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Manufacturing upholstered furniture in the southeastern U.S.: A comparative cost assessment

Joshua O. Idassi

Steven H. Bullard
Stephen F. Austin State University, Arthur Temple College of Forestry and Agriculture,
bullardsh@sfasu.edu

MANUFACTURING UPHOLSTERED FURNITURE IN THE SOUTHEASTERN U.S.: A COMPARATIVE COST ASSESSMENT

Joshua O. Idassi and Steven H. Bullard[1]

Abstract: The upholstered household furniture industry (SIC 2512) is extremely important in the economies of Alabama, Mississippi, North Carolina, and Tennessee. This study uses a comparative cost approach to assess the differences that exist in the manufacturing and distribution of upholstered wood household furniture among southeast U.S. states. Secondary data for raw material, labor, and transportation costs were obtained from the U.S. Department of Commerce, Bureau of the Census, for 1982, 1987, and 1992. Total costs were estimated for raw material, labor, and transportation of the finished products. A simple cost index was constructed for each cost component. Analysis of variance and multiple regression were applied to examine the significance and sensitivity of the cost components as they related to the value of shipments. An additional five states were added to add robustness to the data set during sensitivity analysis. A comparison of the simple cost index among states indicated that Alabama has a small, nonprofitable industry. To be competitive the State of Alabama needs to improve the business climate for the manufacturing of upholstered furniture. Manufacturers of upholstered furniture in Mississippi depend upon North Carolina for the supply of non-wood materials. Policy makers in Mississippi should develop specific incentives to create an excellent business location for suppliers of non-wood materials in northeast Mississippi. When several parameters of the initial model were altered by 10, 25, and 50 percent, the results revealed that overall the upholstered household furniture industry in the southeastern U.S. is not sensitive to change.

Introduction

Background

The upholstered household furniture industry (SIC 2512) is extremely important in Alabama, North Carolina, Mississippi, and Tennessee. In 1987 these states employed 60 percent of all upholstered furniture production workers in the U.S., and accounted for 60 percent of value added and value of shipments (Seldon and Bullard 1992). In 1992, Alabama, Mississippi, North Carolina, and Tennessee employed 66 percent of all upholstered furniture production workers in the nation, and accounted for 66 percent of the industry's value added and value of shipments (U.S. Department of Commerce, Bureau of the Census 1995).

Cost leadership, product differentiation, and focus are three important strategies for U.S. industries to succeed and prosper in competitive regional markets (Porter 1990). The competitiveness of a region's industries depends on its costs of production and services relative to those of other U.S. industries and overseas competitors (Committee for Economic Development 1984). This study focuses on the costs of raw materials, labor, and transportation, three essential cost components for manufacturing and distributing upholstered household furniture. It presents the differences in aggregate and relative cost per unit output of manufacturing and distributing upholstered furniture among states in the

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southeastern U.S. as a measure of relative competitiveness. A comparative cost assessment of the aggregate and the relative unit cost of raw materials, labor, and transportation for Alabama, Mississippi, North Carolina, and Tennessee provides a tool for investigating the relative competitiveness of SIC 2512 producers in the southeastern U.S. The identification of costs of raw materials, labor, and transportation as essential cost components in the manufacture and distribution of SIC 2512 is supported by Rubin and Zorn (1986) who compared manufacturing costs at the state level of a group of hypothetical firms. Rubin and Zorn (1986) reported that the relative contribution of each of the four cost components to the total cost for Furniture and Fixtures (SIC 25) was: labor, about 71 percent; transportation, 23 percent; energy, 5 percent; while state and local taxes comprised 1 percent.

Taxes and capital costs were also considered as potential cost factors. When measured as a direct cost to businesses, state and local taxes are small compared to the costs of labor and transportation (Seidman 1987). Poor business climate and high taxes both had negative effects on employment growth, and overall state and local tax efforts are important determinants of state employment growth (Plaut and Pluta 1983). Bullard (1989) reported that large and small manufacturing plants have equal access to capital. Smaller manufacturers have remained competitive because of the lowering of the maximum corporate tax rate to 34 percent. Also, tax changes have reduced or eliminated various capital-related credits and deductions that are generally more beneficial to larger firms and more capital-intensive industries. Producers of SIC 2512 in the southeastern U.S. have concentrated their shipments to markets of neighboring regions while still serving the eastern markets. The five leading regional markets for furniture and homefurnishings from the southeast states in 1987 and 1992 were California, New York, Florida, Texas, and Illinois (Figure 1).

Industries that are using a low-cost strategy eventually are able to choose the range of products to produce, the distribution channels to employ, the types of customers to serve, the geographic areas in which to sell, and the array of related industries with which to compete (Porter 1990). Hill (1988) suggested that differentiation can be employed as a means of establishing a low-cost position. When the increases in costs, due to differentiation, are outweighed by cost reduction associated with expanding volume, then differentiation can be seen as a way of achieving a low-cost position.

Production Function

According to McGuigan and Moyer (1993) production functions can be expressed in the form of a mathematical model, schedule (table), or graph. The production function concept assumes that firms operate efficiently and get the most from their inputs. A production function for a firm in the upholstered household furniture industry can be represented in form of a mathematical model:

$$Q = f(X, Y) \tag{1}$$

Where: Q = Quantity of output of upholstered household furniture ($ millions),
X and Y = Represent the quantities of the two inputs (raw materials and labor),
f = Incorporates the existing technology in producing Q from X and Y.

Costs of a fixed input (machines, equipment, and real estate) must be incurred regardless of whether the production process is operated at a high or a low level. A variable input is defined as one whose quantity employed in the process changes, depending on the desired quantity of output to be produced. Marginal and average product functions can be derived from the total product function. The marginal product is the incremental change in total output (ΔQ) that can be produced by the use of one more unit of the variable input (ΔX). The marginal product (MPx) is given by:

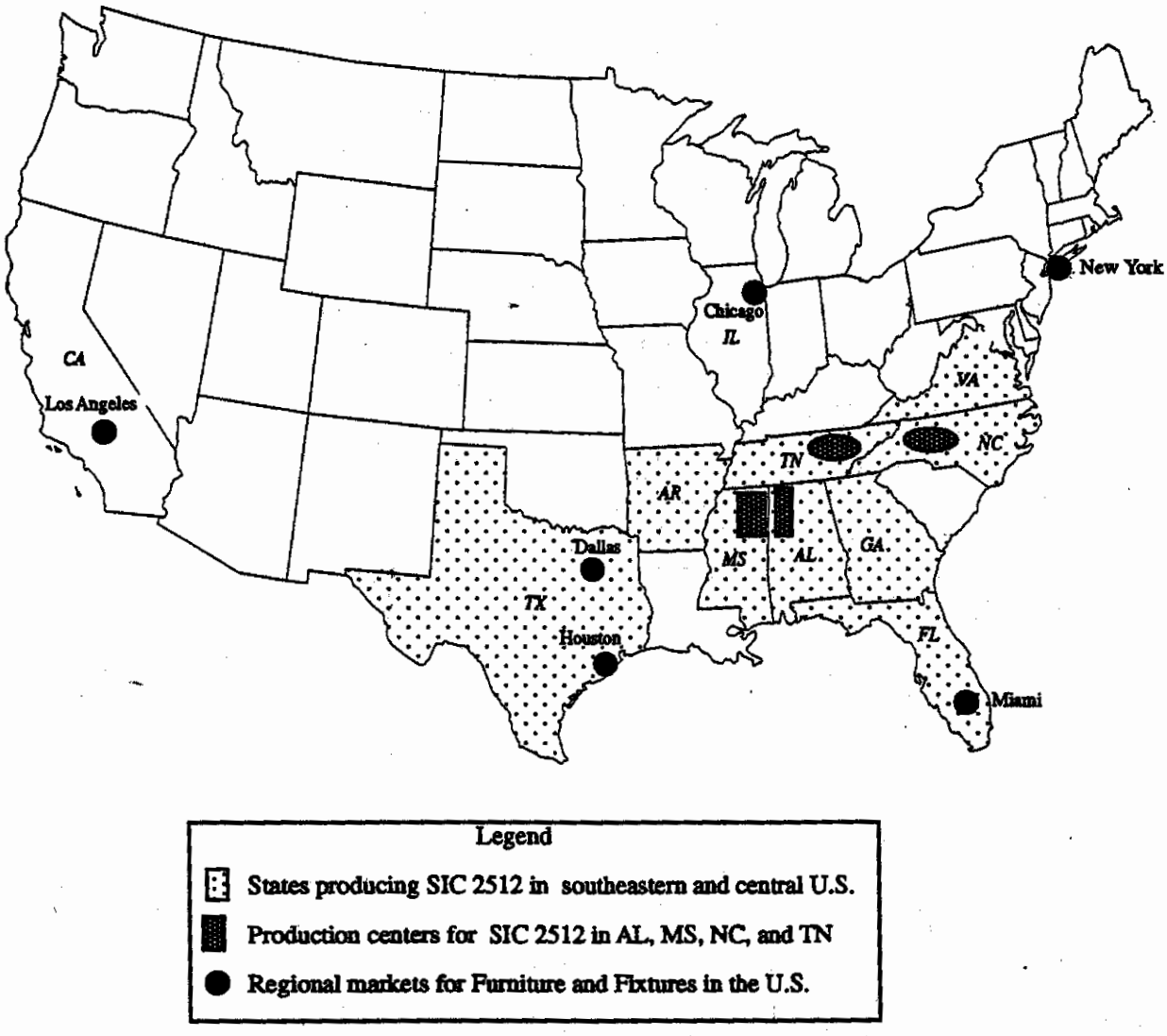

Figure 1. States manufacturing and distributing upholstered household furniture in the southeastern and central U.S.

$$Mp_x = \frac{\Delta Q}{\Delta X} \tag{2}$$

The marginal product can be obtained by taking the partial (first) derivative of Q with respect to X. The average product is defined as the ratio of total output to the amount of the variable input used in producing the output. The average product (AP) is given as:

$$Ap_x = \frac{Q}{X} \tag{3}$$

According to McGuigan and Moyer (1993) the elasticity of production is defined as the percentage change in the output Q resulting from a given percentage change in the amount of the variable input X employed in the production process, with Y (fixed variable) remaining constant. The production elasticity indicates the responsiveness of output to changes in the given input:

$$E_x = \frac{\%\Delta Q}{\%\Delta X} \quad or, \quad E_x = \frac{MP_x}{APx} \tag{4}$$

This shows that the elasticity of production is equal to the ratio of the marginal product to average product of input X. One important characteristic of the production function is that it describes how output responds in the long run to changes in the scale of the firm. McGuigan and Moyer (1993) described a long-run situation in which all inputs are variable and the firm increases the amount of all inputs by the same proportion. A firm must be aware of returns to scale of operations so that the firm can estimate how its unit costs would be affected as it expands or contracts its scale of operations. If the firm has increasing returns to scale, an increase in its scale of operations will more than proportionally increase its output and thereby lower unit costs. If a firm has constant returns to scale, an increase in its scale of operations will increase output by the same proportion and unit cost will remain constant. Finally, with decreasing returns to scale, an increase in the scale of operations of a firm will increase its output by a smaller proportion, so that unit costs will increase.

John R. Moroney in 1967 used a cross sectional data to estimate Cobb-Douglas production functions for eighteen U.S. manufacturing industries (McGuigan and Moyer 1993). Aggregate data on plants located within each state were used to fit the following three variable model:

$$Q = \alpha\ L_p^{\beta 1} L_n^{\beta 2} K^{\beta 3} \tag{5}$$

Where: Q = The value added by the production plants,
L_p = The production worker work-hours,
L_n = Non production work-years,
K = Gross book value of depreciable and depletable assets.

Several of the industries showed that the sum of the elasticities, (ß1 + ß2 + ß3) ranged from a low of 0.947 for petroleum to a high of 1.109 for furniture. Thirteen industries of the 18 industries statistically tested indicated that the sum of the elasticities was not significantly different from 1.0. The level of production in this study depends on the levels of inputs which are separated into two categories: raw materials and labor. According to Berndt (1991), dual to the production function (Equation 1) there exists a cost function relating the minimum possible total cost $C = \sum_i p_i X_i$ of producing a given level of output (Q), and the state of technical knowledge (A). The prices (p1, p2, and pn) of the inputs are fixed and exogenous.

$$C = g(p1, p2, \ldots, Pn, Q; A) \tag{6}$$

Average or unit cost c is defined as C / Q. According to Berndt (1991), if returns to scale are increasing, then doubling all inputs more than doubles output, and average cost falls. If returns to scale are decreasing, then doubling all inputs results in less than a doubling of output, and average cost increases. If returns to scale are constant, then doubling all inputs results in an equiproportional doubling of output, and average cost is unaffected. Declining long-run average costs over the lower part of the range of possible outputs are usually attributed to economies of scale. McGuigan and Moyer (1993) reported that the sources of economies of scale can be divided into three categories:

product-specific economies, (economies of scale related to the output of one product); plant-specific economies, (economies of scale related to the total output of one plant); and firm-specific economies, (economies of scale related to the total output of a firm's operations).

The direct way to pursue a comparative cost study for an industry is to obtain enough information and to estimate the total costs of production that industry would incur in each of the regions to be compared (Isard 1960). It is assumed in this study that capital costs and technology in the production of upholstered household furniture are the same throughout the southeastern U.S. Two hypotheses were tested to assess the differences among states in the manufacturing and distributing of upholstered household furniture in the southeastern U.S.:

Ho: The mean responses of the cost components in the manufacturing and distribution of upholstered household furniture do not differ among states in southeastern U.S.

Ho: The production of upholstered household furniture in southeastern U.S. is not sensitive to potential changes of the cost components.

Procedure

Data Sources and the Estimation of Total Costs

The cross-sectional time-series data was collected in 1982, 1987, and 1992. Personal communications were made with private sources involved in research and management of SIC 2512 firms in the southeast and central region. Data were collected for the four leading producers of SIC 2512 in the Southeast U.S.—Alabama, Mississippi, North Carolina, and Tennessee (Figure 1). Five more states—Arkansas, Florida, Georgia, Texas, and Virginia were added to the data set to add to the robustness of the data set during sensitivity analysis.

Deflated total transportation costs were estimated by multiplying the total outbound tonnage from a given production center to a regional market, by mileage, and by transportation rates per truck for the years 1982, 1987, and 1992. Cost of materials data for the manufacturing of SIC 2512 for the years 1982, 1987, and 1992, were obtained from the U.S. Department of Commerce (USDC), Census of Manufactures, and were deflated to 1982 dollars. Deflated total annual wages were added to unemployment taxes and workmen's compensation premiums to estimate total labor cost for SIC 2512 by state. Deflated value of shipments (in millions of dollars) were used as a proxy for output.

Simple Cost Indexes for Relative Unit Cost

A simple cost index for a particular year was calculated by dividing that year's cost by the output during the base year (Alabama 1982) and multiplying the result by 100. An analysis of variance with a multiple pair-wise comparison test was used to measure the significance of differences among states in the production of SIC 2512 in the southeastern U.S. Before conducting sensitivity analysis, a Chow test (Hair *et al.* 1987) was conducted to test if structural changes to the sample resulted when changes were made. A multiple regression analysis was applied to assess how sensitive the industry is to potential changes in the production of SIC 2512 in the southeastern region.

Results

The value of shipments and costs of manufacturing and distributing upholstered household furniture in Alabama for the years 1982, 1987, and 1992 were the lowest in comparison to the three leading states, North Carolina, Mississippi, and Tennessee (Table 1). The increase in value of shipments and costs of manufacturing and distributing upholstered household furniture in Mississippi, North Carolina, and Tennessee in years 1982, 1987, and 1992 may be due to the increase in economies of scale in most

Table 1. Value of shipments and estimated aggregate total costs (in millions deflated to 1982 dollars) for the manufacturing and distribution of SIC 2512 in 1982, 1987, and 1992 for Alabama, Mississippi, North Carolina, and Tennessee.

State	Year	Value of Shipments	Raw Materials	Labor	Transportation
AL	1982	63.8	32.4	17.1	43.2
	1987	69.3	35.2	18.7	26.4
	1992	34.8	16.2	13.2	21.1
MS	1982	537.2	286.2	119.6	31.9
	1987	909.4	523.7	260.9	22.1
	1992	1,396.1	755.3	296.8	11.6
NC	1982	1,172.3	591.8	341.5	114.9
	1987	1,585.0	870.2	471.2	135.8
	1992	1,752.9	892.6	411.2	88.7
TN	1982	307.9	150.0	82.9	16.4
	1987	374.5	183.5	109.6	15.8
	1992	531.0	234.2	127.9	16.7

Sources: USDC Bureau of the Census (1995), USDC Bureau of the Census Geographical Series, and other private data sources

lines of furniture production as a result of the consolidation and merger of smaller firms. The simple cost indexes reflect the average costs (Table 2 and Figures 2, 3, and 4). The results show that Alabama's relative unit cost indexes are extremely high compared to Mississippi, North Carolina, and Tennessee.

Mississippi and North Carolina firms have lower unit raw materials and labor costs. Compared to the base year, 1982 for Alabama, their firms experience economies of scale. Mississippi's unit raw material costs were higher and significantly different from North Carolina and Tennessee. Mississippi's firms have been incurring larger distribution costs by obtaining the non-wood materials from North Carolina and some New England states. In contrast Tennessee's SIC 2512 industry is located in the eastern part of the state, and thus enjoys close proximity to New England and the Carolinas. Compared to Alabama, firms in North Carolina, Mississippi, and Tennessee experienced no significant difference in unit labor costs in 1982, 1987, and 1992. The unit transportation costs for Mississippi, North Carolina, and Tennessee were extremely low and were not significantly different. This justified the omission of transportation costs in sensitivity analysis. Furniture producers in the southeast are located near the regional markets and therefore enjoy the same transportation cost advantage over other U.S. producers.

When the costs of raw materials and labor were changed by 10 percent, 25 percent, and 50 percent, there were no significant structural changes. Overall the upholstered household furniture industry in the southeastern U.S. is not sensitive to changes, but there is not enough evidence to determine if changes for individual states were significant. The industry has experienced consistently low labor and raw materials costs elasticities since 1982. The cost elasticities for the industry in Mississippi indicate

Table 2. Relative unit cost index for the manufacturing and distribution of upholstered household furniture in 1982, 1987, and 1992 for Alabama, Mississippi, North Carolina, and Tennessee.

State	Year	Unit Raw Materials	Unit Labor	Transportation
AL	1982	100.0	100.0	100.0
	1987	117.0	141.6	100.0
	1992	91.7	141.6	113.0
MS	1982	104.9	83.3	11.0
	1987	113.4	107.3	3.7
	1992	106.5	79.5	0.2
NC	1982	99.4	108.9	0.1
	1987	108.1	111.2	18.5
	1992	99.2	87.7	9.3
TN	1982	95.9	100.7	9.3
	1987	96.5	109.4	7.4
	1992	86.8	90.2	5.6

Sources: USDC Bureau of the Census (1995), USDC Bureau of the Census Geographical Series, and other private data sources

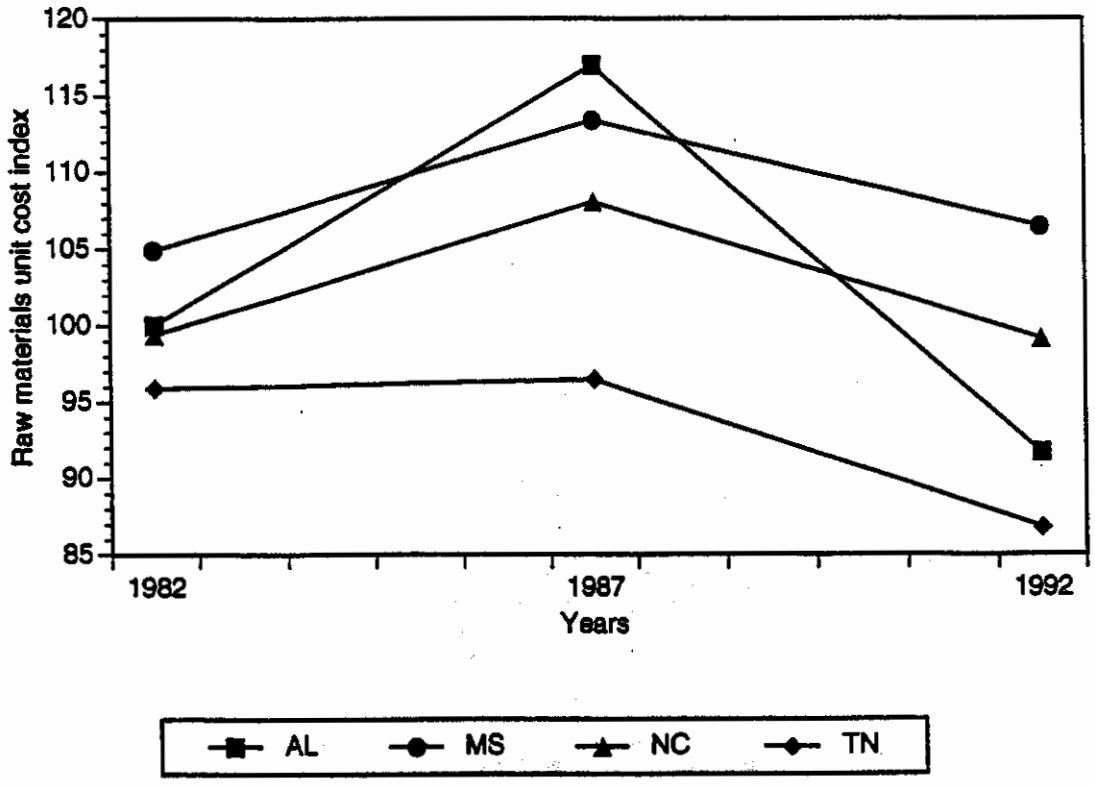

Figure 2. Raw material unit cost index for SIC 2512 for Alabama, Mississippi, North Carolina, and Tennessee in 1982, 1987, and 1992.

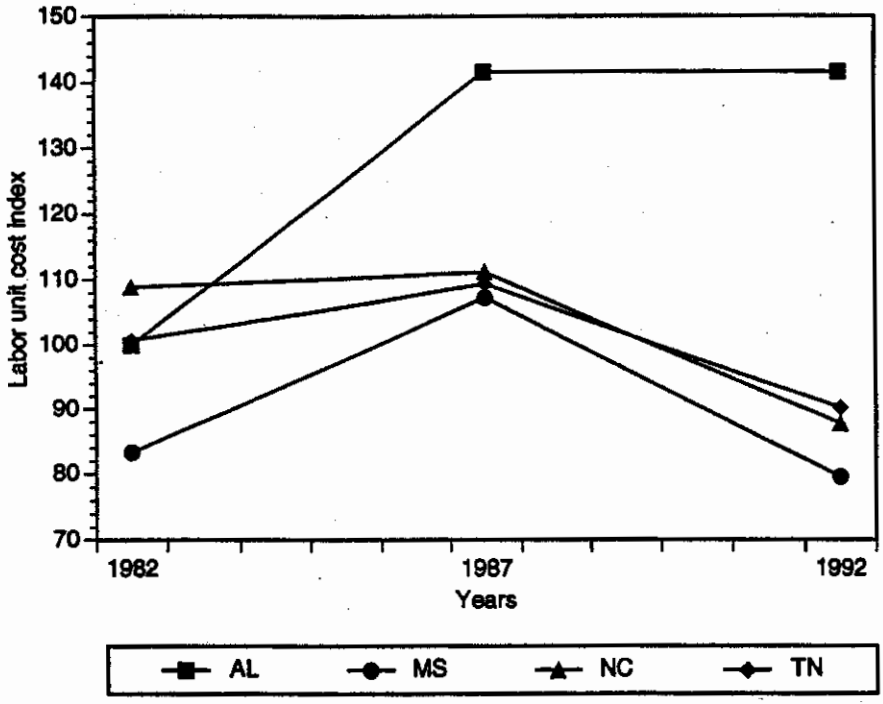

Figure 3. Labor unit cost index for SIC 2512 for Alabama, Mississippi, North Carolina, and Tennessee in 1982, 1987, and 1992.

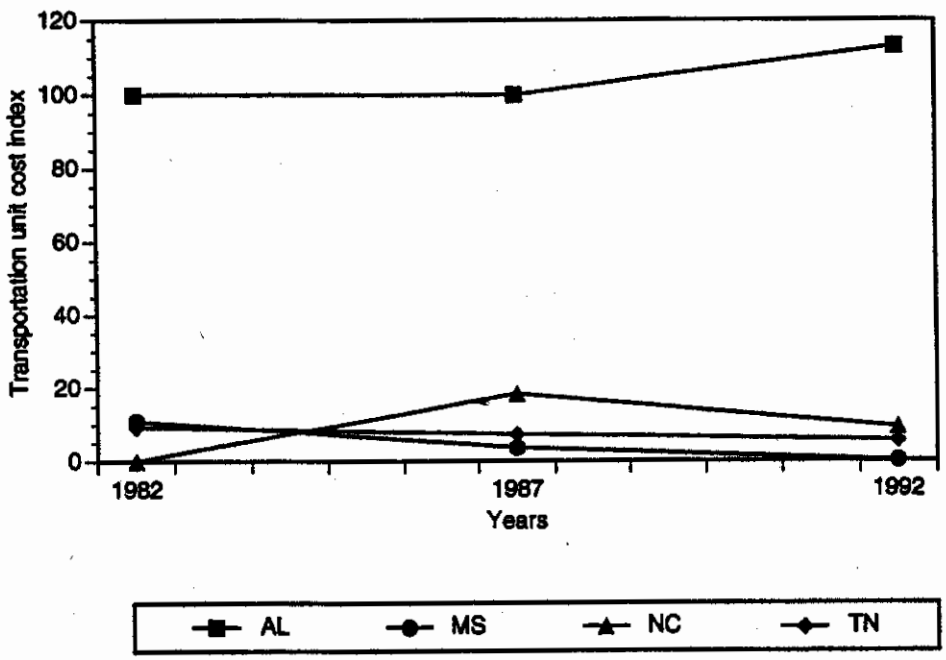

Figure 4. Transportation unit cost index for SIC 2512 for Alabama, Mississippi, North Carolina, and Tennessee in 1982, 1987, and 1992.

increasing returns to scale (1.3), in North Carolina constant returns to scale (1.0), and in Tennessee decreasing returns to scale (0.95).

Conclusions

The data sample used for this study was small and therefore the results obtained should be used with caution. The results may be used for policy makers and for the management of firms in the upholstered household furniture industry. First, Alabama's SIC 2512 firms are relatively small (10-50 employees) and may lack economies of scale advantages. Alabama's industry lacks the concentration of higher management and labor teams with entrepreneurial skills

Second, most suppliers of non-wood raw materials for Mississippi's SIC 2512 firms are located in North Carolina and some New England states. The increase in unit raw material costs for Mississippi relative to other states has been attributed to the large freight charges for shipping raw materials from North Carolina. For Mississippi firms to continue to be competitive in the production of upholstered household furniture, policy makers and the management of the industry should work together to improve the attractiveness of locating non-wood materials producers in northeast Mississippi.

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