

Rural Competitiveness: Results of the 1996 Rural Manufacturing Survey
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Greenberg. Food and Rural Economics Division, Economic Research Service,
U.S. Department of Agriculture. Agricultural Economic Report No. 776.

Abstract

Establishments in metropolitan and nonmetropolitan locations are surprisingly similar in their adoption of new technologies, worker skill requirements, use of government programs and technical assistance, exports, and sources of financing, according to the results of a nationwide survey of 3,909 manufacturing businesses. The most widespread concern of both metro and nonmetro businesses appears to be with quality of labor. Survey respondents report rapidly increasing skill requirements, and many report problems finding qualified workers. Quality of local labor is the most frequently cited problem associated with nonmetro business locations. Access to credit, transportation, and telecommunications infrastructure is a problem of secondary importance for both metro and nonmetro respondents. Rural communities face a considerable challenge in supplying workers with needed skills. The fastest-growing skill requirements—computer, interpersonal/teamwork, and problem-solving skills—are not central to traditional academic instruction.

Keywords: Rural manufacturing, sample survey, worker skills, manufacturing location, credit availability, technology adoption

Acknowledgments

The authors thank the many colleagues who provided helpful suggestions and guidance in the development of the survey. Deborah Tootle played a central role in planning and overseeing the development and testing of the survey instrument. We also appreciate the expert help of Don Dillman and staff at the Social and Economic Sciences Research Center at Washington State University who carried out the survey and helped us refine the questionnaire along the way. We are particularly grateful to Renee Shatos Petrie, the SESRC project Study Director, for the extraordinary skill, care and patience that she brought to the project and to the very skillful, persevering interviewers. We spent a very useful day with Eileen Appelbaum (Economic Policy Institute), Peter Capelli (University of Pennsylvania), and Paul Osterman (Massachusetts Institute of Technology) as they helped us refine questions on technology and work organization. David Barkley (Clemson University), Meric Gertler (University of Toronto), and Deborah Markley (then at Purdue University) spent a day sharing their insights on questions relating to finance, access to resources, and other survey topics. Stu Rosenfeld (Regional Technology Strategies) and Fawn Evenson (Footwear Industries of America) reviewed the questionnaire and suggested a number of helpful improvements. We also thank the following manufacturing associations for graciously consulting with us: American Apparel Manufacturers Association, American Bearing Manufacturers, American Ceramics Society, American Electronics Association, American Gear Manufacturers Association, American Iron and Steel Institute, Chemical Fabrics and Film Association, Equipment Manufacturing Institute, The Fertilizer Institute, Hardwood and Plywood Manufacturers Association, National Frozen Foods Association, and Packaging Machinery Manufacturers, Inc. The survey was funded in part by the Economic Research Service and in part by the Rural Community Development Mission Area, when Robert Nash was its Undersecretary. Linda Ghelfi, Robert Gibbs, Mark Nord, and Leslie Whitener provided comments that greatly improved this manuscript. David Banker, Bob Dubman, and Hisham El-Osta provided valuable insight about analysis of survey statistics. Finally, we thank the respondents who took time from their busy schedules to complete the telephone interviews and written questionnaires. We hope this study adequately reflects their views about what manufacturing businesses need to be competitive.

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Summary

Difficulty finding qualified employees is the most common problem reported by rural manufacturing establishments. In 1996, 60 percent of nonmetro manufacturers reported problems finding qualified applicants for production jobs, and more than 70 percent said quality of local labor was a problem affecting their business' ability to compete. Nonmetro manufacturers were more likely to cite labor quality than any of 20 other potential barriers to competitiveness, including tax rates, environmental regulations, access to business services, training, transportation infrastructure, and labor cost. Manufacturers reported inadequate worker skills as the most important barrier to implementing new technologies and management practices.

The availability of qualified workers and its implications for rural manufacturers' ability to compete in national and global markets are among the issues explored in this 1996 survey of nonmetro and metro manufacturers. The survey looks at indicators of nonmetro establishments' success in a changing business environment. In evaluating rural manufacturers' ability to compete, the survey also explores manufacturers' use of business assistance programs, implementation of advanced technology, use of training programs, and sources of capital.

Most nonmetro manufacturers reported rising skill requirements in the mid-1990's, with interpersonal/teamwork, computer, and problem-solving skills growing the fastest. However, both rural and urban manufacturers noted that the skill most lacking among job applicants was a reliable and acceptable work attitude. Thirty-one percent of nonmetro manufacturers reported a major problem finding job applicants with this characteristic, and 25 percent reported it as a minor problem. This was also the leading skill problem for metro employers.

Nonmetro and metro manufacturers also provided similar responses about what role government business assistance, such as tax breaks, direct subsidies, or loan programs, played in their businesses. Seventy percent of manufacturers indicated that at least one type of government assistance played a role in their operations. No one program, however, was noted as playing a significant role for either rural or urban manufacturers. Just 19 percent of rural manufacturers said government tax breaks were very important to their businesses, an attitude echoed by urban businesses. Eight percent of nonmetro establishments reported government worker training and technology assistance programs were very important to operations.

Nonmetro manufacturers, however, do lag behind metro businesses in some important areas. They were less likely to use several types of advanced technologies and were less likely than urban manufacturers to have research and development units on site. Rural manufacturers noted several problems associated with their locations that were not as frequently highlighted by urban establishments. Forty-five percent of rural manufacturers said they had problems with access to training for employees, while just 29 percent of urban establishments reported such a problem. Thirty-seven percent of nonmetro establishments reported having some problems with access to major customers. Rural manufacturers were about twice as likely as urban establishments to report hav-

ing problems with access to interstates and highways. Forty-eight percent of rural manufacturers also believed the company's ability to recruit managers and professionals was affected, at least to some extent, by the establishment's location.

These findings stem from the 1996 Rural Manufacturing Survey, conducted by USDA's Economic Research Service (ERS) in cooperation with Washington State University. Interviews were conducted with 2,844 manufacturing establishments in nonmetro areas of the United States and with 1,065 metropolitan manufacturers. All establishments employed 10 or more people in manufacturing.

Rural Competitiveness

Results of the 1996 Rural Manufacturing Survey

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Introduction

Manufacturing businesses are an important part of the economic base of many rural areas, providing nearly 17 percent of nonmetropolitan jobs in the United States. Income from manufacturing exceeds 30 percent of total income in 506 of the 2,276 nonmetro counties in the United States (Cook and Mizer). Although service industries are becoming more important in America's economic landscape, manufacturing jobs are among the highest paid rural jobs and manufacturing plants have important backward linkages that can generate additional economic activity within a community. Bernat finds that growth in manufacturing output and productivity often translates to regional economic growth.

A number of new trends have raised concerns about whether rural manufacturers can remain competitive. Manufacturers are increasingly adopting computerized automated production technologies and new management practices. Are rural businesses likewise adopting these new practices? These new technologies and management practices are changing the skill requirements for manufacturing workers. Can rural areas supply workers with the skills necessary to keep rural manufacturers competitive? What characteristics of rural locations are barriers to rural competitiveness? What do businesses say about the adequacy of the pool of labor available to them, access to credit, services, local infrastructure, and schools? Globalization of industry means the ability to compete in world markets is crucial to business success and job creation. Are rural businesses at a disadvantage in the export market? What types of establishments are exporting? Are Government business assistance programs properly targeted? Do they assist the types of businesses that need help?

USDA's Economic Research Service (ERS), in cooperation with Washington State University, conducted the 1996 Rural Manufacturing Survey (RMS) to address such questions. This nationwide survey of manufacturing establishments contains information on basic plant and company characteristics, use of technology and management practices, worker training, barriers to competitiveness, and problems related to obtaining capital for expansion or modernization. Interviews were conducted with 2,844 manufacturing establishments in nonmetropolitan areas of the United States and 1,065 establishments in metropolitan areas. Respondents are representative of establishments with 10 or more employees in all manufacturing industries.¹ This unique source of information on rural businesses is a vitally important tool for rural policymakers in the U.S. Department of Agriculture, Congress, other Federal agencies, and State and local governments. Numerous Federal, State, and local government programs are targeted to help rural businesses stay competitive. While considerable resources are devoted to such programs, researchers, rural development practitioners, and policymakers have few hard facts about the characteristics of rural businesses and what they need to compete in the national and global economies. The information available on these topics is often oriented toward urban businesses and may not be relevant in the rural setting.

This report summarizes the results of the 1996 Rural Manufacturing Survey and provides technical documentation of how the survey was performed and the computation of sample statistics. More in-depth analy-

¹See the appendix for details on the survey design and statistical issues.

ses are available in a series of issue-oriented Economic Research Service reports.

The RMS addresses the issue of rural business competitiveness by asking respondents to rate the importance of various problems that may affect their ability to compete. Responses to other questions provide basic information on the establishment, its products, and its work force that permits analysts to study the relationship between competitiveness and plant characteristics. The survey asked about five broad factors that affect business competitiveness.

- New technology, new management practices, and "lean" just-in-time manufacturing are believed to raise productivity and efficiency of firms. The RMS permits an investigation of the degree to which new technologies and practices are used by rural versus urban establishments, and whether adopters differ from nonadopters. New technologies and flexible manufacturing methods place new demands on workers by requiring them to do multiple tasks, take on increased decision-making responsibility, and work in teams.
- The demands of new technologies and management practices have given rise to concerns about the skills and aptitudes of U.S. workers. The RMS permits investigation of the increase in skill requirements, whether workers have the skills employers are looking for, and what firms are doing to improve worker skills.
- Most communities cannot prosper unless they provide a business environment where firms can compete successfully. The cost and quality of labor, land costs, regulation, tax rates, and access to business services, markets, infrastructure, and capital are factors that can affect a business' ability to compete at a particular location (Blair and Premus). The RMS provides a rare glimpse at the perceptions businesses have about what characteristics of their communities hinder their competitiveness. This information will guide policymakers and economic development officials as they consider how to attract new firms and retain old ones in rural communities.
- Federal, State, and local governments have implemented a number of loan, training, and assistance

Rural Manufacturing Survey: In-depth studies

The following special reports in the Rural Manufacturing Study series published by USDA/ERS (available at <http://www.econ.ag.gov/epubs/pdf/aib/736/>) also are noted in the references:

Fred Gale. *Is There a Rural-Urban Technology Gap?*

Ruy Teixeira. *Rural and Urban Manufacturing Workers: Similar Problems, Similar Challenges.*

David McGranahan. *Local Problems Facing Manufacturers.*

Elizabeth Greenberg and Richard Reeder. *Who Benefits from Business Assistance Programs?*

Other studies that used the Rural Manufacturing Survey data:

Fred Gale. "Value-Added Manufacturing Has Strong Local Linkages."

"Most Value-Added Manufacturing Firms Have Access to Needed Capital."

"Rural Manufacturers in the Export Market."

"How Skill Demands Are Related to Flexible Manufacturing Technology and Management Practices."

"Manufacturing Employers Report Widespread Problems with Labor Quality."

Chin Lee, G. Schluter, and F. Gale. "Most Jobs Created by Exports are in Medium- and High-Skill Occupations."

David McGranahan. "Can Manufacturing Reverse Rural Great Plains Depopulation?"

"The Geography of Technology Adoption."

"Manufacturing Sector in Black Counties Weakens in Era of New Technology."

"Advanced Technology Means Better Pay and Benefits for Workers."

R. Teixeira and D. McGranahan. "Rural Employer Demand and Worker Skills."

programs, tax breaks, and enterprise zones, to assist businesses and promote economic development. The RMS asked respondents to evaluate the importance of six types of programs to business operations, and thereby provides an opportunity to evaluate these programs.

- Access to capital is a key to business success and many government programs are designed to provide fair and equal access to business loans. The RMS provides information about reasons for capital investments, sources of funds, and problems encountered in raising capital.

In this report, responses by nonmetro and metro establishments to each question in the survey are tabulated. Statistics were computed using sample weights described in the appendix, which also provides details

about the survey design and the computation of statistics. The number of observations varies from table to table. Many questions were not asked of all respondents. For example, only those who reported using outside technical assistance were asked about sources of assistance. Also, some respondents did not answer every question they were asked. The number of sample observations upon which the statistics are based is shown as "N=" in the notes at the bottom of each table. The reader should keep in mind that nonmetro establishments were over-sampled in order to assure a sufficient number of observations for analysis. The proportion of nonmetro establishments in the sample is much higher than their share of establishments nationwide, and statistics for metro respondents are less reliable than those for nonmetro respondent (see Appendix: Technical Documentation).

Establishment Attributes

Three-fourths of nonmetro and metro establishments reported they had added products or substantially improved product quality. Nonmetro establishments were more likely than metro manufacturers to report having added employees from 1992 to 1995. They also paid lower average hourly wages and had a lower percentage of workers in professional, technical, and management positions.

Production Methods

Nonmetro establishments are somewhat more likely than metro establishments to employ large batch assembly line methods of producing "large numbers of the same product," while metro plants are more likely to custom-produce individual units or to produce small batches of a distinct product (table 1). About 20 percent used "other" methods, which respondents usually identified in written comments as a combination of the other three methods.

Most respondents seem to have been actively seeking improvements in their operations to respond to markets and lower costs. Three-fourths of establishments said that they had added new products or substantially improved product quality. Nearly half said that they had substantially lowered their costs of production. Responses of metro and nonmetro establishments were similar, but nonmetro plants were slightly less likely to report having added new products and improved product design.

Work Force Characteristics

Nonmetro establishments reported an average of 190 employees in 1995, slightly less than the metro average of 202 (table 2). However, the tendency has been for nonmetro plants to expand employment, while metro plants appear to be shrinking employment. The average number of jobs reported in 1992 was 182 (8 less than the 1995 average) for nonmetro plants and 231 (29 more than the 1995 average) for metro plants. These results are consistent with regional employment data, which show a modest shift of manufacturing jobs from urban to rural areas. The work force in nonmetro plants is more heavily composed of production labor than in metro plants. Metro plants have more professional, technical, and clerical and other workers. About 10-11 percent of workers are in managerial positions in both metro and nonmetro plants. More than 9 in 10 production workers are permanent full-time employees in both metro and nonmetro establishments.

Table 1—Production methods and product changes by manufacturing establishments

Characteristic	Nonmetro	Metro
	<i>Percent</i>	
How products are generally made:		
Custom produce or make single units for each customer	29*	33*
Produce small batches or limited numbers of a distinct product	17*	23*
Produce large numbers of the same product	34*	24*
Other methods ¹	20	20
Changes to product line in previous 3 years:		
Dropped products	44	47
Added new products	77*	83*
Substantially improved product design	62*	67*
Substantially improved product quality	75	77
Substantially lowered cost of production	47	47

* = Nonmetro-metro difference is statistically significant at 0.05 level.

¹Most respondents described "other methods" as a combination of custom, small batch, and large batch production.

Source: ERS Rural Manufacturing Survey, 1996. N=2,764 nonmetro, 1,059 metro.

Nonmetro plants tend to pay lower wages than metro plants, and 1992-95 wage growth was slower in nonmetro plants. Nonmetro plants paid an average of \$8.88 per hour to production workers in 1995, up from \$7.86 in 1992. Metro plants paid an average of \$10.43 in 1995 and \$9.18 in 1992. The most common benefits provided to production workers were paid sick or vacation leave and contributions toward health insurance. Most establishments also provided a pension or retirement plan. The percentage of plants covered by a collective bargaining agreement was 14-15 percent for both metro and nonmetro plants. The availability of benefits was similar in metro and nonmetro plants, but nonmetro plants were slightly less likely to offer health insurance contributions and paid leave.

Workers with a minority racial or ethnic background made up an average of 41 percent of the production labor in metro plants, compared with only 20 percent in nonmetro plants. Nonmetro plants had a slightly higher percentage of women in their work force. Nonmetro establishments reported an average of 18 percent of production workers with less than a high school degree. An average of 71 percent had completed high school, but did not attend college, and 11 percent had completed at least 1 year of college. On average, nonmetro establishments reported a larger share of workers with a high school degree than did metro establishments, but metro establishments had a slightly higher proportion of workers with college training.

Table 2—Work force characteristics of manufacturing establishments

Characteristic	Unit	Nonmetro	Metro
Average employees, 1995	Number	190*	202*
Average employees, 1992	Number	182*	231*
Management (including financial and legal officers)	Percent	10	11
Professional and technical (engineers, scientists, computer specialists, draftsmen, lawyers)	Percent	6*	11*
Production workers, including foremen	Percent	75*	66*
Other workers (sales, clerical, administrative support)	Percent	9*	12*
Production workers:			
Permanent full-time	Percent	93	92
Permanent part-time	Percent	4	3
Temporary	Percent	3	5
Number of production workers varies seasonally by at least 20 percent	Percent	17	15
Average hourly wage, production workers, 1995	Dollars	8.88*	10.43*
Average hourly wage, production workers, 1992	Dollars	7.86*	9.18*
Benefits provided to production workers:			
Pension or retirement plan	Percent	63	61
Contribution toward employee group health insurance	Percent	87*	92*
Profit-sharing/stock purchase plan	Percent	39	39
Paid sick leave or vacation leave	Percent	91*	93*
Covered by a collective bargaining agreement	Percent	14	15
Production workers with minority ethnic/racial background	Percent	20*	41*
Production workers who are women	Percent	31	27
Highest level of education achieved by production workers:			
Less than high school degree	Percent	18*	23*
High school degree and less than 1 year college	Percent	71*	65*
One or more years of college	Percent	11*	13*

* = Nonmetro-metro difference is statistically significant at 0.05 level.

Source: ERS Rural Manufacturing Survey, 1996. N=2,764 nonmetro, 1,059 metro.

Advanced Technology and New Management Practices

Both nonmetro and metro establishments cited lack of worker skills as the biggest problem when implementing new technologies or management practices.

Advanced technology and new management practices are often cited as key determinants of manufacturing competitiveness. Nonmetro plants were somewhat less likely to use four of five advanced technologies asked about on the survey (table 3). In particular, use of computer-assisted design technologies and use of local area computer networks were 9 percentage points higher for metro than nonmetro establishments. Several of the technologies are used by a smaller percentage of workers in nonmetro plants.

Nonmetro plants compared much more favorably with metro plants in their use of advanced management practices. Nonmetro plants were more likely to report using two of five management practices, and nonmetro-metro rates of use were equal for the other three. The percentage of production workers involved in the practices was the same in metro and nonmetro plants.

Nonmetro establishments were less likely than their metro counterparts to include a research and develop-

ment unit, reflecting the tendency for R&D functions to be concentrated in urban areas. A little more than half of both metro and nonmetro establishments reported having used outside expertise for implementing new technologies or management practices in the previous 3 years.

The most important sources of technical assistance were the firms or establishments with which the plants do business. Customers or suppliers and other locations or branches of the same firm were the most important sources of expertise, followed by machinery, equipment, or software vendors (table 4). Public/university technology assistance programs were less frequently cited, but half of respondents rated these as either "very important" or "somewhat important." Nonmetro plants placed more importance on other branches of their firm, competitors, and public/university programs, while metro plants placed greater importance on consultants.

Table 3—Use of advanced technologies and management practices by manufacturing establishments

Type of technology/practice	Plants reporting usage		Production workers using ¹	
	Nonmetro	Metro	Nonmetro	Metro
	Percent		Percent	
Type of technology				
Numerically or computer-controlled machines	51	53	22*	28*
Programmable controllers	47*	44*	19*	23*
Computer-assisted design or engineering (CAD)	45*	54*	12	14
A local area computer network	33*	42*	20*	28*
CAD linked to computer-assisted machining (CAD-CAM)	21*	25*	15	16
Type of management practice				
Job rotation	59*	53*	60	57
Self-directed or self-managed work teams	49	47	60	61
Employee problem-solving groups or quality circles	49*	45*	59	58
TQM or total quality management	45	43	68	69
Statistical process control	37	38	41	41
Establishment includes a research and development unit	22*	30*	NA	NA
Establishment used outside technical assistance	55	53	NA	NA

* = Nonmetro-metro difference is statistically significant at 0.05 level. NA = not applicable.

¹Percent is only for establishments that report using the technology.

Source: ERS Rural Manufacturing Survey, 1996. N=2743 nonmetro, 1043 metro.

"Adequacy of worker skills" was clearly the biggest problem reported by manufacturing establishments when implementing new technologies or management practices. Over 30 percent of both metro and nonmetro respondents cited that factor as a major problem (table 5). Employee turnover and the time and cost of implementation were major problems for about 20 percent of nonmetro plants. "Availability of adequate technical assistance" and "obtaining sufficient capital" were rated as major problems by relatively few respondents, but

about 40 percent cited these as minor problems. Employee turnover was cited more often by nonmetro plants than by metro plants as a major problem. Nonmetro plants were less likely than metro plants to cite "time and cost of implementation" and "obtaining sufficient capital" as major problems.²

²Gale (1997) and McGranahan (1998b) provide more detailed analysis of technology and management practice adoption.

Table 4—Importance of outside expertise concerning new technologies and management practices used by manufacturing establishments

Source of expertise	Nonmetro		Metro	
	Very important	Somewhat important	Very important	Somewhat important
	<i>Percent</i>		<i>Percent</i>	
Customers or suppliers	50	38	46	42
Other locations or branches of the firm	49*	31*	45*	30*
Machinery, equipment, or software vendors	41	43	42	44
Private or nonprofit consultants	21*	39*	28*	39*
Partners	17	15	15	15
Competitors	14*	36*	9*	38*
Public, vocational, or university technology assistance programs	16*	38*	11*	28*
State or national industry associations	13	35	10	37

Note: "Not Important" responses are not shown.

* = Nonmetro-metro responses are significantly different at 0.05 level.

Source: ERS Rural Manufacturing Survey, 1996. Applies only to those using technical assistance.

N=1,495 nonmetro, 559 metro.

Table 5—Problems encountered by manufacturing establishments implementing new technologies and management practices

Problem	Nonmetro			Metro		
	Very important	Somewhat important	Not important	Very important	Somewhat important	Not important
	<i>Percent</i>			<i>Percent</i>		
Adequacy of worker skills	31	44	24	33	45	21
Employee turnover	20*	38*	41*	12*	41*	46*
Time and cost of implementation	19*	46*	33*	24*	47*	27*
Obtaining sufficient capital	15*	32*	50*	19*	33*	46*
Availability of adequate technical assistance	11	40	48	10	39	50
Getting resources from headquarters ¹	7	37	56	6	40	53

* = Nonmetro-metro responses are significantly different at 0.05 level.

¹Branch plants of multiunit firms only. "Don't know" responses are not shown.

Source: ERS Rural Manufacturing Survey, 1996. N=2,742 nonmetro, 1,054 metro.

Worker Skill Requirements

About 50 percent of manufacturing establishments reported they found it increasingly difficult to find qualified workers for production jobs.

The increasing sophistication and technical nature of many tasks in manufacturing work suggest increasing levels of skill needed for production jobs. Accordingly, most manufacturing establishments reported increasing requirements in computer, problem-solving, and other technical skills (table 6). Another skill requirement that has risen rapidly (faster than any except computer skills) is interpersonal/teamwork skills, a reflection of the prevalence of new forms of work force organization that require work in teams and on multiple tasks. Needs for basic academic skills (reading and math) have increased at a slower rate. More than half of respondents reported that reading and math skill requirements stayed the same. Changes in skill requirements for metro and nonmetro establishments were similar, but a larger percentage of metro plants reported that computer skills required of employees had "increased a lot." Nonmetro plants reported somewhat greater increases in reading and math skills required of employees.

The survey responses suggest that the supply of qualified workers has not kept up with employers' demand.

Over 60 percent of establishments reported difficulty finding qualified applicants for production worker jobs, and over 40 percent had difficulty finding qualified applicants for management work (table 7). For about half of respondents, problems finding qualified applicants for production jobs had increased in the previous 3 years. Problems finding qualified workers were identical for metro and nonmetro plants. On average, both metro and nonmetro respondents said three out of four production workers were fully proficient at their jobs, which means that about one-fourth were not fully proficient. A little less than half of establishments paid for formal training for production workers. Most also said that formal training had increased in the previous 3 years, responses consistent with manufacturers' growing problems with finding skilled workers.

Apparently, the skill most lacking in manufacturing employers' pool of job applicants is "a reliable and acceptable work attitude" (table 8). Thirty-one percent of nonmetro respondents reported a major problem finding job applicants with this characteristic, and 25

Table 6—Change in production worker skill requirements reported by manufacturing establishments, last 3 years

Problem	Nonmetro			Metro		
	Increased a lot	Increased a little	Stayed the same	Increased a lot	Increased a little	Stayed the same
		<i>Percent</i>			<i>Percent</i>	
Interpersonal/teamwork skills	32	29	37	33	28	36
Computer skills	32*	32*	32*	40*	29*	27*
Problem-solving skills	29	32	37	28	33	36
Technical skills, other than computer	17	38	42	17	37	43
Basic math skills	16*	32*	50*	14*	29*	54*
Basic reading skills	13*	26*	60*	14*	21*	62*

* = Nonmetro-metro responses are significantly different at 0.05 level. "Don't know" responses not shown.

Source: ERS Rural Manufacturing Survey, 1996. N=2,625 nonmetro, 1,021 metro.

percent reported it as a minor problem. This was also the leading problem for metro employers. Employers rated problem-solving and other technical skills next in importance, followed by computer and interpersonal/teamwork skills. Basic academic skills were less serious problems, but most employers reported either a major or minor problem finding job applicants with adequate math and reading skills. Metro and

nonmetro responses were very similar. Compared with metro establishments, nonmetro establishments were more likely to report problems with interpersonal/teamwork skills and less likely to report problems with basic reading skills. Other metro-nonmetro comparisons were not statistically different.

Table 7—Worker proficiency and training reported by manufacturing establishments

Characteristic	Nonmetro	Metro
	<i>Percent</i>	
Have had problems finding qualified applicants for:		
Management or professional jobs	42	43
Production jobs	62	61
During the past 3 years, problems finding qualified applicants for production jobs have:		
Increased	50	50
Stayed the same	41	42
Decreased	9	8
Average percent of production workers fully proficient at their current job	75	75
Establishment currently pays for formal training for production workers	48	46
In the last 3 years, formal training for production workers has: ¹		
Increased a lot	32	31
Increased a little	39	44
Stayed the same	26	23
Decreased	2	2

¹Includes only respondents who report providing formal training. N=1,288 nonmetro, 475 metro. Source: ERS Rural Manufacturing Survey, 1996. N=2,700 nonmetro, 1,006 metro, except where noted.

Table 8—Problems finding qualified job applicants for production jobs with specific skills

Type of skill	Nonmetro		Metro	
	Major problem	Minor problem	Major problem	Minor problem
	<i>Percent</i>		<i>Percent</i>	
A reliable and acceptable work attitude	31	25	28	25
Problem-solving skills	22	29	21	29
Technical skills, other than computer	21	25	24	24
Computer skills	16	23	15	26
Interpersonal/teamwork skills	15*	33*	12*	30*
Basic math skills	12	30	14	28
Basic reading skills	5*	27*	8*	26*

* = Nonmetro-metro responses are significantly different at 0.05 level.

¹Includes respondents who said they had no overall problems finding qualified production workers. "Don't know" responses not shown (usually less than 1 percent). N=2,700 nonmetro, 1,006 metro. Source: ERS Rural Manufacturing Survey, 1996.

The most important reason for increasing training for production workers was a "heightened concern about product quality," cited as very important by 78 percent of nonmetro respondents (table 9). Improved productivity was the second-leading reason, while adoption of new equipment and management practices was cited less often. The reported lower quality of today's pool of job applicants was cited as important or very important by 71 percent of nonmetro respondents, but other reasons were cited more frequently. Nonmetro respondents placed slightly more importance on product quality and less importance on adoption of new equipment than metro respondents.

Most establishments relied on internal programs for training (table 10). Machinery, equipment, and software

vendors were also cited frequently as important sources of training, followed by higher education institutions, other branches of the firm, and private training firms and consultants. Nonmetro establishments placed more importance on internal programs, educational institutions, and other branches of the firm than did metro establishments. Metro establishments placed more importance on private training sources, while the importance of machinery, equipment, or software vendors was not statistically different for metro and nonmetro establishments.³

³For more analysis of worker skills problems, see Teixeira and McGranahan (1998), and Gale (1998c).

Table 9—Reasons for increasing training for production workers

Reason	Nonmetro		Metro	
	Very important	Somewhat important	Very important	Somewhat important
	<i>Percent</i>		<i>Percent</i>	
A heightened concern about product quality	78*	19*	74*	21*
To improve productivity	70	26	67	27
Adoption of new types of equipment	48*	39*	53*	28*
Adoption of new management practices	44	39	41	40
New employees are less skilled than new employees hired in previous years	37	34	36	31

* = Significant difference between nonmetro and metro responses at the 0.05 level.
Includes only respondents who increased formal training. N=924 nonmetro, 358 metro.
"Not important" responses are not shown.
Source: ERS Rural Manufacturing Survey, 1996.

Table 10—Importance of various training sources for production workers reported by manufacturing establishments

Source of training	Nonmetro		Metro	
	Very important	Somewhat important	Very important	Somewhat important
	<i>Percent</i>		<i>Percent</i>	
Programs within the establishment	59*	34*	57*	32*
Machinery, equipment, or software vendors	34	46	37	41
Vo-tech institutions, colleges, and universities	28*	46*	22*	44*
Other branches of the firm	28*	40*	26*	33*
Private training firms and consultants	16*	38*	17*	43*

* = Significant difference between nonmetro and metro responses at the 0.05 level.
Includes only respondents who reported providing formal training. "Not important" responses are not shown. N=1,287 nonmetro, 478 metro.
Source: ERS Rural Manufacturing Survey, 1996.

Government Business Assistance

Tax breaks by State or local governments were the most commonly used form of government assistance to both rural and metro manufacturers. But nearly one-third of the respondents thought that none of the six programs listed in the survey was important.

Governments at various levels (Federal, State, local) assist businesses in a variety of ways: through tax breaks, direct subsidies, loan programs, provision of training or technical assistance programs, government-backed industrial parks, and enterprise zones. "Tax breaks by State or local government" were the most commonly used form of government business assistance, cited as "very important" by 19 percent, and "somewhat important" by 27 percent of nonmetro establishments (table 11). However, a majority of respondents (55 percent) said tax breaks were not important to their businesses. Government-assisted training and technology programs were considered "somewhat important" by about one-fifth, and "very important" by 8 percent of manufacturing establishments.

Government-assisted industrial parks or enterprise zones were "very important" to 7 percent and "somewhat important" to 14 percent. Loan programs, including direct government loans, loans insured or guaran-

teed by the government, and revolving loan funds, were cited least often. Overall, nearly 70 percent of respondents attached some importance to at least one of the six types of government assistance they were asked about. Twenty-eight percent cited at least one of the six government programs as "very important," and about half reported at least one to be "somewhat important." A sizeable minority of 31 percent did not cite any of the programs as important. Nonmetro and metro establishments' assessments of the importance of government programs were quite similar. Nonmetro establishments were slightly more likely to place importance on worker-training/technology-assistance programs, direct loans, and revolving loan funds. Metro and nonmetro responses regarding the importance of tax breaks, industrial parks/enterprise zones, and insured or guaranteed loans were not statistically different.⁴

⁴Greenberg and Reeder (1998) provide more detailed analysis of government program use.

Table 11—Importance of government or government-sponsored programs to business operations in last 3 years

Type of program	Nonmetro		Metro	
	Very important	Somewhat important	Very important	Somewhat important
	<i>Percent</i>		<i>Percent</i>	
Tax breaks by State or local government	19	27	18	27
Government-assisted worker-training programs or technology assistance programs	8*	21*	6*	19*
Government-assisted industrial parks or enterprise zones	7	14	6	13
Direct loans from a government agency	7*	8*	5*	5*
Government insurance or guarantee for loans	5	8	6	7
Revolving loan funds run by a nonprofit organization	4*	6*	2*	4*
One or more of the above programs	28	52	26	49

* = Significant difference between nonmetro and metro responses at the 0.05 level.

"Not Important" responses are not shown.

Source: ERS Rural Manufacturing Survey, 1996. N=2,658 nonmetro, 1,026 metro.

Impact of Location

Rural manufacturers were more likely than metro manufacturers to go outside their local area to buy materials and make sales. Quality of local labor was the most frequently cited of 21 possible location-related problems among both nonmetro and metro manufacturers. Access to other firms, training, and transportation were other problems most often reported by rural manufacturers. Lack of knowledge and costs, rather than adequate infrastructure, were the biggest barriers to implementing telecommunications technologies by rural manufacturers.

Suppliers and Markets

The increasingly prevalent "lean" approach to manufacturing emphasizes close relationships with suppliers, short production runs, and just-in-time inventory management to reduce costs of holding inventory. A potential disadvantage for rural locations is their relative isolation from other firms. On average, nonmetro manufacturing plants bought only 31 percent of materials, parts, and inputs in their local area (within a 1-hour drive), while metro plants purchased 41 percent of their materials and inputs locally (table 12). The percentage of sales made within the establishment's local area was also slightly higher for metro establishments, again suggesting stronger local connections for metro plants, but the difference was rather small (8 percentage points). However, 48 percent of both nonmetro and metro plants used just-in-time inventory management, and 49 percent of nonmetro plants had a customer that used just-in-time, suggesting that isolation of rural locations may be less important than one might think.

The share of shipments exported overseas was only slightly higher (2 percentage points) for metro than for nonmetro plants.

Nonmetro establishments were slightly more likely than metro plants to use outside marketing expertise (table 12). The most common sources of marketing expertise were other branches or locations of multiunit firms (table 13). Industry groups were of secondary importance, and public or university programs were "very important" to 3 percent and "somewhat important" to 19 percent of nonmetro establishments that used outside marketing assistance. Sources of marketing assistance were similar for metro and nonmetro establishments, except that nonmetro establishments placed less importance on local industry groups.⁵

⁵For more analysis of local purchases by food and forest-related value-added manufacturers, see Gale (1998a). Gale (1998d) provides detailed analysis of rural manufactured exports.

Table 12—Supplier and market information for manufacturing establishments

Characteristic	Nonmetro	Metro
	<i>Percent</i>	
Percentage of raw materials, parts and other inputs obtained locally	31*	41*
Major machinery and equipment suppliers custom tailor their products to fit the establishment's needs	57*	53*
Establishments using just-in-time inventory and production system	48	48
Establishments acting as a supplier to other establishments using a just-in-time system	49	48
Destination of 1995 final shipments:		
Within a one hour drive	21*	29*
Elsewhere in the United States	71*	60*
Outside the United States	8*	10*
Establishments using marketing assistance from outside the establishment	42*	37*

* = Significant difference between nonmetro and metro responses at the 0.05 level.

Telecommunications

Communication with customers, suppliers, and headquarters is believed to be an important ingredient to success in manufacturing today, an industry in which quick turnaround times, lean inventories, and rapidly changing markets are common. Nonmetro plants appeared to be somewhat less likely than metro plants to make regular use of computer linkages to other locations and other firms, modems, and the Internet (table 14). Nearly all plants used fax machines. Satellite communications were used by only 8 percent of nonmetro plants and 5 percent of metro plants. Nonmetro establishments were more likely than metro establishments to use satellite communications, but they were less likely to use the other telecommunications technologies.

The most important barrier to telecommunications use was "lack of knowledge," identified as a major problem by 18 percent and as a minor problem by 49 percent of nonmetro respondents (table 15). Many rural America experts argue that inadequacy of telecommunications

infrastructure is a key barrier to rural telecommunications use, but nonmetro survey respondents reported that "lack of access to adequate telecommunications infrastructure" was less of a problem than lack of knowledge and cost of equipment or software. In fact, more than half said infrastructure access was not an important problem. Respondents cited the cost of using telecommunications more often than infrastructure access as "somewhat important." Knowledge and costs appeared to be higher barriers to telecommunications use by manufacturing plants than infrastructure.

Nonmetro establishments did place higher importance on infrastructure as a telecommunications barrier than did metro establishments, while cost of equipment and software was cited less frequently by nonmetro establishments.

Nonmetro establishments obtained less assistance and expertise locally than metro establishments, but lack of local assistance seems to be a relatively minor problem for most manufacturers. For more analysis of telecommunications, see Gale (1997).

Table 13—Sources of marketing assistance used by manufacturing establishments

Source of expertise	Nonmetro		Metro	
	Very important	Somewhat important	Very important	Somewhat important
	<i>Percent</i>		<i>Percent</i>	
Another location or branch of the firm ¹	68	18	63	19
State or national industry associations	9	43	8	40
Local industry groups	7*	31*	7*	41*
Public or university programs	3	19	3	15

* = Significant difference between nonmetro and metro responses at the 0.05 level.

¹Applies only to multiunit firms. N=663 nonmetro, 182 metro.

Answered only by establishments reporting use of outside marketing assistance.

Table 14—Use of telecommunications technologies by manufacturing establishments

Type of technology	Nonmetro	Metro
	<i>Percent</i>	
Fax machines	98*	99*
Computer links to other locations in the same company ¹	72*	76*
Modems	64*	74*
Computer links to other companies	27*	31*
Internet	24*	35*
Satellite communications	8*	5*

¹Applies only to establishments in multiunit firms.

* = Significant difference between nonmetro and metro responses at the 0.05 level.

Problems Associated with Rural Business Locations

There have been many studies of the factors affecting business location decisions, and many disadvantages of rural locations have been identified: labor problems, lack of infrastructure, lack of access to other businesses and services, and, in some areas, tax rates and environmental regulations that discourage business activity. When asked about the importance of 21 possible location-related problems that limit their ability to compete, nonmetro manufacturers cited quality of local labor

most frequently (table 16). More than a third said labor quality was a major problem, and 41 percent said it was a minor problem. Quality of local labor (along with State and local tax rates) was also the problem most frequently cited by metro respondents. Most nonmetro respondents also identified State and local tax rates and environmental regulations as either major or minor problems. Tax rates were a major concern for more metro than nonmetro respondents. Another important rural problem was the "attractiveness of area to managers and professionals," which was cited more often by nonmetro than metro respondents. Nonmetro

Table 15—Problems limiting use of telecommunications by manufacturing establishments

Limiting factor	Nonmetro		Metro	
	Major problem	Minor problem	Major problem	Minor problem
	<i>Percent</i>			
Lack of knowledge	18	49	21	48
Cost of equipment and software	16*	44*	18*	48*
Lack of access to adequate telecommunications infrastructure	11*	34*	6*	29*
Cost of using telecommunications	8	41	7	45

"Not a problem" responses are not shown. N=2,703 nonmetro, 1,040 metro.

* = Significant difference between nonmetro and metro responses at the 0.05 level.

Source: ERS Rural Manufacturing Survey, 1996.

respondents were more likely to report problems with access to other firms, access to training programs, and transportation infrastructure, but these tended to be minor problems in comparison with labor quality, taxes, and environmental regulations. Nonmetro plants were less likely than metro plants to report problems with cost-related factors, including tax rates, labor costs, and land and facilities costs. Metro and nonmetro respondents, however, reported labor quality and envi-

ronmental regulations as problems with equal frequency. Also, similar percentages of metro and nonmetro respondents rated access to financial institutions and local labor relations as relatively minor problems.⁶

⁶McGranahan (1998a, 1998b) provides more in-depth analysis of local competitiveness problems.

Table 16—Factors related to the establishment's location that limit its ability to compete¹

Factor	Nonmetro		Metro	
	Major problem	Minor problem	Major problem	Minor problem
	<i>Percent</i>			
Quality of local labor	34	41	33	39
State and local tax rates	23*	42*	31*	42*
Environmental regulations	22	36	23	35
Attractiveness of area to managers and professionals	15*	33*	8*	23*
Quality of primary and secondary schools	10*	26*	8*	24*
Access to training courses	9*	36*	6*	23*
Local cost of labor	7*	29*	12*	34*
Access to airport facilities and services	9*	35*	2*	14*
Cost of facilities and land	8*	30*	18*	36*
Water and sewer systems	8*	23*	6*	19*
Access to material suppliers	7*	33*	3*	25*
Access to Interstates and major highways	7*	20*	3*	12*
Access to major customers	6*	31*	6*	25*
Local roads and bridges	6*	25*	4*	17*
Railroad access	6*	14*	2*	8*
Access to machinery and equipment suppliers	5*	29*	2*	20*
Access to information about markets	5*	29*	6*	25*
Access to financial institutions	4	20	5	17
Prevailing local labor-management relations	4	23	3	21
Police and fire protection	2*	16*	2*	9*
Access to legal and other business services	1*	19*	1*	11*

¹ "Not a problem" responses are not shown. N=2,715 nonmetro, 1,040 metro.

* = Significant difference between nonmetro and metro responses at the 0.05 level.

Source: ERS Rural Manufacturing Survey, 1996.

Raising Capital

Fifty-seven percent of nonmetro manufacturers reported a major expansion or modernization during 1992-1995, with nearly two-thirds of those companies using funds borrowed from a bank or savings and loan. Capital seems to be equally available for both metro and nonmetro manufacturers.

Financing Capital Improvements

About three out of four nonmetro manufacturing establishments had a business or financial plan, slightly less than the proportion of metro establishments (table 17). About half of those who had a plan reported using outside experts to develop it. For plants that are part of multiunit firms, the most important source of expertise was "other locations" (headquarters, for example), used by two-thirds of multiunit respondents (table 18). After

"other locations," banks or other financial institutions and private or nonprofit corporations were the most important sources, identified as "very important" by one in five nonmetro respondents. Respondents apparently did not rely heavily on any other particular source of expertise. For each of the other six sources of expertise they were asked about, most nonmetro respondents said they were "not important." Nonmetro establishments were less likely than metro establishments to use assistance from banks, private companies, or nonprof-

Table 17—Financing of capital investments by manufacturing businesses

Factor	Nonmetro	Metro
	<i>Percent</i>	
Establishment has a business or financial plan	76*	79*
Used outside experts when developing plan ¹	49*	46*
Planned or initiated major expansion or modernization in the last 3 years	57*	53*
Capital improvement plans were curtailed ²	16	16
Used internal sources of financing: ²		
Retained earnings were used	63	67
Financing was obtained from elsewhere in the firm ³	57	55
Borrowed funds were used ²	67	65
Percentage of borrowed funds long-term (over 3 years)	69	69
Borrowed funds were acquired from: ⁴		
Financial firm (bank, savings and loan)	93	90
Individuals and families	21	25
Other firms (such as insurance company)	4	4
Issued bonds	4	3
New equity investments were used ²	10*	13*
A government program had a role in financing capital improvements ²	18*	15*

* = Significant difference between nonmetro and metro responses at the 0.05 level.

¹Applies only to those having a financial plan. N=1,536 nonmetro, 820 metro.

²Applies only to those that planned expansion/modernization. N=1,515 nonmetro, 552 metro.

³Multiunit firms that planned an expansion/modernization only. N=630 nonmetro, 189 metro.

⁴Applies only to those that used borrowed funds to finance expansion/modernization. N=948 nonmetro, 342 metro.

Percentage of respondents who reported using source are reported.

Source: ERS Rural Manufacturing Survey, 1996.

its, but they were more likely to use assistance from public or university programs.

Fifty-seven percent of nonmetro respondents reported having planned or initiated a major expansion or modernization in the previous 3 years, a slightly higher share than the 53 percent of metro establishments (table 17). Improving quality control was the most important reason for undertaking an expansion or modernization (table 19); 80 percent of respondents cited improved quality control either "somewhat important" or "very important." That was followed by expansion of production capacity and changes in the product line. Replacement of old or damaged equipment and technology adoption were cited less frequently. Respondents cited compliance with new regulations the least frequently of the six reasons listed in the questionnaire, but nearly a fifth of plants said compliance

was a "very important" reason for their expansion or modernization. While nonmetro and metro plants noted similar reasons for capital improvements, metro plants were more likely to report expansion of production capacity as "very important."

Most respondents who had made capital improvements reported having used at least some internally generated funds to finance their expansions or modernizations (table 17). Sixty-three percent of nonmetro respondents reported using retained earnings, and 57 percent of those in multiunit firms used financing from elsewhere in their firm. Two out of three reported using borrowed funds, and 69 percent of those respondents used long-term debt. Over 90 percent reported borrowing from a bank or savings and loan and about 20 percent reported borrowing from individuals or families. Few respondents reported issuing bonds or borrowing from other

Table 18—Sources of outside expertise used in developing business or financial plans by manufacturing establishments

Source of expertise	Nonmetro		Metro	
	Very important	Somewhat important	Very important	Somewhat important
	<i>Percent</i>			
Other locations of the firm ¹	66	21	69	18
Bank or other financial institution	20*	29*	21*	35*
Private or nonprofit corporation	20*	26*	26*	30*
Partners	16	17	17	17
Competitors	11	31	8	29
State or national industry association	6	25	5	23
Public, college, or university programs	6*	20*	4*	12*

* = Significant difference between nonmetro and metro responses at the 0.05 level.

"Not Important" responses are not shown.

¹Includes only establishments in multiunit firms.

Includes only establishments reporting using assistance to develop a business or financial plan.

N=999 nonmetro, 378 metro.

Source: ERS Rural Manufacturing Survey, 1996.

firms. Only 10 percent of nonmetro respondents created new equity investments (such as stocks) to raise capital, and 18 percent said that a government program had some role in financing their investment. Metro and nonmetro respondents' sources of financing were similar, except that nonmetro establishments were more likely to use government programs to obtain financing and less likely to use new equity investments.

Financing problems did not affect capital investment plans for most respondents. Of those who reported having undergone an expansion or modernization, only 16 percent of both metro and nonmetro respondents reported that problems caused them to curtail their plans for capital improvements (table 17). Of the four problems asked about, "uncertain or changing product

market situation" was cited as a major problem most often (table 20). "Difficulty arranging outside financing" was a major problem for 11 percent of both metro and nonmetro respondents, and was the second leading major problem overall. However, it was cited less often as a minor problem. A significant minority of firms seemed to have difficulty acquiring financing, but this did not seem to be a problem for most manufacturing plants. The similarity of the metro and nonmetro responses suggests that capital is equally available to metro and nonmetro manufacturing establishments.⁷

⁷Milkove, McGranahan, and Sullivan (forthcoming) and Gale (1998b) provide more detailed analysis of finance and capital issues.

Table 19—Reasons for investing in capital improvements by manufacturing establishments

Reason for investment	Nonmetro		Metro	
	Very important	Somewhat important	Very important	Somewhat important
	<i>Percent</i>			
Improve quality control	47	34	46	35
Expand production capacity	79	16	77	16
Change or add to the product line	45	27	46	29
Replace old or damaged equipment	38	28	36	30
Adopt new technology or management practice	35	32	38	31
Comply with new regulations	19	27	18	26

* = Significant difference between nonmetro and metro responses at the 0.05 level. "Not important" responses are not shown. Includes only establishments reporting a major expansion or modernization within the past 3 years. N=1,534 nonmetro, 558 metro.

Table 20—Problems encountered in carrying out capital investment plans by manufacturing businesses

Problems	Nonmetro		Metro	
	Very important	Somewhat important	Very important	Somewhat important
	<i>Percent</i>			
Uncertain or changing product market situation	12	38	15	33
Difficulty arranging outside financing	11	28	11	25
Difficulty acquiring support from headquarters ¹	9*	46*	8*	29*
Underestimated financial costs	8	35	7	34

* = Significant difference between nonmetro and metro responses at the 0.05 level. "Not important" responses are not shown. Includes only establishments reporting a major expansion or modernization within the past 3 years. N=1,512 nonmetro, 551 metro.

¹Includes only establishments in multiunit firms.
Source: ERS Rural Manufacturing Survey, 1996.

Locally Available Expertise and Capital

One of the disadvantages of rural business locations is lack of contact with other businesses and lack of access to information and expertise in relatively remote rural areas. The survey asked respondents to state what part of financing, worker training, financial planning, technical and marketing assistance was obtained in their local area, defined as "within a 1-hour drive." As expected, nonmetro establishments reported obtaining a lower proportion of assistance and expertise locally than did metro establishments, but the nonmetro-metro difference in the proportion of financing obtained locally was not statistically significant.

Financial capital seemed to be available locally to most nonmetro establishments—56 percent said they

obtained "all or almost all" financing for capital investments locally (table 21). However, one in three reported obtaining "little or none" locally. Worker training was also generally available in the local area, as most nonmetro respondents reported obtaining "all or almost all" or "over half" locally. Business financial planning expertise was somewhat less available locally, and technical and marketing expertise generally were not obtained in a nonmetro establishment's local area. While nonmetro establishments seemed to obtain less assistance and expertise locally, responses to other questions about problems with training, financing, and technology adoption barriers suggest that lack of local assistance is a relatively minor problem associated with rural location.

Table 21—Expertise and assistance obtained locally by manufacturing establishments¹

Type of assistance	Nonmetro				Metro			
	All or almost all	More than half	Less than half	Little or none	All or almost all	More than half	Less than half	Little or none
	<i>Percent</i>							
Financing for capital investments in last three years ²	56	5	6	33	61	6	5	27
Worker training source outside the establishment ³	45*	23*	16*	16*	61*	19*	9*	11*
Business financial planning expertise ⁴	38*	13*	13*	36*	49*	15*	10*	25*
Expertise concerning new technologies and management practices ⁵	16*	17*	29*	37*	33*	19*	24*	24*
Marketing assistance ⁶	15*	8*	15*	62*	18*	9*	20*	52*

* = Significant difference between nonmetro and metro responses at the 0.05 level.

¹Locally = within a 1-hour drive.

²Establishments reporting an expansion/modernization. N=1,478 nonmetro, 527 metro.

³Establishments reporting outside training. N=1293 nonmetro, 477 metro.

⁴Establishments reporting using outside expertise to develop a business or financial plan. N=999 nonmetro, 377 metro.

⁵Establishments reporting technical assistance. N=1,495 nonmetro, 556 metro.

⁶Establishments reporting marketing assistance. N=1,128 nonmetro, 372 metro.

Source: ERS Rural Manufacturing Survey, 1996.

Conclusions

This report provides a statistical profile of rural manufacturing businesses and includes much information not previously available. The results confirm that rural manufacturers employ a lower percentage of workers in higher-skill nonproduction jobs and that they pay lower wages. Businesses at nonmetro locations tend to perceive fewer problems with cost-related factors, but more problems with access to other firms and infrastructure. In many respects, however, metro and nonmetro businesses are surprisingly similar. They generally reported similar problems with implementing new technologies, skill requirements, worker quality, use of government programs and technical assistance, and sources of financing.

The most widespread concern of both metro and nonmetro manufacturing plants appears to be the quality of labor available. Both metro and nonmetro respondents reported rapidly increasing skill requirements in interpersonal/teamwork skills, computer, problem-solving, and other technical skills. About half said that problems finding qualified job applicants have increased, and quality of local labor was the most frequently cited problem associated with nonmetro business locations. The adequacy of worker skills was the biggest problem encountered by manufacturers when implementing new technologies and management practices.

Many rural development efforts are aimed at improving access to credit, transportation and telecommunications

infrastructure, and technical assistance. In this survey, however, both rural and urban businesses tend to report these as being relatively minor problems.

Infrastructure, training and technical assistance, and tax breaks are important selling points in industrial recruitment efforts, so individual communities have incentives to provide them. The low level of concern with these problems may reflect the success of past policy efforts. In any case, perceived problems with these factors have lower priority with most businesses than do those with labor quality. We should also remember that this survey covered only manufacturing businesses. Businesses in other economic sectors may give different responses.

Both rural and urban communities face the difficult challenge of supplying workers with adequate skills to preserve their manufacturing job base. New technologies and management practices give workers multiple tasks, increase decision-making responsibility, and require them to work in teams. These developments have increased skill requirements, but the needed skills include many that are not emphasized in traditional academic preparation. Among the skills most sought by employers are a reliable and acceptable work attitude, interpersonal and teamwork skills, problem-solving, computer, and technical skills. How to develop these skills will be the subject of further investigation and considerable debate.

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Appendix:

Technical Documentation

The Survey Process

The Rural Manufacturing Survey (RMS) is a stratified random sample of all U.S. manufacturing establishments with 10 or more employees. The sample was drawn from a list purchased from a private vendor, Survey Sampling, Inc., of Westport, Connecticut. The sampling frame included all establishments in Standard Industrial Classification (SIC) Division D, with the exception of SIC 2711 (newspaper publishing). The Social and Economic Sciences Research Center at Washington State University (WSU) attempted to contact a sample of 8,800 establishments during the summer of 1996. The initial step was a verification interview, in which establishments were called to ascertain whether they were manufacturers with at least 10 employees and, if so, who in the business should be interviewed. These people were then asked to participate in the survey through a letter from the U.S. Department of Agriculture Under Secretary for Research, Education, and Economics.

In the initial screening call to the establishment, the interviewer stated that the questions asked in the study required knowledge of "the types of technology used in manufacturing, management practices, the education, training and pay of production workers, problems in hiring and problems in access to capital for expansion or modernization." The interviewer asked who, at that location, was most knowledgeable about this broad range of issues. The person named was the target respondent, and their phone number and address were taken. About two-thirds of target respondents were either a head of the organization or the general/plant manager (app. table 1). In branch plants, more than half of target respondents were heads of production, while in headquarter establishments the largest number of respondents were heads of the organization. Human resources directors and financial and administrative officers responded in a significant number of establishments.

The data were collected in a half-hour phone interview.⁸ At least partial interviews were completed for 3,909

⁸Potential respondents not reached by phone or lacking time were sent a printed version of the questionnaire, which they could return by fax or mail. The interview was conducted with the most senior manager available at the location.

establishments (3,418 by phone; 491 by mail or fax). The 4,891 establishments not contacted included 2,235 determined to be ineligible and 115 eligible cases that refused to participate. Eligibility could not be determined for the remaining 2,656. WSU estimates that about 5,600 of the sampled cases were eligible for the study. The estimated response rate is 68 percent. Stratification of the RMS sample is based on metro-nonmetro location, nonmetro west-nonwest, and three employment size classes. The nine strata are shown in appendix table 2. The goal of the survey was to obtain reliable information on nonmetro establishments as well as a small sample of metro establishments for comparison. Nonmetro plants were more likely to be included in the sample than metro plants (about 7.5 percent vs. 0.7 percent). Also oversampled were large plants and nonmetro plants in the West. The sample includes nearly one-third of large plants in the nonmetro West.⁹

In their comments given at the end of the interview, many respondents said they were not able to answer all of the questions accurately, either because the range of questions was too broad for one person to answer or because they did not have records at hand to provide detailed information. Consequently, information is frequently missing for several variables, including costs, shipments, wages, and employees, especially values for 1992.

Sample Weights

Statistics obtained from a stratified sample do not reflect the population unless a weighting scheme is used to correct for the stratification in the sample. For example, the average number of technologies used computed from the unweighted sample will be affected by the disproportionate number of large establishments (which tend to use more technologies than others). Weights were calculated so that the weighted survey statistics will fairly represent all U.S. manufacturing establishments with 10 or more employees.¹⁰ Let N_h

⁹Although the sample was drawn in 1996, the population numbers in appendix table 2 are from Bureau of the Census, *1993 County Business Patterns*, which was the most up-to-date information available at the time.

¹⁰For description of analysis of stratified survey data, see Levy and Lemeshow.

represent the population in stratum h , n_h the sample size in stratum h , q_h the sampling rate in stratum h . The sample weights are:

$$WEIGHT_h = \frac{N_h}{n_h} = \frac{1}{q_h},$$

where, $\sum_{h=1}^9 n_h WEIGHT_h = N$

WEIGHT is equal to the inverse of the probability of being included in the sample, and the weights sum to the estimated population size, N .

Computation of Sample Statistics

Mean employment can be estimated by taking a weighted average of means across strata. The mean for a stratified random sample can be computed as,

$$\bar{x} = \sum_{h=1}^L \left[\frac{N_h}{N} \right] \bar{x}_h,$$

where \bar{x}_h is the mean for stratum h , and L is the number of strata.¹¹ This is simply a weighted average of the stratum means and is equivalent to computing an overall mean using WEIGHT. The overall mean computed in this manner is 104 employees. The mean for metro strata is 103, and, for nonmetro strata, the mean is 110. The estimated total employment for the population represented by the sample is simply $N \bar{x}$. Appendix table 3 shows that the nonmetro establishments represent employment of about 4.2 million, and metro establishments in the sample represent about 15.4 million jobs.¹²

Reliability of the estimates can be judged using the standard errors, which are basically complex weighted averages of the standard errors of the various strata.

¹¹See Levy and Lemeshow, chapter 6, for more details.

¹²The intent of the RMS was not to estimate the number of jobs in nonmetro manufacturing, since those estimates can be obtained from other sources. Comparisons with other estimates are made here to judge the representativeness of the sample. If the RMS data produce estimates comparable to those obtained from other sources, we can have greater confidence in the data.

The standard error of the mean \bar{x} is computed by

$$\hat{se}(\bar{x}) = \left(\frac{1}{N} \right) \left[\sum_{h=1}^L N_h^2 \left(\frac{s_h^2}{n_h} \right) \left(\frac{N_h - n_h}{N_h} \right) \right]^{1/2}$$

where s_h^2 is the standard error for stratum h .

The term $(N_h - n_h)/N_h$ is the finite population correction (FPC) factor and can be expressed more intuitively as $1 - (n_h/N_h)$. When the sample is a large proportion of the population, this term becomes smaller and deflates the sample variance. The FPC takes on values ranging from 0.998 to 0.996 for the three metro strata, but is as low as 0.679 for nonmetro strata. The standard errors can also be computed for metro and nonmetro subgroups. The nonmetro mean employment per establishment is measured with much greater precision (standard deviation of 2) than the metro mean (standard deviation of 8). A 95-percent confidence interval for nonmetro employment per establishment runs from approximately 100 to 108. The standard error of total employment,

$\hat{se}(x)$ is $N \hat{se}(\bar{x})$, is 90,800 for nonmetro total employment and 1.2 million for the metro total.

A 95-percent confidence interval for total nonmetro employment estimated from the RMS is from 4.01 to 4.36 million (appendix table 3). Note that the Census Bureau estimate from the Annual Survey of Manufacturers (4.04 million) for 1994 falls within this interval, although it is near the lower bound. The Bureau of Economic Analysis (BEA) estimate for the same year is slightly above the upper bound, at 4.4 million. A 95-percent confidence interval for metro employment estimated from the RMS runs from 13.1 to 17.7 million. The Census Bureau estimate for 1994 falls below the lower bound of the confidence interval, but the BEA estimate falls within the interval. We can be fairly confident about the representativeness of nonmetro results since the RMS estimate falls between two other estimates. The metro estimate is consistent with the BEA estimate, although it is higher than the Census number.

Most of the questions on the RMS are yes-no questions, thus most analysis will be of proportions, $p_y = N_y/N$ (often converted to percent), where N_y is the number of establishments having the characteristic y . The estimate \hat{p}_y is found as a weighted average of the stratum values, $\hat{p}_{hy} = n_{hy} / n_h$, analogous to the formula for \bar{x} .

The standard error is computed by

$$\hat{se}(p_y) = \frac{1}{N} \left[\sum_{h=1}^L N_h^2 \left(\frac{\hat{p}_{hy}(1-\hat{p}_{hy})}{n_h-1} \right) \frac{N_h-n_h}{N_h} \right]^{\frac{1}{2}}$$

where \hat{p}_{hy} is the proportion with characteristic y computed for stratum h .

Using these formulas, as an example, we computed the percentage of establishments reporting use of computer-assisted design or engineering (Q17 on the RMS questionnaire). As was the case with employment, the means are found by taking weighted averages of stratum means. The nonmetro mean is 44.8 percent, while the metro mean is 53.8 percent. Standard errors within strata are fairly large, due to the small number of observations within each stratum. The metro and nonmetro means are measured with more precision, however. A 95-percent confidence interval for the nonmetro percentage ranges from 42.8 to 46.8 percent. The t-value for a test of the difference between metro and nonmetro percentages is equal to 6.1, indicating a statistically significant difference.

Appendix table 1—People contacted as survey respondents

Position in plant	Branch plants	Others	Total
	<i>Percent</i>		
Head of:			
Organization (owner, CEO, VP)	43.2	6.2	30.7
Production (General or Plant Manager)	26.2	57.0	36.6
Human Resources (Personnel Director)	9.3	17.9	12.2
Finance/Administration (CFO, Office Administrator)	9.6	5.4	8.2
Department			
Production (Foreman, Engineer)	1.0	3.0	1.7
Human Resources	2.9	4.3	3.4
Finance (Bookkeeper, accountant)	1.3	0.5	1.0
Other or missing	6.3	5.9	6.2
Total	100	100	100
Number of cases	2,591	1,315	3,906

Source: ERS Rural Manufacturing Survey, 1996.

Appendix table 2—Number of establishments by strata, Rural Manufacturing Survey

Stratum: Geography	Stratum: Plant size	Establishments		Sampling rate
		Sample ¹	Population ²	
Region	<i>Employment</i>	<i>Number</i>	<i>Number</i>	<i>Percent</i>
Metro	10-49	365	97,920	0.4
Metro	50-249	503	41,788	1.2
Metro	250 or more	197	10,215	1.9
Nonmetro-West	10-49	172	2,815	6.1
Nonmetro-West	50-249	135	978	13.8
Nonmetro-West	250 or more	63	196	32.1
Nonmetro-Nonwest	10-49	851	19,776	4.3
Nonmetro-Nonwest	50-249	997	10,613	9.4
Nonmetro-Nonwest	250 or more	626	3,654	17.1
Metro total	NA	1,065	149,923	0.7
Nonmetro total	NA	2,844	38,032	7.5
Overall total	NA	3,909	187,955	2.1

¹Completed usable interviews. ²Estimated from U.S. Department of Commerce, County Business Patterns.
Source: ERS Rural Manufacturing Survey, 1996.

Appendix table 3—Comparison of RMS total manufacturing employment with other estimates

Item	Nonmetro	Metro
	<i>Million</i>	<i>Million</i>
RMS estimate, 1995	4.2	15.4
95-percent confidence interval	(4.01, 4.36)	(13.06, 17.74)
BEA, 1995	4.44	14.79
Census, 1994	4.04	12.87

Source: ERS Rural Manufacturing Survey; ERS analysis of Bureau of Economic Analysis unpublished data; U.S. Department of Commerce, Bureau of the Census, Annual Survey of Manufacturers, unpublished tabulation.