

Predominant Purpose Statement

Final, March 26, 2004

#387 Lewis, "Measuring Geographic Differences in Technical Change in the US Manufacturing Sector."

A. Criteria

The predominant purpose of this project is to increase the utility of Title 13, Chapter 5 data by meeting the criteria listed below. In broad terms, there are four parts to this project. Each part is consistent with a criterion listed in Title 13, Chapter 5 for increasing the utility of Census Bureau data collection programs.

First, the 1988, 1991, 1993 Surveys of Manufacturing Technology (SMTs) will be used to prepare estimates of manufacturing technology use by state and metropolitan area. No regional technology-use tables have previously been made from these data. This part of the project is described further under Criteria 2 and 7 below.

Second, the project will estimate the impact that the skills of workers in a local labor market have on the adoption of manufacturing technology in that market, as well as estimating the productivity impact of any technology adoption. The productivity impact will be estimated by matching 1988 and 1993 SMTs by plant to, respectively, the 1987 and 1992 Censuses of Manufacturers (CMs) and using the matched data to estimate augmented Cobb-Douglass production functions. This is also further described under Criteria 2 and 7 below.

Third, each of the SMTs will be matched to the universe of establishments covered by the survey in order to assess how geographically representative the SMT is. More specifically, the 1988 and 1993 SMTs will be matched to one year prior CMs and each SMT will be matched to, respectively, the 1988, 1991 and 1993 County Business Patterns (CBP) county or state summary file. Particular attention in this analysis will be given to whether future technology-use surveys could be performed more efficiently by stratifying geographically (such as by state). This part of the project is further described under Criterion 6 below.

Fourth, the SMT-CM and SMT-CBP matches will be used to develop new county- and state-representative sample weights for the SMT. These weights will be used in the first and second parts of this project. Details are found under Criterion 9 below.

Criterion 2: Leading to new or improved methodology to collect, measure, or tabulate a Title 13, Chapter 5 survey, census, or estimate

Criterion 7: Preparing estimates of population and characteristics of population as authorized under Title 13, Chapter 5.

This project will use the 1988, 1991 and 1993 Surveys of Manufacturing Technology (SMTs) to prepare estimates for release to the public of the use of different types of manufacturing technology by state and metropolitan area (for the largest metropolitan areas). These estimates will make use of

geographically representative population weights developed by this project, described below. In addition, if it is possible to do so without compromising the confidentiality of individual survey responses, these same statistics will also be cross-tabulated by two-digit industry and by other major plant characteristics covered in the survey (for example, age of plant, size of plant, union status of plant). Sample sizes are likely to be sufficient to make such tabulations publicly available without risk of disclosure.¹

The tabulations of SMT data that are available now can be found in the Bureau's *Current Industrial Reports* on manufacturing technology.² These *Reports* are quite comprehensive in their tabulations of the SMT responses, but contain no separate tabulations by geographic location. Making available separate tabulations of SMT data by location is potentially important in light of recent evidence suggesting that employers in different US markets adopt technology at substantially different rates.³ Thus, this project will tabulate the SMT by geographic area. In particular, for comparability, this project will attempt to tabulate statistics in a similar fashion to the original *Reports* on manufacturing technology, but separately for each state and metropolitan area. For reasons of sample size, there will likely be less detail in the geographically stratified versions on the tables. For example, Table 1 of the 1988 report shows estimates of the percent of manufacturing establishments using none of, or at least 1, 2, 3, 4, or 5 of the 17 technologies covered by the SMT. If sample sizes allow, this project will therefore estimate these fractions for each state and large metropolitan area in 1988. If sample sizes are insufficient to tabulate with that level of detail, cells that contain too few firms will be repressed, or aggregated with other cells (say, by grouping together adjacent categories, as in 1-2 technologies, 3-4 technologies etc). The original 1988 *Report* also had a more detailed cross-tabulation of these fractions by two-digit industry, plant size, age of plant, and other plant characteristics. This project will try to create this more detailed table by state and metropolitan area to the extent it is possible to do so, carrying out comparable types of data suppression or cell aggregation in order not to risk revealing confidential information.⁴

A second part of this project involves estimating the effect the skills of workers in a labor market have on the use of technology in that market, and the effect the technology has on productivity. In particular, technology use at the metropolitan area level will be regressed on the skills of the labor force – observed in the Census of Population and contemporaneous Current Population Surveys – across metropolitan areas. To estimate the productivity impact, Cobb-Douglas production functions will be estimated using data from the Censuses of Manufacturers for 1987 and 1992. Matched (by plant) to, respectively, the 1988 and 1993 SMT, these production functions will then be augmented by terms that assess whether the skills of workers in the labor market that a plant occupies (but not working at the plant) affect the plant's productivity, either through their effect on

¹ This was demonstrated in the project proposal.

² A separate report was published from each year of survey data. They are: *Manufacturing Technology 1988*, SMT(88)-1, published 1989; *Manufacturing Technology: Factors Affecting Adoption 1991*, SMT(91)-2, published 1993; and *Manufacturing Technology: Prevalence and Plans for Use 1993*, SMT(93)-3, published 1994.

³ For example, Current Population Survey data show that the use of personal computers at work has grown substantially faster in certain metropolitan areas than in others. Work by this project's author showed that US labor markets adapted to changes in worker mix during the 1980s by changing technology rather than industry mix or wages. Recent evidence also indicates that increases in wage inequality have been driven by differences in the rate of computer investment at different plants (Dunne, Foster, Haltiwanger and Troske (2002)).

⁴ Plant characteristics could also be aggregated together in this case.

the plant's use of technology or by some other means.⁵ In both cases, in order to give the estimates a more credibly causal interpretation, specifications will be run which difference over time (i.e. between surveys), which control for other fixed effects (e.g. industry), and which instrument for local work force skills with the skills of immigrants that have historically settled in the local labor market.⁶ A goal of these estimates is to inform the Bureau's understanding of the forces that drive the wide productivity differences across labor markets in the US.

Thus, this project will use existing Census Bureau survey data to develop state and metropolitan area manufacturing technology use statistics. It will also assess the impact that the skills of the local work force have on technology use, and assess the impact manufacturing technology has on productivity. The project will increase the Census Bureau's knowledge base regarding the spatial distribution of technology, the determinants of the spatial distribution of technology, and the importance of the spatial distribution of technology and worker skills in driving spatial differences in productivity.

Criterion 6: Constructing, verifying, or improving the sampling frame for a census or survey authorized under Title 13, Chapter 5.

An assessment of the geographic coverage of the SMT will be carried out by comparing the SMT's to the universe of manufacturing establishments. In particular the 1988 SMT will be matched to the 1987 Censuses of Manufacturers, the 1993 SMT will be matched to the 1992 Census of Manufacturers and, in addition, each SMT will be matched to, respectively, the 1988, 1991 and 1993 County Business Patterns county (and state) summary data for the appropriate year, by strata (class size and three-digit industry) and county (or state). With these matches it will be possible to assess the geographic coverage of the survey by comparing the estimated number of establishments in each strata-state or strata-county cell in the SMT to the number of establishments in the population of manufacturing establishments for that cell. Any systematic shortcomings will be noted and a report on the geographic coverage of the SMT will be written.

Having good geographic coverage in the SMT is important for two reasons. First, it insures that the regional statistics on technology use being generated by this project (described above) are unbiased, and the regression results are nationally representative. In addition, though, if it were correct that technology use differs substantially by location within the US, then a sample that is not regionally stratified may produce national statistics that are less precise than would be produced by a regionally stratified sample of the same size.⁷ As a part of the report on geographic coverage, therefore, the

⁵ The skills of workers outside a plant but in the same locality may affect the productivity of that plant if there are spillovers from having skilled workers nearby. The work of Moretti provides empirical support for such spillovers.

⁶ These models are described in detail in the original proposal, as is the instrument. In brief, the instrument assigns recent immigrants from each country to metropolitan areas in proportion to where the US immigrants from that country lived in 1970. Summing across countries, one has an estimate of the impact immigration would have on the local work force mix if immigrants today were settling in the same markets as did their predecessors in 1970. This instrument is surprisingly strongly correlated with changes in work force mix much later than 1970, due to the fact that immigrant settlement patterns are fairly stable over time.

⁷ The SMT was stratified by industry and establishment size. Within these strata, a simple random sample was taken across all establishments in the SMT universe, regardless of location. Note that a simple random sample like this is the most efficient technique for producing nationally representative statistics except in the case where technology-use variation between different locations (e.g. states) is sufficiently large compared to technology-use variation within those locations. In that case, insuring proper regional representation can produce more accurate national

project will investigate how different the standard errors on national technology use statistics – those in the *Current Industrial Reports* on manufacturing technology – would have been if the sample had been regionally stratified. Recommendations for the design of future technology surveys, including the exact nature of any geographic stratification if it seems appropriate, will be made.

Criterion 9: Developing statistical weights for a survey authorized under Title 13, Chapter 5.

The match of SMT data to other data (described in the previous section) will also be used to create two sets of regionally representative sample weights: one set that is representative of establishments, and one set that is representative of *employment*. Both sets of weights correct first of all for any regional discrepancies in the representation of establishments in the SMT that occur by chance. (States or counties that have fewer SMT survey respondents than they should to be representative of the population will be assigned a larger weight, and states or counties where establishments are overrepresented will be assigned a smaller weight. See the proposal for details.) Employment weights will be generated by matching 1988 and 1993 SMT establishments to their exact employment levels in the 1987 and 1992 Censuses of Manufacturers, respectively, by establishment id; and also by matching each SMT by sample strata-region (state or county) cells to the County Business Patterns summary data for the same year. Adding these new weights to the SMT will allow future users of the SMT micro data to create tabulations of the data for an arbitrary US region (comprised of counties and/or states) that is representative of the establishments or workers in that region.

B. FTI Items

The following FTI items from the following files will be needed by the researcher to conduct this project:

Census of Manufacturers (CM) 1987 and 1992

EIN	Employer Identification Number
CFN	Census File Number (includes EIN)
LFO	Legal Form of Organization
IND	Industrial Classification
ST	State
COU	County
SW	Salaries and Wages (IRS Payroll)
TE	Total Employment
TVS	Shipments (IRS receipts)
TAE	Total Assets End of Year

statistics (most importantly when the sample is small). National samples that are not stratified by region produce, on average, unbiased national statistics, but those statistics include noise due to variation in the regional composition of the sample. Stratifying eliminates that source of noise.

Surveys of Manufacturing Technology (SMT) 1988, 1991, 1993

EIN Employer Identification Number
CFN Census File Number (includes EIN)
IND Industrial Classification
ST State
COU County

C. Project Completion

After this project has been completed, the researcher will produce a paper for publication in a professional journal, and has plans to present findings at professional meetings in the future upon acceptance. He will produce a technical memorandum summarizing the key findings pertinent to Census Bureau Chapter 5, Title 13 programs. In addition, the researcher will produce a Post Project Certification (PPC) summarizing whether and how the criteria described in the project proposal's Predominant Purpose Statement (PPS), as well as any others, were or were not met.