Manufacturing Specialization in the Southeast: Rural Necessity, Rural Possibility or Rural Vestige?

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ABSTRACT: This paper examines three alternative explanations for manufacturing specialization in rural areas: 1) the greater efficiency of very large plants; 2) the "localization" advantages identified with a number of firms in the same industry locating near each other; or 3) a strategy to gain bargaining power by a dominant employer in the county.

Keywords: rural manufacturing, specialization, economies of scale, localization, monopsony

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Introduction

Since the late 1980s rural areas in the Southeast have increased manufacturing employment in absolute numbers while urban areas have shed this employment. As a result, the relative manufacturing dependence of rural areas has increased, and many of these areas are specialized in one manufacturing industry. However, there is considerable uncertainty as to the dangers or benefits of specialization. The trend toward industrial diversification—deriving support as a policy goal from the analogy of an investment portfolio in which the collection of industry is thought to determine the stability of a local economy (Brown and Pheasant 1987; Smith and Gibson 1988)—may be slowed or reversed suggesting strong vulnerabilities to economic shocks. Or, if the concentration of manufacturing in rural areas is in declining industries then the long–term prospects for economic growth are seemingly bleak. Countering these claims, recent work on endogenous growth (Romer 1986), interregional trade (Gilchrist and St. Louis 1991) and industrial clusters (Henry and Drabenstott 1996) suggest potential benefits from increased specialization.

This paper examines the validity of three alternative rationales for industrial specialization. Manufacturing specialization in rural areas can be explained by 1) the exploitation of scale economies by very large plants; 2) the "localization" advantages identified with a number of firms in the same industry locating near each other; or 3) a strategy to gain bargaining power in isolated rural labor markets by a dominant employer in the county. To test these rationales cluster analysis is used to identify counties that are specialized in an industry at the two-digit SIC level. The results are then used in an econometric exercise to identify the characteristics associated with manufacturing specialization. Increased understanding of the possible reasons for industrial specialization will help frame policy responses to the potential economic opportunities and economic crises facing rural areas.

Operationalizing Rationales for Industrial Specialization

Internal Economies of Scale

The literature generally supports the conjecture that minimum efficient scale of production may explain industrial specialization in the rural case. Support comes from disparate sources ranging from the 'new economic geography,' the more mature product cycle theory, and empirical investigations in industrial organization. According to Krugman (1991), it is the interaction of scale economies in production and marketing with transportation economies and geographic concentration of raw materials that determines tendencies toward specialization in a fewer number of sites or dispersal across the economic landscape. The theoretical framework of the new economic geography posits that a decrease in transportation costs and an increase in internal scale economies will result in production concentrating in fewer locations. While the decline in transportation costs in modern times is seemingly incontrovertible (Kilkenny 1998) the direction of internal scale economies is more contentious. The trends in the magnitude, and arguably the direction, of scale economies have varied across manufacturing industries over time (Milgrom and Roberts 1990). This provides a source of empirical leverage later in the analysis when we compare the relative importance of minimum efficient scale of production explaining specialization across industries.

The strong association of the product life-cycle hypothesis of industrial development with rural industrialization strongly supports the minimum efficient scale of production rationale. Within this framework emergent industries will be characterized by a large number of small, diverse market niches. More mature industries will be characterized by larger markets of more standardized products with standardized production processes as well. Firms are thus more apt to make large investments in purpose built machinery to replace the higher variable cost combination of general-purpose machinery and more highly skilled workers. Since cost becomes an

increasingly important mediator of exchange, these industries will tend to seek out lower factor costs available in rural areas.

The difficulty in examining this rationale empirically is identifying a proxy that does not lead merely to a tautological interpretation. While average firm size for the industry in the county presents itself as a likely candidate, the measure would do little more than confirm that the presence of significantly larger plants increases the probability of being specialized. It would not provide information on whether or not large plant size is associated with the presence of significant scale economies.

The problem requires a comparison of the observed average establishment size with a disaggregate estimate of average establishment size if local establishments were operating commensurate with the minimum efficient scale of production. For the construction of this disaggregate estimate, establishment size distribution down to the four-digit level provided in *County Business Patterns* is coupled with Census of Manufacturing information on the average plant size of the fifty largest companies (by sales) in each four-digit SIC.[i] Eckard (1994) provides a rationale for associating this metric with minimum efficient scale of production—if internal economies of scale do exist they are most likely to be exploited by the top firms. In notation,

$$MES_i = \frac{Observed\ \ Average\ Establishment\ Size_i \times Total\ \ Number\ of\ \ Establishment_i}{\left[USt50_1 \quad \Lambda \quad USt50_N\right] \cdot \begin{bmatrix} SIC4_1 \\ \mathrm{M} \\ SIC4_N \end{bmatrix}}$$

where $USt50_k$ = average establishment size of the fifty largest firms in the 4-digit industry k included in the 2-digit industry i;
$SIC4_k$ = the number of establishments in the county in the 4-digit industry k included in the 2-digit industry i.

If the MES proxy (ratio of average firm size to top 50 firm size) is close to one, it is believed that the establishments located in the area are operating near minimum efficient scale. In the regression a positive sign will corroborate the internal economies of scale hypothesis.

Localization

Recent work on rural industrial development suggests an alternative explanation for industry specialization emphasizing the importance of external economies of scale (Henry and Drabenstott 1996; Barkley and Henry 1997; Henry and Barkley 1997). The empirical portion of this work confirms that larger concentrations of industry employment in a region are associated with faster rates of employment growth (Henry and Drabenstott, Henry and Barkley 1997). This result is used to suggest the reasonableness of competitive advantages flowing from the localization of economic activity defined by industry concentration. Three benefits of localization in a Marshallian industrial district are 1) a pooled market for workers with specialized skills, 2) the provision of nontraded inputs to an industry with greater variety and lower cost, and 3) information flows that create technological spillovers.

However, there are alternative interpretations of these empirical results that may gain insight from the present analysis. Since there is no inclusion of variables that address the concentration of industry employment across firms in these 'clusters' it is not possible to discern the effects attributable to external versus internal economies of scale. A large industry presence could be the result of one or a few larger firms or a collection of numerous smaller firms. Alternatively, the empirical analysis could be doing little more than identifying regions with sources of comparative advantage that have little to do with localization economies. By explicitly considering the concentration of industry employment across firms, this analysis can empirically assess the veracity of claims regarding external economies of scale due to localization effects.

Again we find that theoretical development of the concepts has outpaced empirical development of valid proxies for the relations of interest. Given the discussion above we propose an axiomatic justification for the measure used to test the localization hypothesis. The measure should be increasing in the number of firms in a county—the assumption is that the probability of technological spillovers, sourcing inputs locally or deriving labor pooling advantages will increase as the number of establishments in an industry increase. However, the raw number of firms by itself is insufficient as it ignores the size dependency of some of these benefits. For example, establishments of similar size are more likely to be operating at similar levels of technological sophistication increasing the value of potential spillovers. Similarly, employment opportunities will be the most substitutable across similar size establishments. Thus, the measure should also be increasing in the dispersal of employment across these firms and decreasing in the concentration of employment in only a few. A composite measure that satisfies these requirements can be expressed as follows:

$$LOC_i = \frac{Number\ of\ \ Firms_i}{\sum_{n\,in\,i} (Establishment\ Employment_n / Industry\ Employment_i)^2}$$

LOC will equal one in the case of a single establishment and increase in the number of establishments and the dispersion of employment across these plants. The localization hypothesis will be corroborated by a positive estimate.

Monopsony

The 'company town' construct is a powerful one in suggesting the strategic motivation for locating large plants in small places of relative isolation. The possibility also raises the most unequivocal justification for industrial diversification. Not only will diversification produce the reputed benefits related to the stability of employment demand, greater competition in the local labor market would also produce an unambiguous, positive welfare effect. While evidence of the

company town phenomenon is largely anecdotal—and this anecdotal evidence is of itself inconclusive (e.g., Boal 1995)—our epistemological motivation is one of confirmation requiring that we consider all plausible alternatives (for theoretical motivation of the strategy see Lofgren 1996; Yeh, *et al.* 1996; Jones 1988). Indeed, a positive result would generate the most definitive policy implications.

To empirically test this explanation we again find the Herfindahl Concentration Index productive—though this time in its canonical form. We examine concentration in the manufacturing sector as a whole. It is calculated as follows:

$$MON = \sum_{n} (Establishment\ Employment_{n} / Total\ Manufacturing\ Employment)^{2}$$

If a county is truly a "company town" and only has one manufacturing firm then the Herfindahl Index (MON) would have a value of one. Thus, we would expect a positive sign on the coefficient of the monopsony power variable if this were a valid explanation of industry specialization.

The Data

The problem of nondisclosure of detailed data of industrial structures at the non-metropolitan level is addressed here using a simple algorithm that uses disclosed employment size ranges in County Business Patterns (CBP) to arrive at consistent employment estimates at the 2-digit SIC level (Kreahling, Smith, and Frumento 1996).[ii]

These employment estimates are then used in a disjoint cluster analysis to identify industrial structures that may demonstrate single industry specialization.[iii] Cluster analysis classifies objects (counties) into groups based on the similarity of the object's collection of attributes (employment share by industry). Export base theory serves as the justification for limiting the analysis to manufacturing, mining and exportable services-producing industries. Indeed, the computation of locational Gini coefficients confirms that "locational clustering" is most pronounced for manufacturing and selected service sectors (Barkley and Henry 1997 pp. 310-311). Industry

employment shares are defined as the proportion of total private employment rather than total employment. The policy goal of diversification seeks to lessen the variability in output caused by a change in market demand, which argues against including a largely exogenous source of government employment in the analysis.

The analysis includes all counties in Alabama, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Virginia. Reducing the sources of bias motivated the inclusion of metropolitan counties in the clustering exercise. There are increasing indications that the conventional metro/nonmetro dichotomy may be of limited usefulness (Brown 1993). Especially in the context of the Southeast—where many smaller metropolitan places maintain strong specialization in manufacturing and where the rural/agricultural nexus is indistinct—the exclusion of all metropolitan counties would be arbitrary.

The resulting cluster structure contains 15 county types, 13 of which can be described as industry specializations. Two of these specializations are non-manufacturing industries: one Mining and one in Business Services. The manufacturing specializations make up 11 of the clusters corresponding to Food and Kindred Products, Textiles, Apparel, Lumber, Furniture, Paper, Chemicals, Primary Metals, Fabricated Metals, Electrical Equipment and Transportation Equipment. The two nonspecialized categories were labeled Diversified Manufacturing—describing the relatively large share of employment in manufacturing but lacking a dominant industry—and Nonbasic—describing counties that did not have a large share of employment in any of the export base industries included in the analysis.

The Model

The objective of the econometric exercise is to identify which of the rationales, if any, are associated with the identification of a county as specialized. A logit model is used to model the binary indicator of a county being specialized or not being specialized in a particular industry. [iv]

The logit model estimates the probability of an event based on explanatory factors in such a way that the probability remains in the interval [0,1]. Maximum likelihood estimation (MLE) is used and provides consistent estimates of the parameter coefficients.

The probability of a county being specialized in an industry, as a function of the alternative rationales discussed earlier, is modeled as:

$$P_i = 1/(1 + e^{-X`\beta})$$

where $X`\beta = \beta_0 + \beta_1 MES_i + \beta_2 LOC_i + \beta_3 MON_i + \beta_4 POP_i$

P_i = the probability of county i being specialized in the industry being tested
MES_i = minimum efficient scale of production in county i for the tested industry
LOC_i = localization economies in county i for this industry
MON_i = monopsonistic power in county i
POP_i = population of county i

The model is estimated for each of the eleven manufacturing specializations identified by the cluster analysis. The hypothesis tests of interest are whether or not the individual parameters associated with the various proxies of the rationales for rural specialization are powerful in explaining the probability that a county is specialized in an industry. The critical significance level is set at 0.05 for a two-tailed test.

The explanatory variables in the model are proxies for minimum efficient scale of production (MES), localization economies (LOC), and monopsony power (MON). County population (POP) is included to examine the maintained hypothesis that specialization is explained by the combination of one of the 3 rationales with small settlement size. In review, MES is proxied by actual average establishment size for the county divided by the constructed value for the average size of a top fifty company for that county. LOC is proxied by the number of establishments in an industry divided by the Herfindahl concentration index for the industry. Finally, MON is proxied by the Herfindahl concentration index for all manufacturing in the county. A positive estimate will corroborate any one of the alternative hypotheses thought to explain single industry specialization.

Results

In general the results of the econometric exercise (summarized in Table 1) are promising. For each industry the system statistics (log-likelihood test, concordant probabilities and the pseudo R^2) suggest that the model as a whole is powerful in identifying various characteristics associated with specialization. While at least one of the variables is significant in each equation it is notable that the collection of significant variables differ by regression. The implications are that industries differ in important respects devaluing aggregate analysis of 'the manufacturing sector' and that industry specificity will be important in framing policy responses to the problems or opportunities presented by specialization.

However, the statistical success of the exercise should make us more sensitive to the economic information actually conveyed by the analysis. The minimum efficient scale (MES) variable is found to be significant for each industry but Paper. The prudent question regarding this result is to ask whether the MES variable is capturing information that is distinct from the average observed establishment size variable used in construction of the proxy. A strong correlation between MES and observed firm size ($\rho > 0.80$) seriously devalues the economic interpretation of the MES estimate for the Apparel, Lumber, Furniture, Electrical Equipment, and Fabricated Metals industries. For these industries, the result becomes tautological: counties with larger plants will demonstrate a higher probability of being specialized. In these cases, relative establishment size is largely indistinguishable from the relative size of the MES proxy.

In the remaining five regressions there are two distinct phenomena observed. For the Chemicals, Transportation Equipment, and Primary Metals industries there are noticeable differences between the expected average establishment size in general and specialized counties[v]. This suggests that specialization may be partially explained by differences in the 4-digit industry mix for these three cases (e.g., an automobile body plant is on average an order of magnitude

bigger than various automobile parts plants). In this case it is difficult to untangle the MES effects from the industry mix effects. However, Textiles and Food provide strong evidence of the exploitation of scale economies consistent with the conceptual foundations of the proxy. With these industries the expected average establishment size is nearly identical for general and specialized counties. Therefore, with the Food and Textiles industries larger observed average plant size in specialized counties is arguably the result of core firms exploiting internal economies of scale.

The Localization proxy (LOC) is positive and significant for the Food, Textiles, Apparel, Lumber, Furniture, Primary Metals, and Fabricated Metals industries. Again, a closer examination of the distribution of the localization variable is informative. As shown in Table 2 the mean values for specialized counties in Food, Apparel, Primary Metals, and Fabricated Metals are relatively small and roughly equivalent to the localization value for all counties. This suggests that the strength of the association may result from correctly identifying non-specialized counties; i.e., single establishment counties. The localization variable is considerably larger for Lumber. But here again there is little difference in the mean level between specialized and non-specialized counties suggesting that the localization variable may be more determinative of those counties with an exceptionally low probability of being specialized. The relatively high values for the localization value can be in part explained by the co-location of logging camps and sawmills.

A positive case of external economies being strongly associated with industry specialization is most evident for the Textiles and Furniture industries. Comparing the distribution of this variable between specialized and non-specialized counties (Table 2) in combination with the regression results provide convincing evidence that the exploitation of external economies of scale is a rationale for specialization in the Furniture and Textiles industries. The fact that both these

industries have often been the focus of studies examining localization economies (Kristensen 1991, Piore and Sabel 1984, Sforzi 1991) reinforces the conclusion that this process may be operating in rural specializations.

The monopsony power proxy (MON) is significant in the Textiles, Paper, and Electrical Machinery regressions (Table 1). However, the Textiles estimate is the wrong sign reinforcing the conclusion that the creation of localization economies is the rationale for specialization in this industry. With both Paper and Electrical Machinery the odds ratio for monopsony power is extremely high (see Table 1). This suggests empirically that those counties with the highest concentration indexes are consistently specialized. Examining the Beale codes for the specialized counties in these industries reveals that ten of the twelve specialized counties in Paper and that twelve out of fifteen specialized counties in Electrical Machinery are rural with most of them having populations less than 20,000. Plus, six of the counties for each are non-adjacent to metropolitan areas. The fact that many of these counties are most likely to contain, small, less mobile labor forces reinforces the suggestion that the pursuit of monopsony power is a consistent explanation of specialization in the Paper and Electrical Machinery industries.[vi]

Conclusion

The monopsony explanation for specialization presents itself as the strongest case where industrial diversification has clear advantages as a policy goal. Not only will these communities reduce their vulnerability to shocks in the dominant industry, increased competition in the local labor market will also have direct benefits for the workforce. While possible in any industry, the analysis suggests that this phenomenon is more prevalent in counties specialized in Paper and Electrical Machinery. However, the feasibility of industrial diversification as a policy goal is perhaps uncomfortably tied to the political structure of the local economy.

The intermediate case for diversification is found in those counties specialized in indus-

tries likely to derive benefits from internal economies of scale. Diversification of itself will not work at cross purposes to the rationale of industry specialization identified in Food, Chemicals, Primary Metals and Transportation Equipment. Rather, any technical economies in production may impose substantial "portfolio constraints" on how employment is distributed across industries. Public policies that reduce the volatility of local employment demand (e.g., sheltering profits that are used for skill upgrading during downturns) may be a more feasible approach than attracting new industries. Real conflicts may emerge, however, in considering the advisability of substantial expansion of an existing plant relative to the attraction of diversified employment.

Finally, the localization rationale for specialization presents a counter to the benefits of greater diversification. If a critical mass of independent firms is a prerequisite for the competitiveness of local industry then the goal of diversification would merely dilute the possibility of external economies. The appropriate policy response is made more difficult by the substantial import penetration in those industries identified as most likely to generate external economies—i.e., Textiles and Furniture. Yet, the folly of trying to pick the most appropriate industrial structure argues against either the purposive concentration or divestment of these industries. Rather, policy in this instance (and in all other contexts where localization benefits are evident despite being found in other industries) should concentrate on enhancing and augmenting the already extant localization benefits. Training consortia, specialized machine or business service bureaus, facilitating co-production relations—among other 'real services'—are clear and proven means of increasing the competitiveness of local economies that have already begun to discover the advantages of localization (Brusco 1992).

Table 1
Regression Results for Each Industry

	SIC 20 Food (n=547)	**SIC 22 Textiles** (n=364)	**SIC 23 Apparel** (n=587)	**SIC 24 Lumber** (n=702)	**SIC 25 Furniture** (n=449)	**SIC 26 Paper** (n=298)
Intercept						
Coefficient	-1.16	.30	-.29	-2.03*	-2.24	-5.05*
P-Value	.27	.587	.58	.0185	.0718	.0129
MES						
Coefficient	.21*	1.02*	1.09*[t]	4.47*[t]	1.99*[t]	.59
P-Value	.0001	.0001	.0001	.0001	.0001	.0865
Odds Ratio	1.235	2.779	2.96	86.96	7.342	1.8
Localization						
Coefficient	.056*	.033*	.076*	.015*	.072*	.21
P-value	.0042	.0001	.0001	.002	.0002	.17
Odds Ratio	1.058	1.03	1.08	1.02	1.075	1.235
Monopsony						
Coefficient	-3.74	-3.6*	-.47	.054	-1.67	10.69*
P-Value	.14	.015	.593	.97	.57	.0076
Odds Ratio	0.024	.027	.624	1.06	.189	999.0
Population						
Coefficient	-.00004*	-.00003*	-.0001*	-.0001*	-.0001*	-.0001*
P-Value	.0054	.0001	.0001	.0001	.0006	.0467
Odds Ratio	1.0	1.0	1.0	1.0	1.0	1.0
Concordant	87.3%	87.7%	86.7%	87.3%	95.3%	96.7%
-2 log l	39.232*	106.58*	185.74*	76.46*	68.76*	50.1*
Pseudo R^2	.074	.287	.24	.098	.148	.201
% of Counties Specialized	4.7	30.22	23.34	5.55	3.8	3.02

* indicates significance at the .05 confidence level

t indicates correlation between MES proxy and observed average firm size is greater than .80

Table 1 (cont'd)
Regression Results for Each Industry

	SIC 28 Chemicals (n=398)	**SIC 33 Primary Metals** (n=263)	**SIC 34 Fabricated Metals** (n=490)	**SIC 36 Electrical Machinery** (n=331)	**SIC 37 Transportation Equipment** (n=380)
Intercept					
Coefficient	-4.2*	-2.98*	-3.86*	-5.88*	-2.49*
P-Value	.0001	.007	.001	.0001	.037
MES					
Coefficient	.73*	1.05*	1.63*[t]	.92*[t]	1.95*
P-Value	.0001	.0001	.0001	.0001	.0004
Odds Ratio	2.09	2.87	5.13	2.51	7.054
Localization					
Coefficient	.025	.09*	.08*	.037	.07
P-value	.217	.046	.016	.138	.103
Odds Ratio	1.026	1.095	1.078	1.038	1.072
Monopsony					
Coefficient	3.18	.29	2.08	7.6*	-.43
P-Value	.16	.92	.365	.002	.865
Odds Ratio	24.025	1.34	8.026	999.0	.645
Population					
Coefficient	-.00002	-.00002	-.0001*	-.00002	-.00004*
P-Value	.116	.105	.018	.23	.027
Odds Ratio	1.0	1.0	1.0	1.0	1.0
Concordant	91.6%	82.6%	90.3%	91.1%	90.1%
-2 log l	46.657*	26.087*	45.6*	40.66*	31.47*
Pseudo R^2	.113	.09	.08	.11	.076
% of Counties Specialized	4.92	6.46	2.86	4.75	4.47

* indicates significance at the .05 confidence level

t indicates correlation between MES proxy and observed average firm size is greater than .80

Table 2
Mean Localization Values

Industry	All Counties w/ Employment	Specialized Counties
Food	10.49	9.48
Textiles	17.72	35.72
Apparel	11.07	7.11
Lumber	32.31	32.54
Furniture	12.35	96.06
Primary Metals	4.32	6.42
Fabricated Metals	19.11	8.04

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[i] Unfortunately, the last time these data were compiled was in the 1977 Census of Manufacturers.

[ii] Comparing results from the estimation procedure with data provided in the ES-202 series available for an individual state are encouraging. Major discrepancies arise only when county employment is reported by an administrative unit elsewhere in the state for the ES-202 series. This suggests a considerable advantage to using the CBP estimates in analyses utilizing employment levels. However, the estimates are not appropriate for examining changes in employment over time.

[iii] PROC FASTCLUS available in the SAS Statistical Package is used in the analysis.

[iv] PROC LOGISTIC available in the SAS Statistical Package is used in the analysis.

[v] Expected average establishment size is a constructed value for each county that is estimated in the same manner as the constructed value for average firm size for the top fifty firms for each county.

[vi] At least for Paper industries alternative explanations for the result may emerge from the importance of being close to large timber stocks or the strong disamenities associated with production, either of which would favor more sparsely populated locations.