.

[b] N = 3,042.

[c] All sales ($000) adjusted to 1997 dollars.

declined during the same period. This trend can be further understood by analyzing the operators' characteristics. The average number of operators seeking off-farm employment increased from 219 to 232 operators per county. Furthermore, fewer operators were residing in 1997 on farms than previously and the average number of operators with on-farm residences declined from 453 to 446 per county. Finally, the mean age of operators in 1997 increased to 55 years as the operators continued to age while younger generations have not entered farming.

The demand for labor resources also changed during the 1990s. The number of farms with hired workers declined as did the average number of farm workers per county. These findings suggest that agricultural workers have continued to be displaced by mechanized equipment or are employed through labor contracts. The average value of farm equipment and buildings increased by over one million dollars per county. Contract labor and custom work expenses also increased suggesting that operators were relying on third parties to perform specialized services.

The number of corporate farms increased while individual/family and partnership operations declined. The average number of corporate enterprises per county increased from 27.8 to 32.3, compared to the average number of partnerships per county which declined from 61.4 to 55.5 for the same period. This evidence points to the continued concentration and growing scale of agriculture.

After each variable was adjusted to improve its distributional symmetry (see Scott 2003), principal factor analysis was used to determine whether the 18 variables adequately contributed to a single composite measure of agricultural structure in each time period. This procedure was based on the fundamental assumption that the observed variables were a linear combination of a set of variables (Kim and Mueller 1978). The analysis produced one component (eigenvalue >

11.5) with each census year's data. Factor score results were applied to each county's data to calculate a single scale value that signified the predominate form of agricultural organization.[2] Each county had one agristructural value for each study year.

We arbitrarily divided each scale (i.e., 1992 and 1997) for mapping purposes into three levels of agristructure and labeled these levels: small (less than -1 standard deviation from the mean), medium (between + and – one standard deviation around the mean), and large (greater than +1 standard deviation from the mean). The 1992 scale values varied from -4.6 to 4.1, while the 1997 values varied from -4.6 to 3.9. Large agricultural systems had, for example, greater land in farms, higher real estate values, more farms with hired labor, more hired workers per farm, greater custom work expenses, and higher machine and equipment values than smaller systems. Scott (2003) provides further details and results regarding the application of the principal factor procedure.

As shown in Table 2, counties were classified for 1992 as large (N = 381), medium (N = 2,222) and small farming (N = 431) systems. Similarly, they were classified for 1997 as having large (N = 401), medium (N = 2,189) and small farming (N = 444) systems. A comparison of the 1992 and 1997 groupings shows that 1,879 counties (62 %) remained unchanged in their broad agristructure classification. Thirty-eight counties' classifications changed from small farming to predominately large farming systems, while 40 other counties had systems that moved in the opposite direction. In total, 573 counties experienced growth in their agristructure system size and 582 counties experienced a downsizing of their agristructural system. These differences between system sizes in 1992 and 1997 were statistically significant ($\chi^2 = 113.16$, $p < .0001$). Figures 1 and 2 illustrate the distributions of agristructural systems among U.S. counties for 1992 and 1997, respectively. Figures 3 through 5 point out the counties that changed their agristructural status during the 1990s.

Table 2. Frequency Distribution of U.S. Agristructure, 1992 and 1997[a]

1997 Agristructural Systems	1992 Agricultural Systems			
	Large	Medium	Small	Total
Large	92	249	40	381
Medium	271	1,667	284	2,222
Small	38	273	120	431
Total	401	2,189	444	3,034

[a] Chi-Square = 113.16, df = 4, p < .0001; Gamma = .323; r = .161, p < .0001.

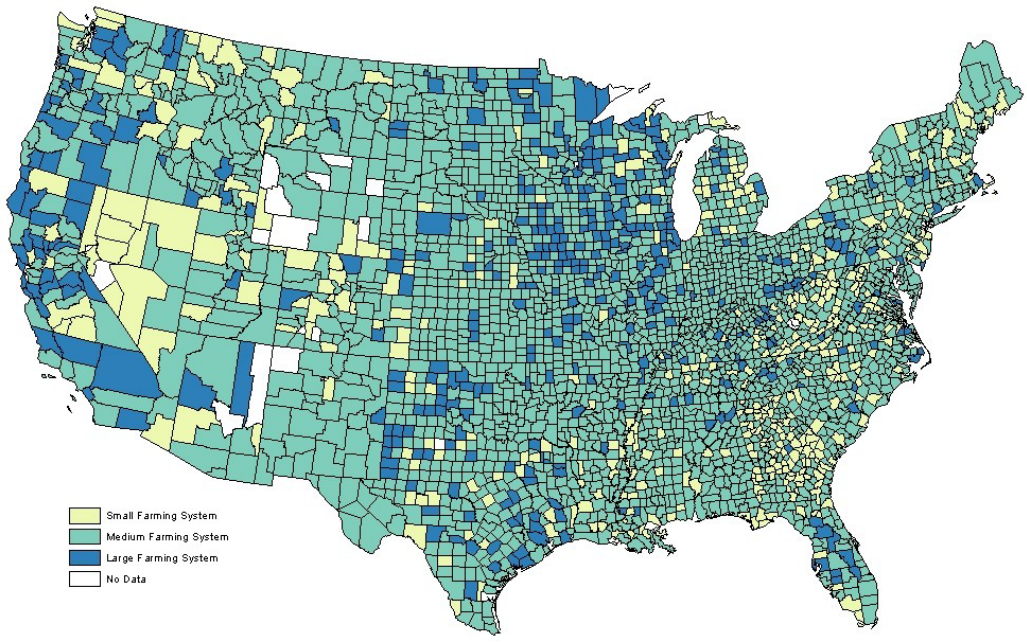

Figure 1. The Structure of U.S. Agristructure in 1992

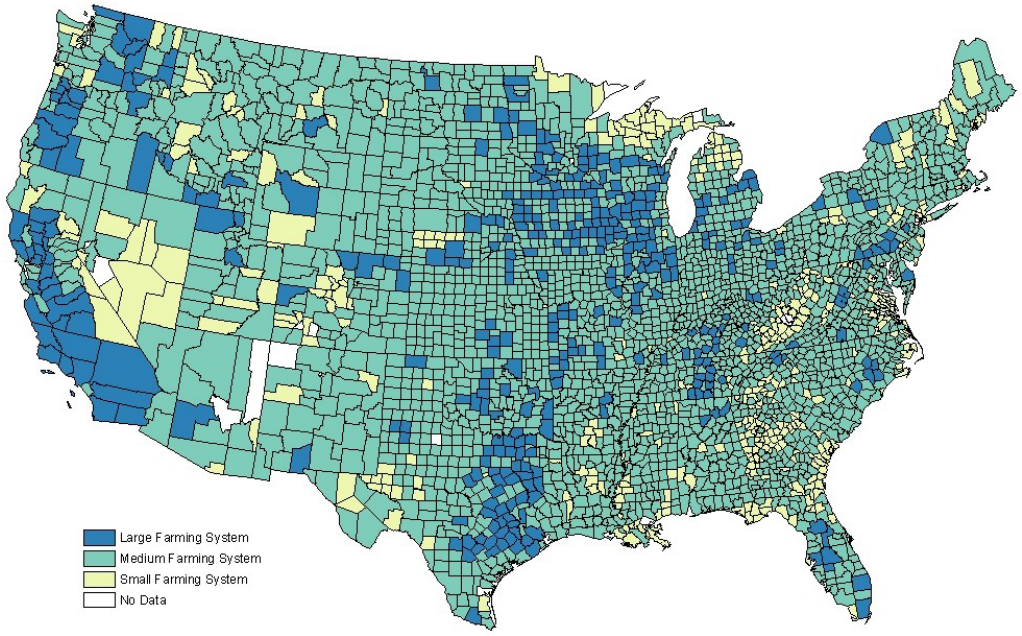

Figure 2. The Structure of U.S. Agristructure in 1997

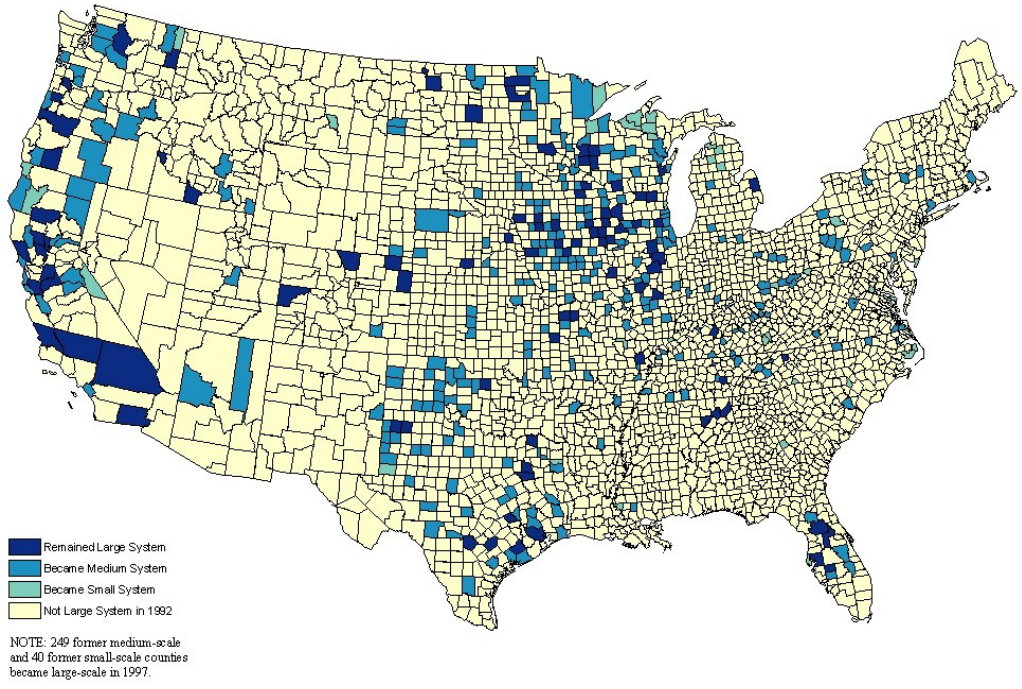

Figure 3. The Change of Large Scale Agriculture Systems form 1992 to 1997

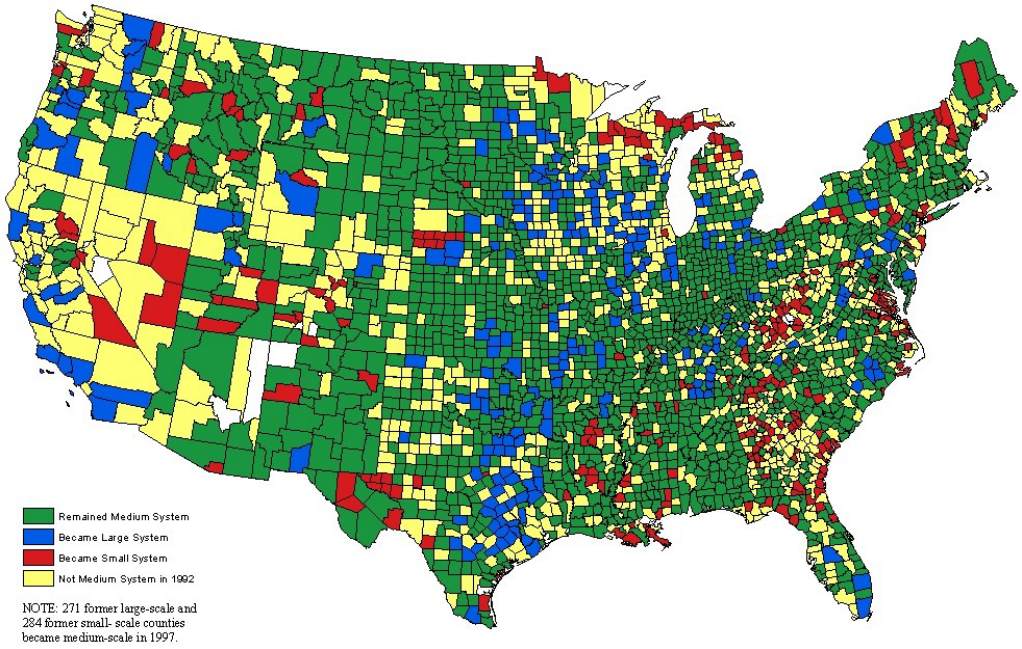

Figure 4. The Change of Medium Scale Agriculture Systems from 1992 to 1997

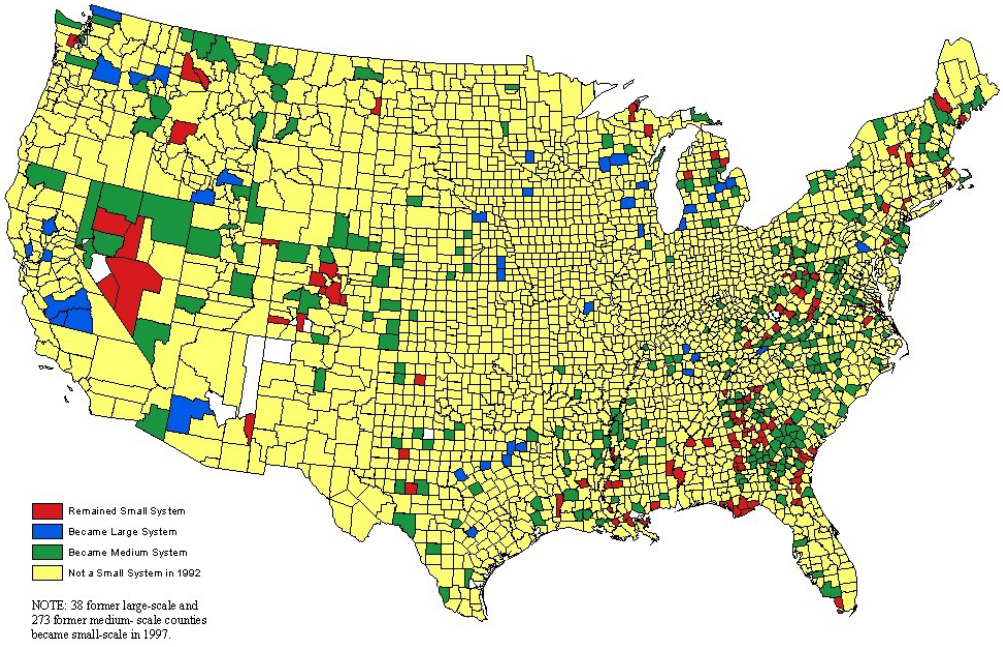

Figure 5. The Change of Small Scale Agriculture Systems from 1992 to 1997

Metropolitan Proximity

This variable was a function of population size and distribution and was represented by the rural-urban continuum prepared by Butler and Beale (1994). This classification scheme, originally developed in 1975 and updated after each national census, distinguished metropolitan counties by size and nonmetropolitan counties by degree of urbanization and proximity to metropolitan areas. We adopted the 1993 continuum to assure the closest match to the census data years. We modified the rural-urban continuum codes to be as follows: (0) core metro county with one million inhabitants or more, (1) fringe metro county with one million inhabitants or more, (2) metro county with 250,000 to 1,000,000 inhabitants, (3) metro county with less than 250,000 inhabitants, (4) adjacent nonmetro county with 20,000 or more urban inhabitants, (5) adjacent nonmetro county with 2,500 to 19,999 inhabitants, (6) adjacent nonmetro county with less than 2,500 inhabitants, (7) nonadjacent nonmetro county with 20,000 inhabitants or more, (8) nonadjacent nonmetro county with 2,500 to 19,999 inhabitants, and (9) nonadjacent nonmetro county with less than 2,500 inhabitants. Table 3 reports the number of counties in each category. Figures 6 through 8 present the distributions of counties by metropolitan, adjacent and nonadjacent proximity to metro areas, respectively. Approximately 60 percent of the U.S. population lived in urban (adjacent and nonadjacent to metropolitan counties) with at least 20,000 inhabitants. Relative to other areas of the nation, core metropolitan counties were few in number in the Upper Plains states. The distribution of adjacent counties was most evident in the eastern United States. Nonadjacent counties were predominately located west of the Mississippi River.

Table 3. Modified Rural-Urban Continuum Codes, Definitions and Frequencies

Coding	Label	Number and Percentage 1992	(%)	1997	(%)	Definition
Metropolitan						
0	Core Metro	152	(5.0)	153	(5.0)	Central counties of metropolitan areas of 1 million or more
1	Metro Fringe	642	(21.2)	642	(21.1)	Metropolitan counties along fringe of central counties[a]
Nonmetropolitan						
2	Adjacent Urban	131	(4.3)	131	(4.3)	Urban population 20,000+ adjacent to metropolitan area
3	Adjacent less urban	606	(20.2)	607	(20.0)	Urban population 2,500 - 19,999 adjacent to metropolitan area
4	Adjacent rural	245	(8.1)	247	(8.1)	Completely rural (no population of 2,500+) adjacent to metropolitan area
5	Nonadjacent urban	107	(3.5)	105	(3.5)	Urban population 20,000+ not adjacent to metropolitan area
6	Nonadjacent less urban	636	(21.0)	641	(21.1)	Urban population 2,500 - 19,999 not adjacent to metropolitan area
7	Nonadjacent rural	515	(17.0)	516	(17.0)	Completely rural (no population of 2,500+) not adjacent to metropolitan area
Total		3,034	(100.0)	3,042	(100.0)	

[a] This includes metropolitan fringe of 1,000,000 or more population, metropolitan area of 250,000 to 1,000,000 population and urban population less than 250,000 in a metropolitan statistical area.

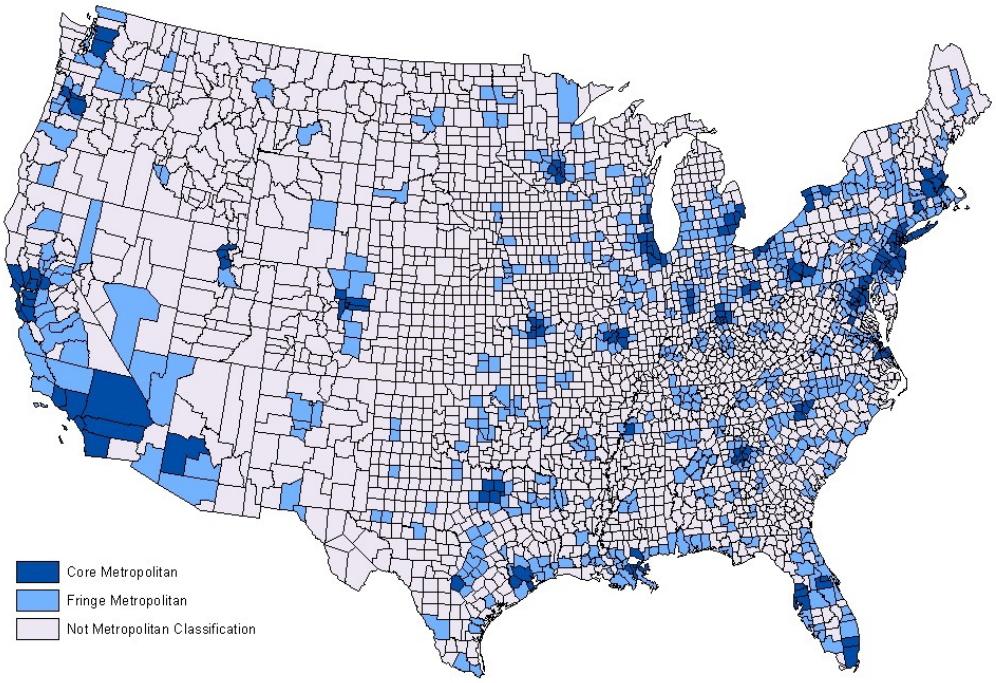

Figure 6. Distribution of Core and Fringe Metropolitan Counties, 1993

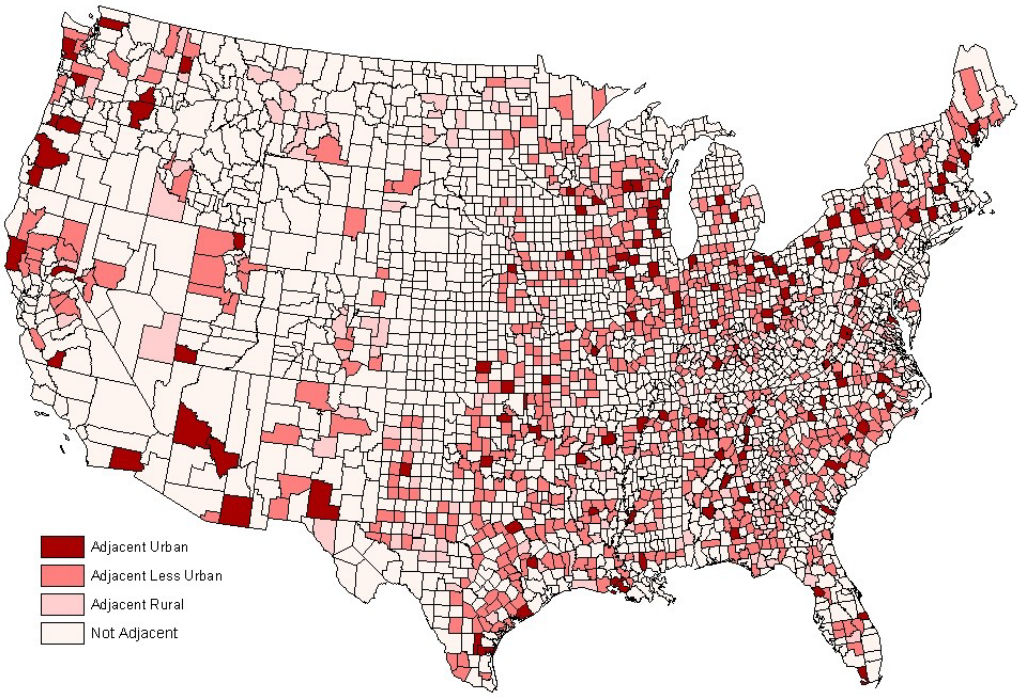

Figure 7. Distribution of Counties Adjacent to Metropolitan Areas, 1993

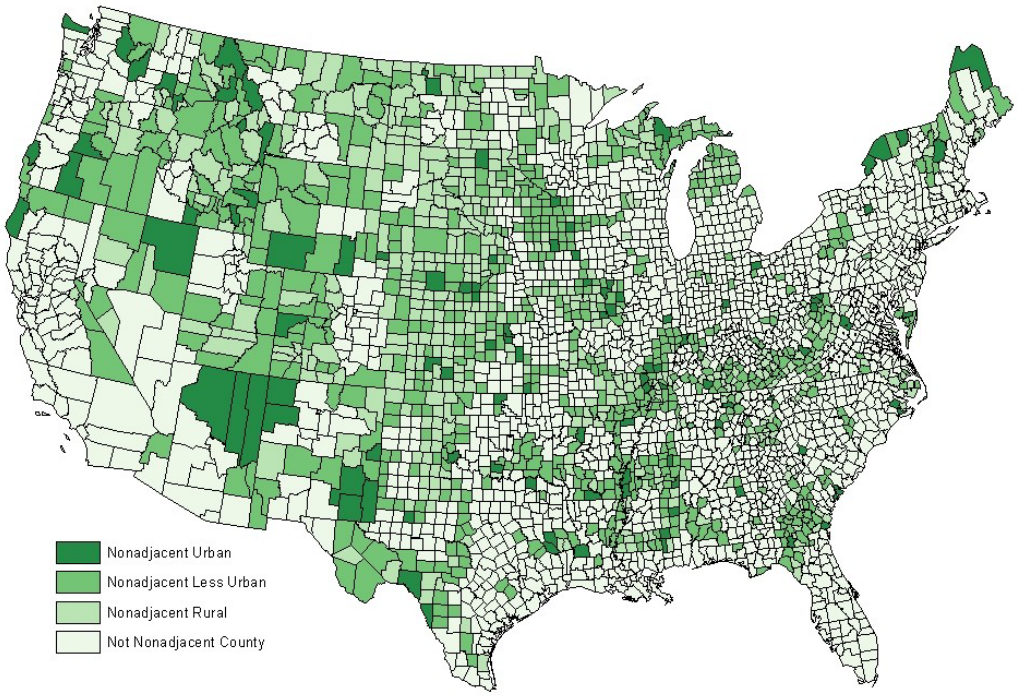

Figure 8. Distribution of Nonadjacent to Metropolitan Areas, 1993

Crosstabulations of agristructure and metropolitan proximity are reported in Table 4 as percentages of the total number of counties used in crosstabulation analysis. Overall, counties dominated by large and small farm systems decreased by 0.6 and 0.4 percent, respectively, while medium farm system counties increased by one percent from 1992 to 1997. Fringe metropolitan counties and nonadjacent rural counties experienced the greatest shift in farm system size from 1992 to 1997. Fringe metropolitan counties had a decrease in farm system size as two percent of counties with large systems downsized to smaller systems by 1997. Nonadjacent rural counties experienced an increase of 1.7 percent of large farm systems. Furthermore, small farm systems increased by 2.5 percent in adjacent urban counties. Core metropolitan, adjacent urban, adjacent less urban, and nonadjacent urban counties only slightly decreased in their system sizes. In contrast, adjacent rural and nonadjacent less urban counties experienced an increase in farming system sizes. Overall in 1992, larger agristructure systems were located closer to population centers while small-farm systems were more likely to have been located in less populated counties. These findings contradict most ideas about the size and location of farms, especially when size is viewed solely in terms of number of acres or amount of sales revenues. This distribution of agristructural systems by metropolitan proximity was statistically significant ($\chi^2 = 207.88$, $p < .0001$). However, by 1997 no significant differences were observed ($\chi^2 = 18.83$, $p = .3824$) in the distribution agristructural systems by metropolitan proximity. In other words, system sizes did not vary by their relative locations to cities.

Resource Regions

We adopted the nine farm resource regions developed by USDA-Economic Research Service to indicate environmental or climatic differences across the nation. These regions are Fruitful Rim, Basin and Range, Northern Great Plains, Prairie Gateway, Eastern Uplands, Northern Crescent, Heartland, Mississippi Portal, and Southern Seaboard (Economic Research

Service 2000). This variable was selected to portray geographic specialization of farm production based on natural resource constraints with commodity production, and farm structure considerations which would

Table 4. Crosstabulations of Agristructure by Metropolitan Proximity

Year and Agricultural System[a]	Metropolitan Proximity County Classification								
	Core	Fringe	Adjacent Urban	Adjacent Less Urban	Adjacent Rural	Nonadjacent Urban	Nonadjacent Less Urban	Nonadjacent Rural	Total
1992[b]									
Large	.9	4.5	1.1	3.3	.3	.7	2.2	.3	13.2
Medium	3.1	14.1	3.0	14.8	5.7	2.6	16.2	12.7	72.2
Small	1.0	2.6	.3	1.9	2.1	.3	2.6	4.0	14.6
Total	5.0	21.2	4.3	20.0	8.1	3.5	21.0	17.0	100.0[d]
1997[c]									
Large	.8	2.5	.6	2.7	.7	.5	2.6	2.0	12.6
Medium	3.6	15.0	3.0	14.8	6.0	2.5	15.8	12.7	73.2
Small	.6	3.7	2.8	2.4	1.4	.5	2.6	2.3	14.2
Total	5.0	21.2	4.3	20.0	8.1	3.5	21.0	17.0	100.0[d]

[a] Values expressed in percentage of total counties, N = 3,034.

[b] Chi-Square = 207.88, df = 14, p < .0001; Gamma = .362; r = -.161, p < .0001.

[c] Chi-Square = 18.83, df = 14, p = .1715; Gamma = -.043; r = .016, p = .3824.

[d] There were 8 cases dropped from 1997 dataset to create this frequency distribution.

require adaptive responses throughout diverse agricultural systems. Several of the original categories were combined to indicate regions with similar geophysical and biological constraints and to facilitate their analysis. The modified regions and their constituent counties are shown in Table 5 and in Figure 9 as the Sunbelt, Mountain, Plains, South, Northern Crescent, and Heartland. Medium-size farming systems were the most numerous in each region. Second to medium-size, small-farm systems dominated in the Northern Crescent, South, and Mountain regions. Moreover, the number of large-farm systems was second to medium-size systems in the Plains, Heartland, and Sunbelt regions. Only counties in the Sunbelt had agristructures that changed from large-farm systems to small-farm systems, during the 1990s.

Production regions are compared by size of agristructure in Table 6. The Northern Crescent region experienced the least amount of agristructural change from 1992 and 1997. The Mountain region had the greatest increase in farm system size as 0.6 percent small-farm counties

Table 5. Frequencies of Resource Regions, 1992 and 1997

	1992[a]		1997[b]	
Region	Counties	Percentage	Counties	Percentage
Sunbelt	273	9.0	278	9.1
Northern Crescent	406	13.4	411	13.5
Plains	572	18.9	572	18.8
South	1048	34.5	1048	34.5
Heartland	543	17.9	543	17.9
Mountain	192	6.3	190	6.3
Total	3,034	100.0	3,042	100.0

[a] N = 3,034.

[b] N = 3,042.

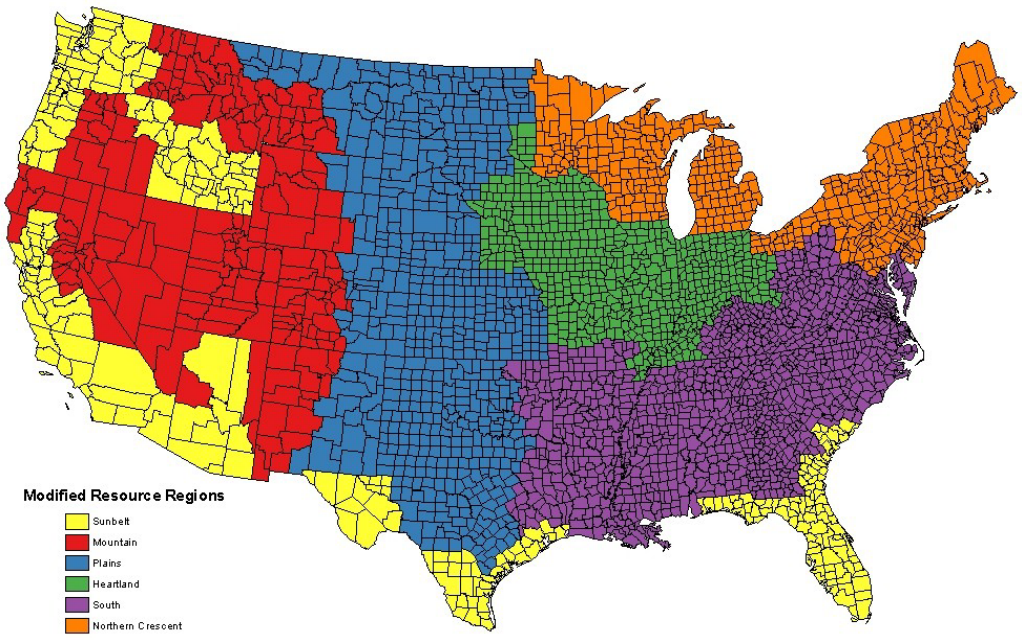

Figure 9. Modified U.S. Farm Resource Regions

developed into large-farm system counties and 0.2 percent into medium systems during the 1990s. The Heartland lost the greatest percentage of counties that had large-farm systems (1.7 %). The Sunbelt also had systems that downsized during the 1990s. Agristructural comparisons by resource region were statistically significant in 1992 ($\chi^2 = 334.30$, $p < .0001$) and 1997 ($\chi^2 = 199.09$, $p < .0001$) which indicated that agristructure was related to resource region.

Table 6. Crosstabulations of Agristructure by Resource Region

	Resource Region						
Agristructural System[a]	Sunbelt	Northern Crescent	Plains	South	Heartland	Mountains	Total
1992[b]							
Large	2.3	2.1	2.3	2.2	4.0	.3	13.2
Medium	5.1	8.6	15.8	24.8	13.8	4.1	72.2
Small	1.7	2.6	.8	7.5	.1	1.9	14.6
Total	9.0	13.4	18.9	34.5	17.9	6.3	100.0[d]
1997[c]							
Large	1.6	2.1	2.4	2.3	2.3	.9	12.6
Medium	5.6	8.5	15.5	25.3	14.3	4.3	73.2
Small	1.8	2.8	1.0	7.0	.5	1.1	14.2
Total	9.0	13.4	18.9	34.5	17.9	6.3	100.0[d]

[a] Values expressed in percentage of total counties, N = 3,034.

[b] Chi-Square = 334.30, df = 10, p < .0001

[c] Chi-Square = 199.09, df = 10, p < .0001

[d] There were 8 cases dropped from 1997 dataset to create this frequency distribution.

Commodity Production

We used crop sales revenue to indicate commodity production. Crop revenue values were obtained from the 1992 and 1997 Censuses of Agriculture for each of five groups of crop commodities. All values were expressed in 1997 dollars. The crop categories were: (1) grains, (2) cotton/cottonseed, (3) fruits/vegetables, (4) nursery/greenhouse, and (5) other crops

(including tobacco, hay, silage, field seeds, and other crops products) and (6) total crop sales revenues (Thomas and Howell 2003). Table 7 presents the total revenues from crop sales and sales revenues of each crop for 1992 and 1997.

The geographic distributions of crops sales revenues provide additional insight of the status of agriculture in the United States and its changes during the 1990s. Figures 10 through 15 illustrate the distribution of total revenues from crop sales and sales revenues of each crop for 1992 (map a) and 1997 (map b). The dollar sales categories reported in each figure were based on original raw sales values. The categories for each commodity were based on each commodity's mean and county values relative to one standard deviation from the mean.

The total number of counties that reported revenues for each farm crop varied slightly for the study years. In regards to total sales revenues, the number of counties with sales between 10 and 115 million dollars and greater than 115 million dollars increased from 1992 to 1997 while the number of counties with sales less than 10 million dollars declined. Total sales revenues greater than 115 million dollars were concentrated in California, Washington, and counties along the Mississippi River and in Florida (Figures 10a and 10b). Clustered counties in the Midwest and along the eastern seaboard had sales revenues between 10 million and 115 million dollars of average sales per county. This general pattern was constant for 1997.

Comparison of the 1992 and 1997 geographical distributions of grain sales shows similar patterns for each year in Figures 11a and 11b. Sales greater than 42 million dollars were concentrated in the Upper Midwest with smaller clusters of counties with high crop sales in California, Washington, and along the Mississippi River. The total number of counties reporting any grain sales decreased from 1992 to 1997. Meanwhile, the number of counties reporting grain sales greater than 42 million dollars increased substantially from 327 counties in 1992 to 393 counties in 1997.

Cotton sales were significantly concentrated in the southern part of the United States as shown in Figures 12a and b. Cotton production expanded from 483 counties in 1992 to 522 counties in 1997. In both study years, clusters of counties with cotton sales greater than 37 million dollars occurred in California, Arizona and along the Mississippi River. Counties with sales less than 37 million dollars were located along the Southeastern coast.

The majority of counties that reported nursery/greenhouse sales produced less than four million dollars. The distribution of nursery/greenhouse sales greater than 14 million dollars were clustered in California, New England, and Florida, as shown in Figures 13a and 13b. Nursery/greenhouse production was generally absent in the nation's Midwestern states. The increase of nursery/greenhouse production was evident as 1,605 and 1,819 counties reported nursery/greenhouse sales for 1992 and 1997, respectively.

Fruit/vegetable sales were most prominent in California, Washington and Florida, as seen in Figures 14a and 14b. Fruit/vegetable sales were reported in 2,134 and 2,044 counties in 1992 and 1997, respectively. However, nearly 80 percent of these counties in each year had fruit/vegetable sales under 10 million dollars. The Great Plains region had the fewest number of counties with fruit/vegetable sales.

The distribution of counties that produced "other crops" occurred in several distinct clusters of counties in 1992 and 1997, as reported in Figures 15a and 15b. Clusters of counties that had "other crops" sales greater than 20 million dollars occurred in California, Arizona, Idaho, Kentucky, Washington, Minnesota, the coastal Carolinas, Florida, and along the mouth of the Mississippi River.

Table 7. Original Means and Standard Deviations for Crop Variables in 1992 and 1997

	1992				1997			
Variables	Reported Sales ($000)	Estimated Sales ($000)[a]	Means[c]	Standard Deviations	Reported Sales ($000)	Estimated Sales ($000)[b]	Means	Standard Deviations
Total crop sales	86,113,029	84,915,895	27,988.1	67,677.3	98,055,656	96,584,413	31,750.3	82,315.5
Grain	41,176,977	41,041,828	13,527.3	21,431.0	46,617,111	46,476,284	15,278.2	24,140.9
Cotton/cottonseed	5,242,529	5,120,785	1,687.8	11,705.4	5,975,478	5,868,626	1,929.2	11,527.8
Nursery/greenhouse	8,739,621	7,860,487	2,590.8	12,806.9	10,942,816	9,974,414	3,278.9	15,405.1
Fruits/vegetables[d]	17,862,527	17,305,936	5,704.0	44,215.0	21,061,959	20,508,251	6,741.7	14,344.7
Other crops[e]	13,091,374	12,416,038	4,092.3	14,113.9	17,258,298	12,803,170	4,208.8	58,410.7

[a] N = 3,034; product of each variable's mean and total observations.
[b] N = 3,042; product of each variable's mean and total observations.
[c] All sales ($000) adjusted to 1997 dollars.
[d] Includes sweet corn, melons, nuts, and berries.
[e] Includes tobacco, hay/silage/field seeds, and other crop products.

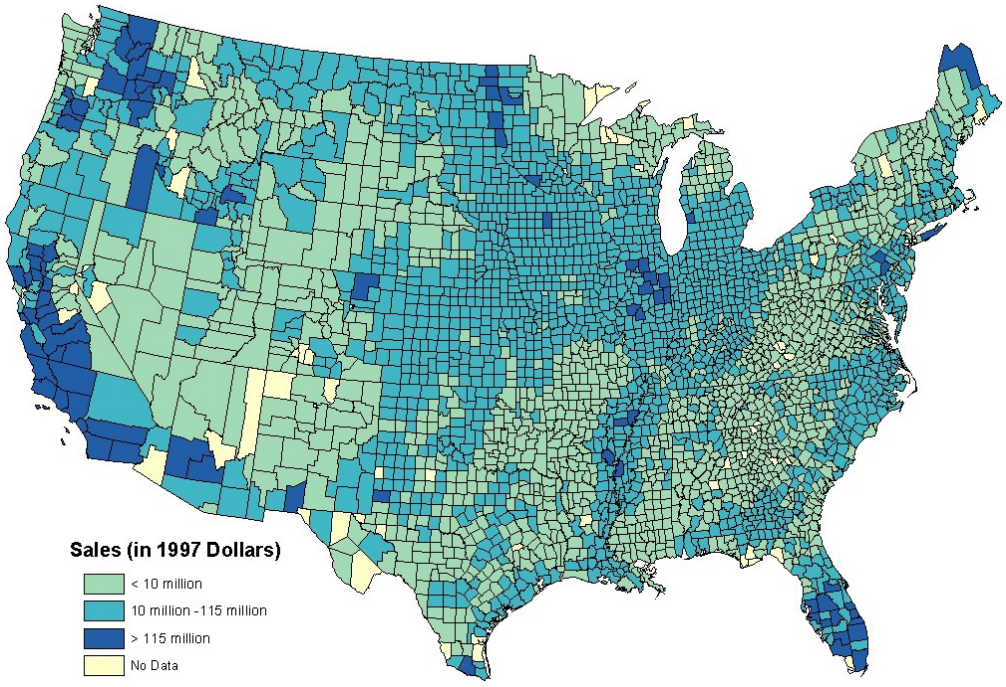

Figure 10a. Distribution of Total U.S. Crop Sales in 1992

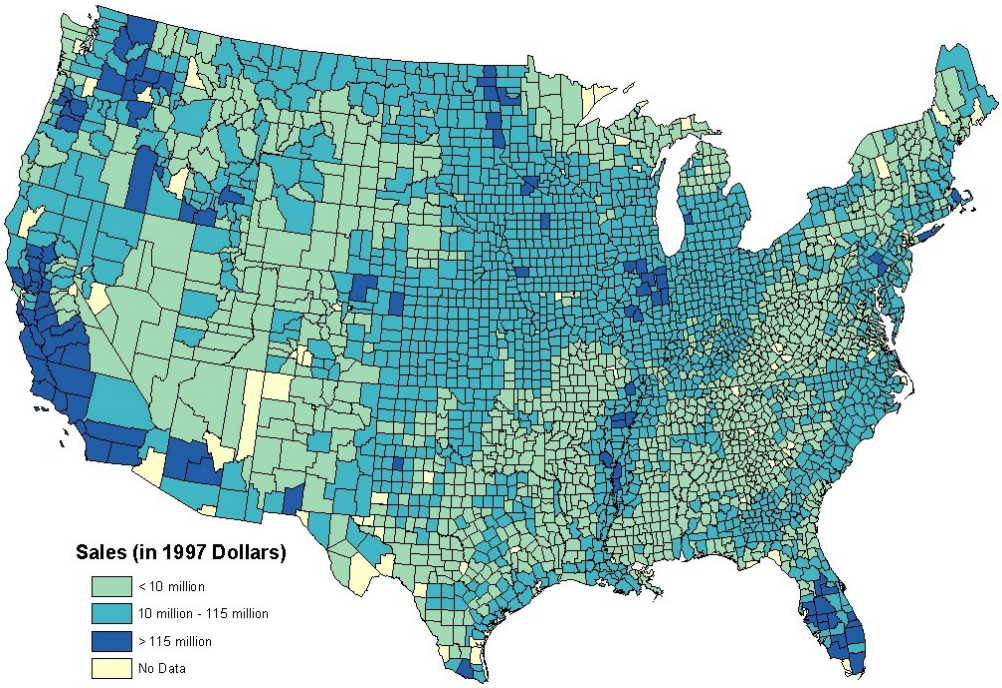

Figure 10b. Distribution of Total U.S. Crop Sales in 1997

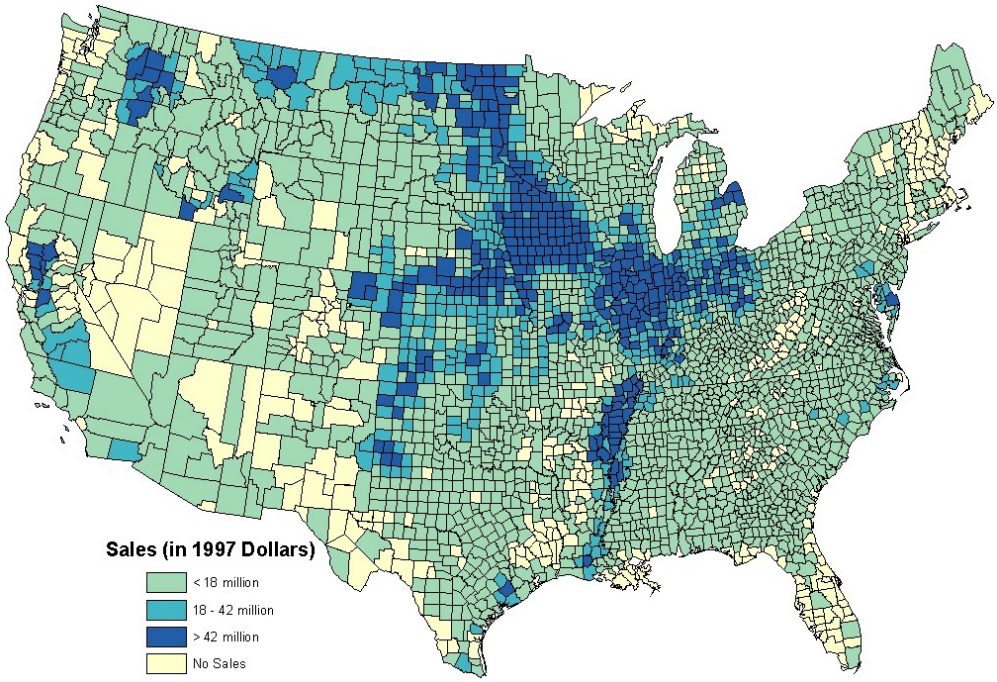

Figure 11a. Distribution of U.S. Grain Sales in 1992

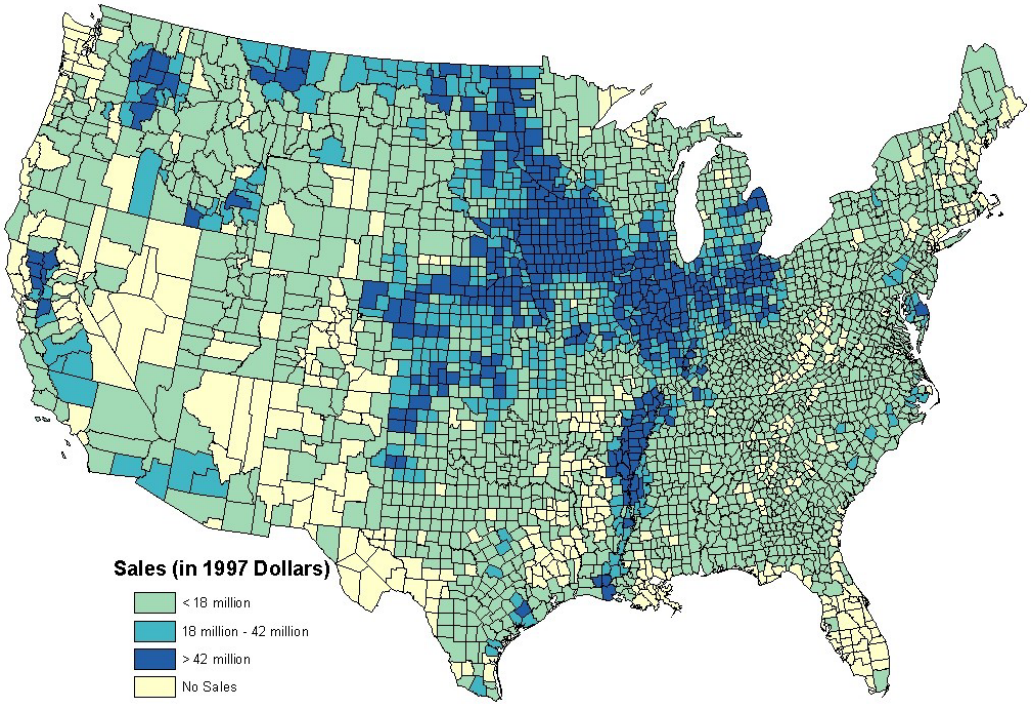

Figure 11b. Distribution of U.S. Grain Sales in 1997

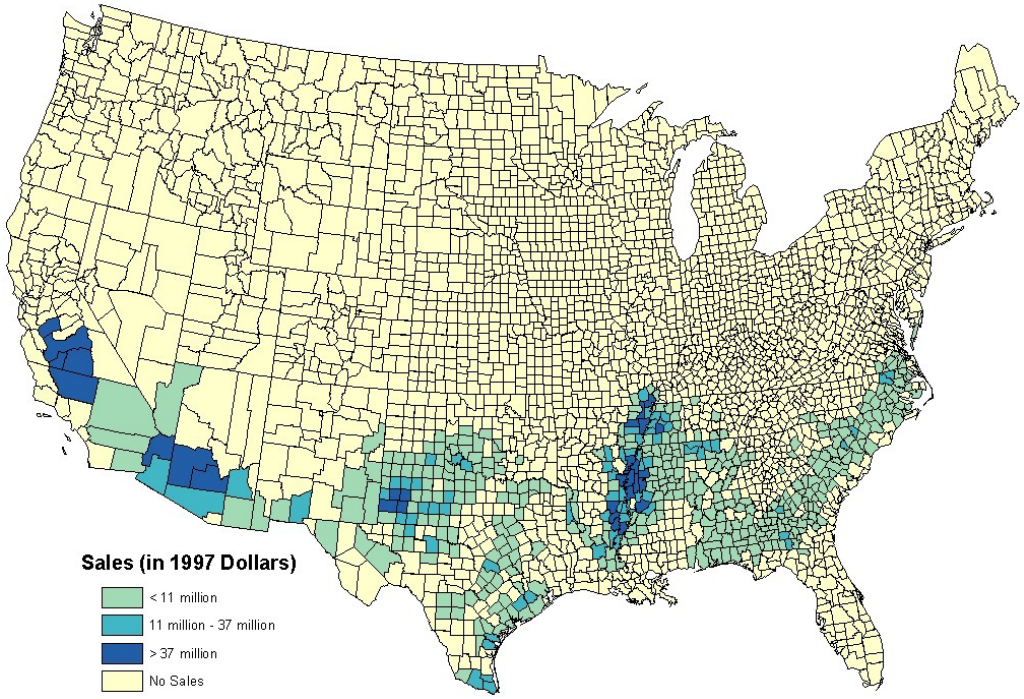

Figure 12a. Distribution of U.S. Cotton Sales in 1992

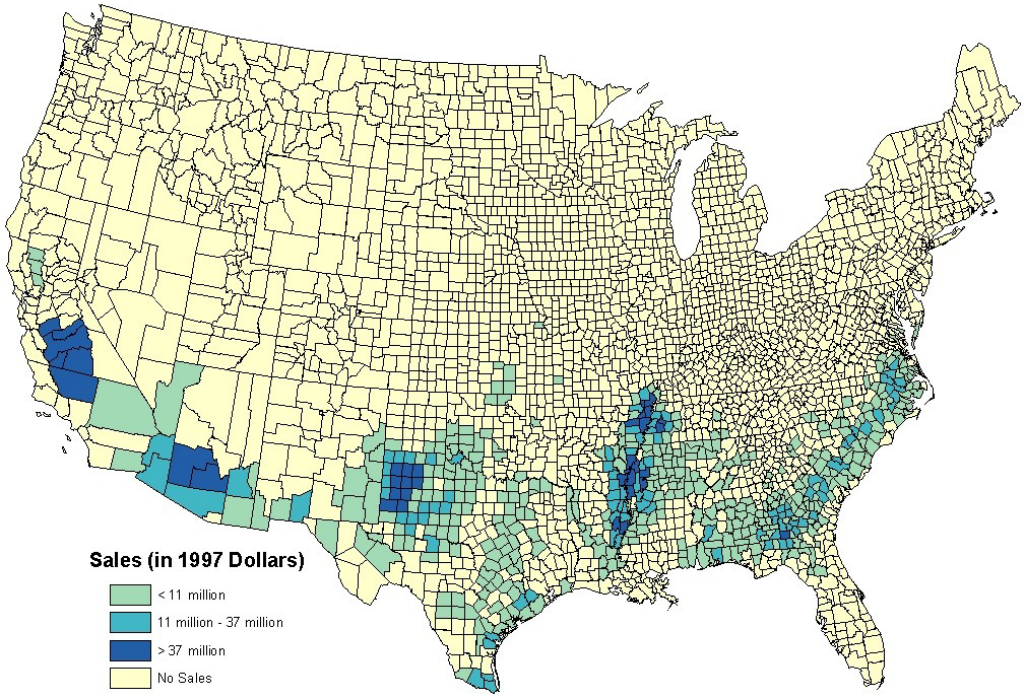

Figure 12b. Distribution of U.S. Cotton Sales in 1992

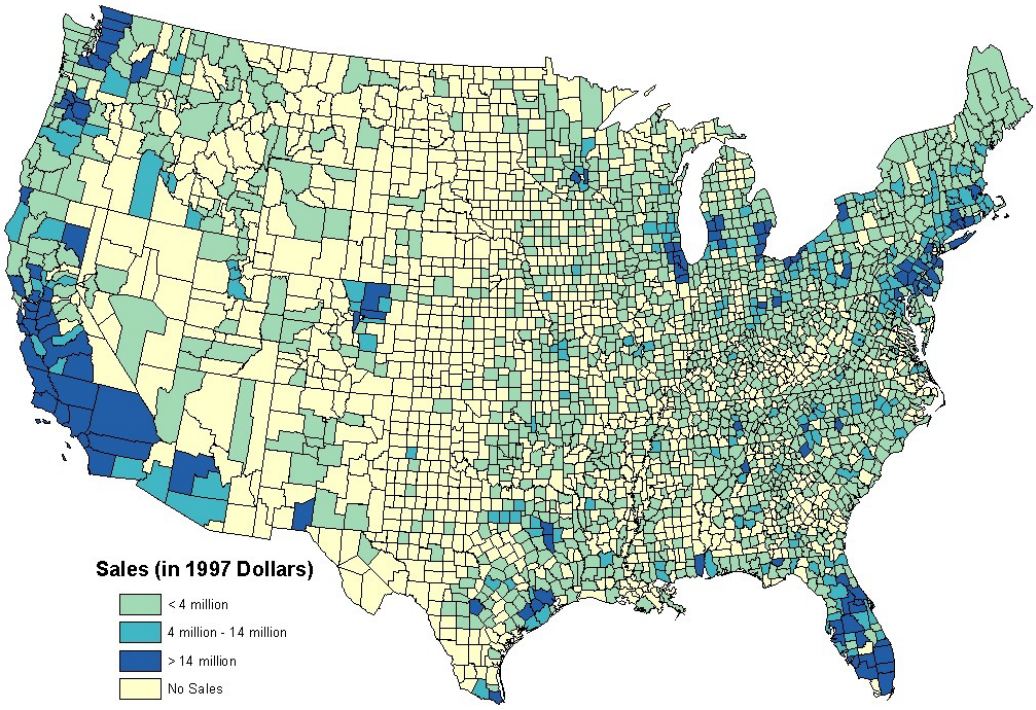

Figure 13a. Distribution of U.S. Nursery/Greenhouse Sales in 1992

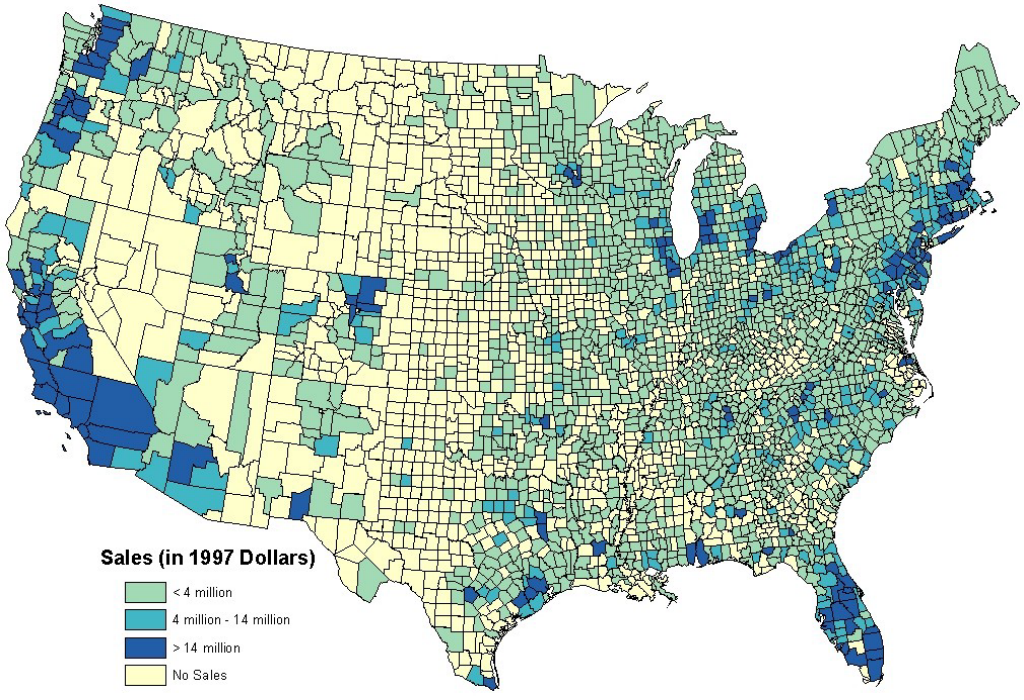

Figure 13b. Distribution of U.S. Nursery/Greenhouse Sales in 1997

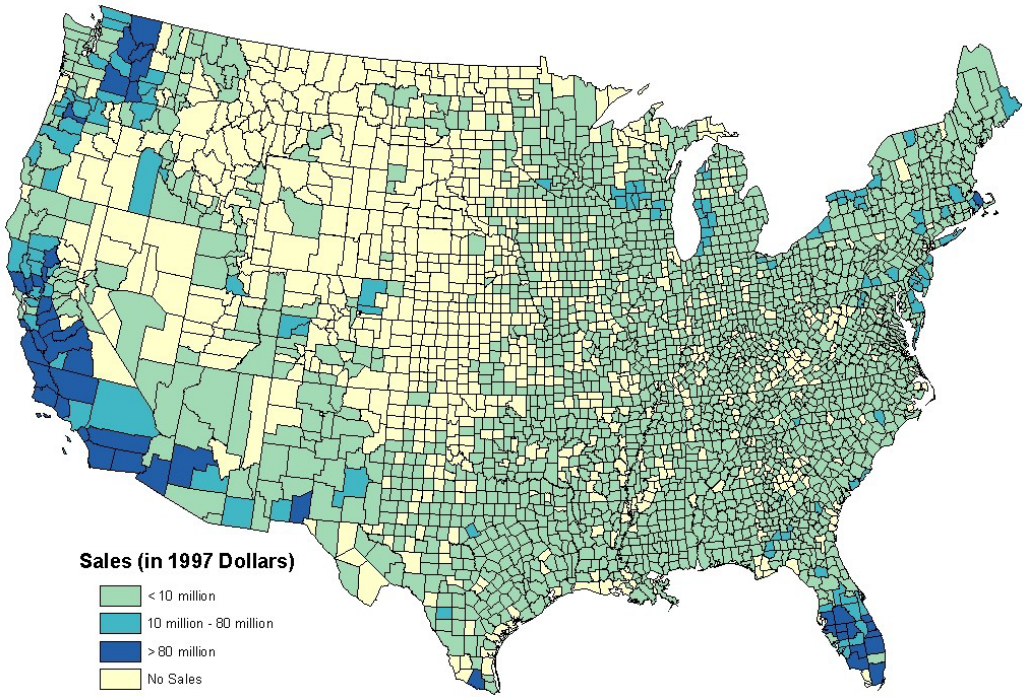

Figure 14a. Distribution of U.S. Fruit/Vegetable Sales in 1992

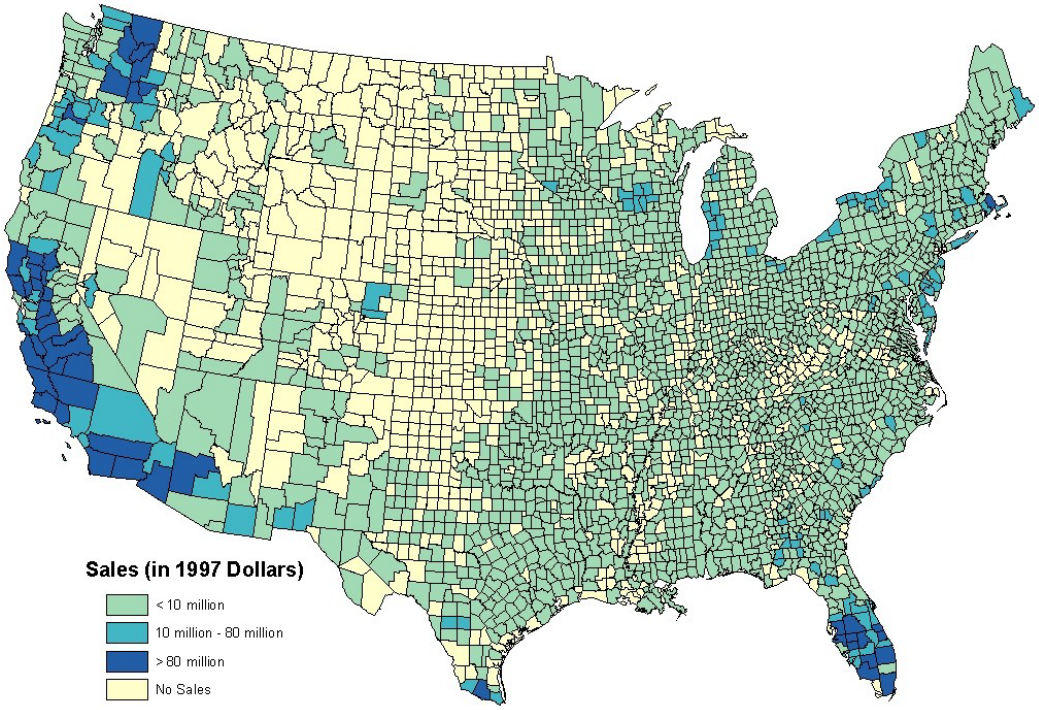

Figure 14b. Distribution of U.S. Fruit/Vegetable Sales in 1997

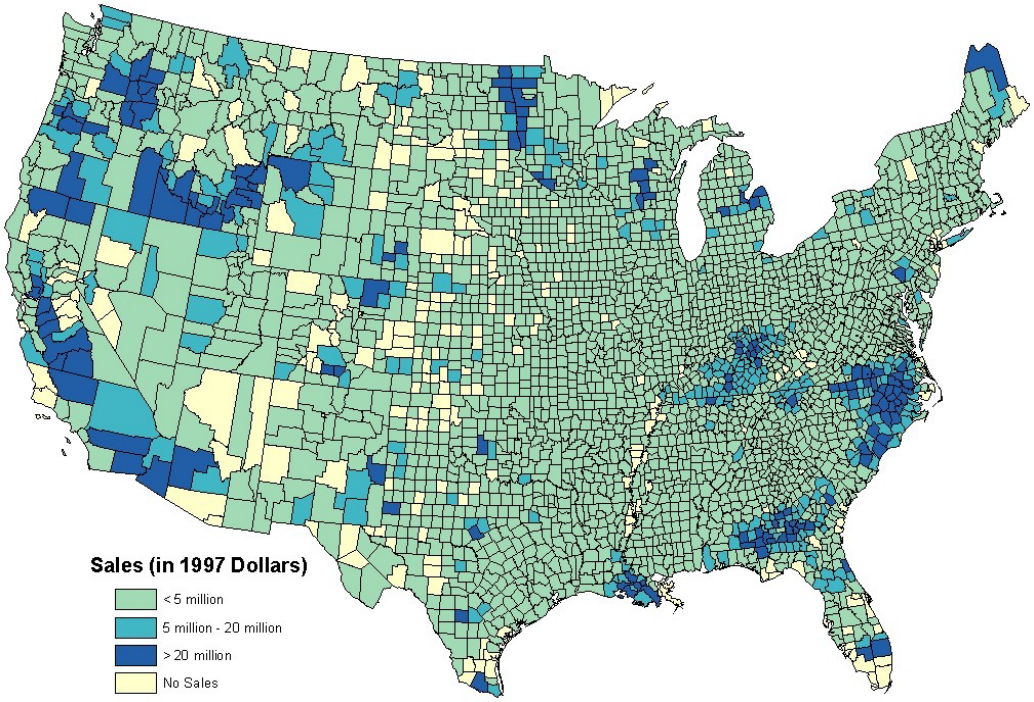

Figure 15a. Distribution of U.S. "Other Crop" Sales in 1992

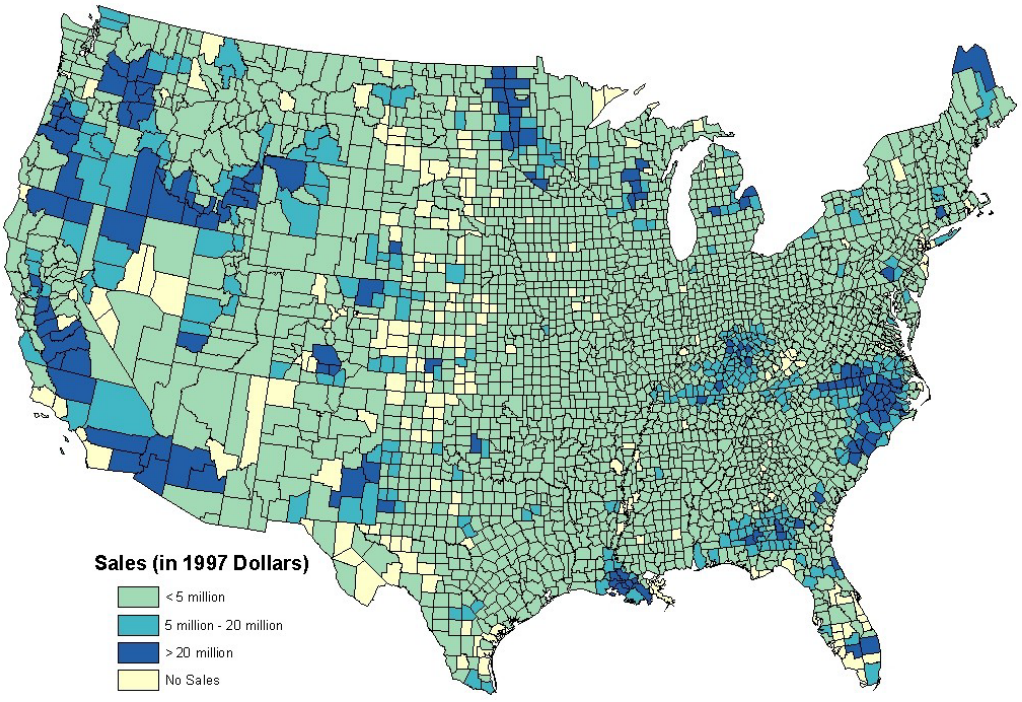

Figure 15b. Distribution of U.S. "Other Crop" Sales in 1997

Bivariate Correlations

After we transformed sales revenues to improve their distributional symmetry in compliance with the statistical assumptions of correlational analysis (Lutz 1983), we calculated correlation coefficients for the three study variables with crop sales revenues for each study year. All correlation coefficients for agristructure and crop revenues were statistically significant in 1992 and 1997. For each year, total crop sales, grains, and "other crops" had the three largest, albeit moderate, correlation coefficients. Sales revenues of total crop sales, grain sales, and "other crop" sales revenues were greater among counties with larger agristructures.

In 1992, cotton sales had the only insignificant association with metropolitan proximity. In 1997, total sales and cotton sales relative to metropolitan proximity were statistically insignificant. For each year, all commodity groups, except for grain sales, had an inverse relationship with metropolitan proximity. This to say that sales revenues were greater for counties located closer to metropolitan areas. In 1992, nursery/greenhouse and fruit/vegetables had the strongest associations with metropolitan proximity. The correlation coefficients for 1997 were much weaker for all commodities, except for grain sales. The decline in association with metropolitan proximity indicated the weakening influence of metropolitan proximity on commodity revenue, or perhaps greater variation in crop sales revenues by location.

The correlation of crop sales with resource regions (with the Mountain Region serving as the reference category) clarified the pattern of sales across the nation. All regions had greater total sales revenues than the Mountain Region in 1992, but five years later the South had fewer total sales revenues than the reference region. The Mountain region increased in grain sales revenues over the Sunbelt and South regions from 1992 to 1997. In both years, the reference region had greater cotton sales than the Northern Crescent and the Heartland. Only the Plains had greater nursery/greenhouse and fruit/vegetable sales revenues than the Mountain region in

both years. The most significant change occurred in "other crops" sales revenues. In 1992, no region had statistically significant fewer revenues than the reference region. However, in 1997 the Mountain region dominated "other crop" production as all other regions had fewer sales revenues. The majority of low to moderate correlation coefficients indicated that the Mountain region did not predominate over any other region regarding sales revenues of specific crops.

Conclusions

We guided this analysis by five questions. We found that: the county-level structure of U.S. agriculture changed from 1992 to 1997; size of agristructure and metropolitan proximity were positively related in 1992, but not in 1997; agristructure varied by resource region in the contiguous 48 states in both periods; and agristructure, metropolitan proximity, and resource region were positively associated with total and specific crop sales revenues in 1992, but less so in 1997. At the beginning of the decade, counties closest to metropolitan areas had the largest agristructural systems and still contributed prominently to crop commodity sales revenues later in the decade. Growth in agristructure size was greatest in the Mountain region, while downsizing was concentrated in the Sunbelt and Heartland regions. Both agristructure and metropolitan proximity influenced levels of crop sales revenues, except for grain and cotton in 1997.

As expected, large agristructure systems were consistently associated with greater crop sales revenues while the smallest systems produced the least revenues. By 1997, metropolitan proximity's influence on sales revenues had declined as county-level agristructures were more varied relative to their metropolitan proximity. Counties located in and closest to metropolitan areas contributed especially to higher nursery/greenhouse and fruit/vegetable sales revenues.

Our research contributes to the growing literature documenting changes in U.S. agricultural production. It demonstrates that much of the nation's crop-based agriculture does

not exist in rural areas as it once did and that "rural" is no longer synonymous with "agriculture" (Thomas and Howell 2003). Although some observers such as Wimberley (1993), advocate the decoupling of agricultural policy and rural community development, the "metropolitanization" of agricultural production indicates that some of these joint policies may be necessary. The contiguous nature of agricultural production and large urbanized populations has implications for every type of community, large or small, whether the concern is municipal services, natural resource, food security, environmental quality, or labor resources. Rather than unequivocally decoupling agricultural and rural policy, we propose that state and federal leaders more closely examine agricultural production relative to its location and type of commodity production. Policies specifically designed for cities and rural areas need to continue and to be updated to address the interface of farm and city life (Vail 1987). Social scientists should likewise direct more attention to these contiguous landscapes, activities, and lifestyles.

Table 8. Pearson Correlation Coefficients of Commodity Sales by Selected Variables

Independent Variables	1992						1997					
	Total Sales	Grains	Cotton	Nursery/ Greenhouse	Fruit/ Vegetables	Other Crops	Total Sales	Grains	Cotton	Nursery/ Greenhouse	Fruit/ Vegetables	Other Crops
Metropolitan Proximity[a]	-.167‡	.047†	-.025	-.585‡	-.464‡	-.152‡	-.012	.095‡	-.026	-.218‡	-.232‡	-.007‡
Agristructure[b]	.569‡	.435‡	.049*	.243‡	.289‡	.391‡	.560‡	.422‡	.045*	.243‡	.300‡	.385‡
Resource Region[c]												
Sunbelt	.315‡	.121†	.274‡	.385‡	.488‡	.081	.050	-.130†	.154‡	.274‡	.260‡	-.100*
Northern Crescent	.235‡	.156‡	-.103*	.483‡	.568‡	.107†	-.005	.373	-.222‡	.418‡	.331‡	-.014
Plains	.341‡	.411‡	.220‡	-.164‡	-.077*	-.060	.031	.225‡	.084*	-.147‡	-.171‡	-.139‡
South	.063*	.033	.222‡	.117‡	.220‡	.033	-.123‡	-.074†	.171*	.072*	.054	-.091‡
Heartland	.607‡	.675‡	-.002	.075*	.137†	-.023	.260‡	.479‡	-.167‡	.064	-.044	-.125‡

[a] Coding as follows: 1 = core metro, 2 = fringe metro, 3 = adjacent urban, 4 = adjacent less urban, 5 = adjacent rural, 6 = nonadjacent urban, 7 = nonadjacent less urban, and 8 = nonadjacent rural.

[b] Coding as follows: 1= small system, 2 = medium system, 3 = large system.

[c] Mountain was the reference category.

* $p < .05$; † $p < .01$; ‡ $p < .001$.

Endnotes

1. Data availability for agristructure variables served as the guide to determine which counties were included for analysis. The dataset and analysis had two constraints: (1) the analysis was arbitrarily restricted to the 48 contiguous states; (2) in order to create the most valid dataset, several key variables (i.e., approximate land area, proportion in farm, number of farms, acres of land in farms) were used to identify nonagricultural counties and their omission from the analysis. Some counties reported no farms while other counties had a small number of farms which prevented discloser of information by the National Agricultural Statistics Service on individual operators. In 1992, at least one of the three key variables was suppressed for thirty-one counties. Likewise, there were twenty-seven counties in 1997 with suppressed values for at least one of these variables. Whenever a variable's data were missing for other counties, zero was substituted to maintain partial comparability with Thomas and associates' (1996) procedures. When the average age of operators in a county was unknown, the national median ages of 53 years for 1992 and 54 years for 1997 were inserted. Finally, gross farm sales, which were included in the study by Thomas and his associates (1996), were omitted from the agristructure index to avoid possible issues of non-independence with the measures for specific crop commodity sales.

2. Factor scores were important for three reasons. First, each score was based on eighteen variables standardized to a mean of zero and standard deviation of one. Because their calculation included the use of standardized units, the scores were expressed in standardized units as well. Thus, the scales could be compared across time and counties. Finally, scales constructed with factor scoring coefficients were based on the assumption that their items were intrinsically related in some degree to other factor dimensions (Harmon 1976; Rummel 1967).

Each county had one structural value for each study year. The omega reliability coefficients for 1992 and 1997 were .978 and .980, respectively. The magnitudes of the coefficients indicated good internal consistency of the agristructural scales (Carmines and Zeller 1978).

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APPENDIX A

Definitions of Agristructural Variables

Definitions of study variables were the same for 1992 and 1997. Data were aggregated at the county level by the U.S. Bureau of the Census for 1992 and the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service for 1997.

Farm Scale

(1) ***Total number of farms:*** A farm was any place from which $2,500 or more of agricultural products were sold or normally would have been sold during the census year.

(2) ***Proportion of county acres in farms:*** The "proportion of county acres in farms" was calculated for 1992 and 1997 by dividing total farm acreage by the 1990 total land area of a county.

(3) ***Average farm size in counties:*** This variable was calculated by dividing the number of farm acres by the number of farms per individual county.

(4) ***Number of small farms:*** The count of farms with actual sales less than $2,500.

(5) ***Total Value of Real Estate:*** Real estate value pertained to the estimated value of land and buildings owned, rented, or leased from others, and rented or leased to others. Market value referred to the value of the land and buildings would sell for under current market conditions. If the value of land and buildings was not reported, it was estimated by USDA using the average value of land and buildings from a similar farm in the same geographic area.

Farm Ownership

(7) ***Number of unincorporated individual and family farms:*** This variable was the number of farms controlled and operated by an individual including family farm operations that are not incorporated and not operated under a partnership agreement.

(8) ***Number of farm partnerships:*** The number of partnerships applied to two or more persons who had agreed on the amount of their contribution (i.e., capital and effort) and the distribution of profits. Co-ownership of land by husband or wife or joint filing of income tax forms by husband and wife was not considered a partnership unless a specific agreement to share contribution, decision-making, profits, and liabilities exists. Production under contract or under a share-rental agreement was not considered a partnership.

(9) ***Number of farm corporations:*** The number of corporations included: cooperatives (defined as an incorporated or unincorporated enterprise or association created and formed jointly by the members), estate or trust (defined as a fund of money or property administration for the benefit of another individual or organization), prison farm, grazing association, Native American reservation, instruction run by a government or religious entity, etc.

Operator Status

(10) ***Number of full owners:*** The term "operator" designated a person who operated a farm, either working or making day-to-day decisions about such things as planting, harvesting, feeding, marketing, etc (senior partner or person in charge). "Full owners" farm only land they own in a county.

(11) ***Number of part owners:*** Part owners were farmers who operated land they owned and also rented from other landowners in a county.

(12) ***Number of tenants:*** Tenants were farmers who operated only land they rented from others or worked on shares with others in a county.

Operator Characteristics

(13) ***Number of operators who work 200 days or more off the farm:*** Off-farm employment involved the number of farm operators who worked at least four hours per day for 200+

days off their farms. Off-farm work included work at a non-farm job, business, or on someone else's farm, but excluded exchange farm work.

(14) ***Number of operators who reside on farm:*** This variable was the number of operators who lived on their farm.

(15) ***Average age of farm operators in each county:*** The average age of operators in each county was calculated by dividing the total of farmers' ages by the number of farmers.

Labor Resources

(16) ***Number of farms with hired workers:*** The number of farms with hired workers included paid family workers in each county. In 1992, hired workers also included hired managers, administrative and clerical employees, and salaried corporate officers in each county.

(17) ***Number of hired farm workers:*** The total number of hired workers included paid family workers on farms and ranches in each county. In 1992, the total number of hired workers also included hired managers, administrative and clerical employees, and salaried corporate officers in each county.

(18) ***Expenses for custom work:*** Expenses were for the use of equipment and for custom work, such as grinding, dusting, and fertilizing, etc. It excluded the application of fertilizer and chemicals in 1992.

(19) ***Expenses for contract labor:*** These expenditures were primarily for labor in harvesting crops, shearing sheep, etc. (excluding money paid to contractors for capital improvements). The expense of items considered primarily machine work in custom work were also included. In 1992, the labor costs of workers furnished on a contract basis by a labor contractor, crew leader, or cooperative for harvesting vegetables or fruit or similar farm activities were added. Expense excluded costs for building repair work done by a construction contractor.

(20) ***Value of farm machines and equipment:*** Estimated market value referred to all machinery and equipment kept primarily on a farm or ranch and used for the farm business. The value of machinery and equipment would sell for in present conditions, (not the replacement or depreciation value) was estimated by USDA.

Total Crop Sales

This included revenues from all crop commodity sales, including nursery and greenhouse sales, as reported by the 1992 and 1997 U.S. Censuses of Agriculture.

Individual Crop Sales

(1) ***Grains*****:** Grains included revenues from corn, soybeans, barley, oats, and other grains sales.

(2) ***Cotton*****:** This included revenues from cotton and cottonseed sales.

(3) ***Nursery & Greenhouse*****:** These revenues included sales from nursery and greenhouse sales.

(4) ***Fruits & Vegetables*****:** These revenues were from sales of vegetables, sweet corn, melons, fruits, nuts, and berries.

(5) ***"Other Crops"*****:** "Other Crops" included revenues from tobacco, hay, silage, field seeds, and other crops sales.