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**THE IMPORTANCE OF ESTABLISHMENT  
DATA IN ECONOMIC RESEARCH**

By

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## Abstract

The importance and usefulness of establishment microdata for economic research and policy analysis is outlined and contrasted with traditional products of statistical agencies -- aggregate cross-section tabulations. It is argued that statistical agencies must begin to seriously rethink the way they view establishment data products.

Keywords: Establishment, Microdata, Aggregation Bias, Data Access

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## I. INTRODUCTION

As part of their basic function, statistical agencies collect data from establishments and then aggregate them for publication into sectors such as industry, region, or economy. Researchers and policy analysts regularly employ these establishment aggregates to estimate economic models and conduct policy analysis. Most economists and statisticians are very familiar with such aggregate measures -- among them, industry shipments, GNP, retail sales, and inventory changes -- and their uses. The many uses for traditional establishment-based aggregate cross-section measures, such as those used in national income and product accounts, are well known. What is less well known is that this aggregate cross-section focus for data products is far too narrow and ignores important economic and policy needs for establishment data.

In this paper I direct attention to the importance of establishment microdata and its access by qualified researchers. **The relatively heavy use of aggregates by researchers and policy analysts is more a reflection of supply than demand.** Given a choice, most users prefer microdata. Where this is impossible, statistical agencies must broaden the scope of their product offerings and provide more information regarding the statistical properties of the aggregates they release.

Aggregation effectively changes the unit of analysis from the establishment -- an economic agent -- to the industry,

region, sector, or economy. This change, from the establishment (or firm) to an industry or other sectorial aggregation, is not innocuous. The conditions under which an individual economic agent's behavior can be adequately represented by the "average" agent's behavior are quite restrictive. If they are not met, then serious measurement error is introduced into estimates of many economic models.

Economists value establishment data not merely for the evaluation and correction of measurement errors in economic models estimated with aggregate data. A broad range of issues simply cannot be addressed without microdata on establishments and the firms that own them. For example, many policy questions revolve around the issue of who bears the costs of particular policy actions -- who wins and who loses. Such questions cannot be answered satisfactorily without individual microdata.

## II. THE ESTABLISHMENT AS THE UNIT OF ANALYSIS

Economic analysis is generally based on a model of individual behavior that specifies the objectives and constraints facing the economic agent. Agents are assumed to maximize an objective function subject to those constraints. The maximization problem can be specified either as a static or dynamic optimization. Solutions to such problems provide relationships for the endogenous variables, the variables the agent has choice over, as functions of the exogenous variables of

the model. Using estimates of the parameters of these models, analysts examine the effect of some change in the agent's environment on her behavior.

For many problems, the establishment is a sensible unit of analysis. For example, from the standpoint of the production decision, the choice of labor, energy, materials, and capital for use in output creation is often made at the plant level. While the firm is the ultimate decision-maker, and thus the preferred unit of analysis for most problems, establishments have very different behavioral patterns, even when owned by the same firm. Thus, establishment data are also necessary in order to understand the behavior of the firm. (The behavior of one establishment is not completely differentiated from another simply by the identity of its owner.) Establishment data are also necessary in order to estimate the marginal impact of some event -- for example, a purchase or divestiture of assets -- on the firm.

Focusing on the production relationship, one can see that the establishments are the primary purchasers of the factors of production: labor, materials and capital products produced by other establishments, services, and energy. Even though the primary resource allocation decisions are likely to be at the firm level, establishment data are also useful in analysis of technical change, both product and process, since technical progress is characterized by changes in the production

relationship. Similarly, the establishment must be the unit of analysis for many environmental issues. Environmental problems involve the production of two outputs, products (good output) and emissions (bad output), at the same establishment. Understanding the relationships between the "good" and the "bad" outputs is essential in developing environmental policies.

### III. AGGREGATION AND ESTABLISHMENT MICRODATA

Earlier I noted that most published data reported by the U.S. statistical system are aggregations. These aggregations reduce the myriad of individual detail to manageable proportions and provide confidentiality protection. Unfortunately, information is lost or distorted in this aggregation process. For some problems, this loss of detail may not matter: The phenomena under study may be sufficiently understood without reference to the underlying microdata. Without analysis of the microdata, however, it is virtually impossible to evaluate the extent of any aggregation error. Moreover, perfectly acceptable aggregate measures at one point in time may be misleading at another point in time because the economy is constantly changing. Aggregation must therefore be approached with substantial caution and must be continually re-evaluated using microdata. This is an important use of establishment data and, in the absence of universal access to the microdata, it cannot be accomplished without an internal program of analytic subject matter research

by the statistical agency. Even then, it is difficult to provide a general demonstration of the importance of aggregation errors in economic research, because the extent to which aggregation bias is present is model-specific. That is, the importance of the error **depends on the application or use of the data**. Thus, the analytical research program needs to be broadly based.

While it is clear that establishment microdata are preferred for many applications, the extent of the problems that arise when aggregates are substituted for microdata on establishments is less well recognized. In earlier work, McGuckin (1990), I argued that the homogeneity of establishment behavior that is assumed in empirical studies based on aggregate data is not evident in the detailed data. A legitimate response to the lack of homogeneity among establishments is that this fact is not sufficient to invalidate the use of aggregate data. Even if the behavior of the individual units to be aggregated is idiosyncratic, the use of aggregate variables introduces negligible bias in the estimated relationship under certain conditions. Unfortunately, as a long line of economic research has demonstrated, these conditions are quite restrictive. (See Solow, 1957 and Fisher, 1993). Thus, even if one is interested only in aggregate responses to alternative policies (such as the effect of changes in pollution regulation, defense reductions on employment in a sector, or tariff increases), aggregate industry responses will not be captured by a simple linear function of an average or

representative firm if the responses of individual firms to changes are very different. In such cases, industry responses will be a weighted average of individual responses, and the weights can change over time.

Recent empirical work at the U.S. Bureau of the Census' Center for Economic Studies (CES), by Baily, Hulten, and Campbell (1992), Davis and Haltiwanger (1990 and 1992), Doms (1993), Doms and Dunne (1992), Dunne (1991), Dunne and Roberts (1990 and 1992), Dunne, Roberts, and Samuelson (1989), Jarmin (1993), McGuckin, Nguyen, and Andrews (1991), Olley and Pakes (1992), Streitwieser (1991), and Troske (1992) extends the evidence on heterogenous plant and firm level responses I cited at that time. This body of work -- and there is much more from CES, as well as from other sources (e.g., Bresnahan and Raff, 1991, and Bertin, Bresnahan, and Raff, 1992) -- shows a striking degree of heterogeneity in the levels and movements of variables such as productivity, employment, growth, output, product structure, investment, and ownership change among establishments located in similar markets, industries, and cohorts.

Moreover, the heterogeneity is not simply a matter of differences in firms and plants continuously operating in an industry. Entry and exit decisions also generate aggregate industry responses that are not simple linear functions of the representative firm. Thus, any analysis of the aggregate effects of a policy or environmental change in a market in which there is

entry and exit must incorporate not only the distribution of the response of the market incumbents, but also an analysis of both the entry and exit that the policy or environmental change induces. For example, recent work at CES by Olley and Pakes (1992) demonstrates significant errors in aggregate estimates of productivity relationships in telecommunications, an industry with substantial entry and exit.

This last example illustrates more than the need to evaluate aggregation bias in traditional cross-section models. It also illustrates that longitudinal microdata are necessary to sort out the fundamental role of entry, exit, and changes (growth and decline) in continuing establishments. They are also necessary for many other economic issues, as is made clear in the next section.

#### IV. MANY PROBLEMS REQUIRE MICRODATA

The problem with exclusive use of aggregate statistics is not simply one of inferior estimates of economic relationships such as the earnings equation, elasticities of production functions, or inventory adjustment coefficients. With aggregate data alone, it is impossible to examine the differential effects of policies on the entities classified within the aggregate. Examining individual changes is necessary if particular components of an aggregate movement are significant. As an example, consider the problem of evaluating product choice and

energy usage decisions in reaction to a change in energy prices. This kind of problem arises in assessments of economic or environmental policies such as imposition of an energy tax. Energy taxes raise the cost of energy, and, in theory, lead establishments to economize on energy use. In the short run, the possibilities for substitution are likely to be restricted so that prices rise for products requiring relatively high energy inputs for production. This causes consumers to reduce their purchases of these products. Consumers will also shift away from products that require substantial energy for their operation (e.g., away from low gas mileage cars).

Ascertaining the precise effects of such policies must include estimates of various elasticities of substitution in both the short and long run. These estimates require information on the mix of products and inputs used by establishments, as well as information on how these factors change over time. Since long-run adjustments in products and processes that substitute for those using high amounts of energy also involve the allocation of research and development resources, decisions on these resources (probably made at the firm level) must also be explicitly treated in the modelling process.

To study this energy tax problem, research associates at CES are extending a dynamic model of firm behavior developed in recent work (Pakes, Berry, and Levinsohn, 1993) to evaluate how structural changes, such as price shocks or government gasoline

mileage requirements, affect the automobile market. The model incorporates both the demand and supply side of the market. It includes estimates of the demand for particular car models in terms of their characteristics. It also includes the supply side of the market through plant production relationships and firm specific technology differences as well as through allowances for entry and exit. The use of longitudinal establishment microdata, along with detailed data on product characteristics from public records to describe the demand side of the market, allows for estimation of the relationships between automobile production costs and automobile product characteristics -- the "cost characteristics surface." In the absence of establishment microdata, a model completely describing the effects of the policy change is not possible. For example, in this application, the responses of small high mileage car makers and low mileage car producers differ. Also, poor people who cannot afford to shift to new high mileage cars will bear a significant burden of the tax. They will continue to use their high mileage cars longer than high income drivers (income effect). Aside from equity issues, this will affect dynamic adjustments and delay increases in the miles per gallon of the average car on the road.

The importance of explicitly dealing with establishments as economic agents is also illustrated in the literature on labor markets. Until very recently, most labor market analyses were carried out using demographic data on individuals -- the supply

side of the labor market. One type of analysis consists of trying to explain earnings differentials among individuals by various characteristics such as education, sex, race, age, family status, and occupation. These studies offer much insight into the factors that explain differences in earnings and have been important in formulating social policies (e.g., support for education, a factor that is positively related to earnings). Despite a large literature on this subject, including analyses of available public use microdata sets on individuals, and despite enormous interest by economists, social planners, sociologists, and policymakers, among others, the earnings models explain less than 50 percent of the variance in earnings in most studies. One explanation for this is that it has been difficult to include the demand side of the market in earnings equations. For example, education stock and skill levels are not completely captured by variables such as years of formal education derived from the supply side data. On-the-job training, learning by doing, and general experience all contribute to earnings and are, at least partially, reflected in the characteristics of the plant in which the worker works. Several studies at CES have documented important differences in worker wages associated with individual establishment characteristics that are not captured well in models estimated with "representative" firm industry data. See Dunne and Roberts (1993) and Dunne and Schmitz (1991).

Research with longitudinal microdata has been at the center of an important recent development in macroeconomics: The idea that understanding aggregate fluctuations requires analysis of time-series fluctuations in the cross-sectional distribution of activity across establishments. This idea contrasts with the standard empirical approach (based on representative agent models) in macroeconomics, which uses aggregate data at the economy-wide or industry level of disaggregation. While pursuit of this new idea is in its infancy, it has already yielded many new insights. For example, the conventional view of recessions -- that jobs disappear temporarily while the creation of new jobs declines, and that most workers are recalled when aggregate demand recovers -- appears incorrect. In fact, job creation continues almost unabated during recessions, while job destructions increase. Furthermore, most jobs created are created permanently, and most jobs lost are lost permanently, at least for the manufacturing sector. See Davis and Haltiwanger (1990 and 1992).

This research also shows that variations in new job creations and destructions, which can be calculated only from longitudinal microdata on establishment employment, are primarily associated with movements among plants within the same industry. That is, both lost jobs and new jobs are observed simultaneously in the same industry as transfers from one plant to another. This means that, for example, the effects of regulatory changes

that may force firms to substitute away from labor and towards capital in production will depend on the **detailed characteristics of the distribution of plants within an industry** and cannot be captured by a representative or average industry response.

Aside from its policy relevance, this new line of macroeconomic research has fundamental implications for statistical data programs. For example, the research suggests that, at a minimum, construction of new measures of the distribution of economic activity within sectors -- such as (1) higher level moments (e.g., variance, skewness, and kurtosis) and (2) longitudinally based measures such as job creation and destruction statistics -- will be required for policy analysis. See Caballero (1992), and Haltiwanger (1993).

Another area of study in which establishment microdata are essential is in the evaluation of the effects of ownership change (mergers, divestitures, leveraged buyouts, etc.). Firms, particularly large ones, have multi-establishment structures, and many firms are diversified across a wide spectrum of industries and products. In order to assess the effects of mergers, the analyst must be able to separate out the components of the firm both at a point in time and across time. This allows for evaluation of the performance of the firm and its components pre- and post-merger. See Lichtenberg (1992), McGuckin, Nguyen, and Andrews (1991), and Long and Ravenscraft (1992a and 1992b).

The use of establishment data in understanding the nature of the firm is not restricted to analysis of the role of ownership change in performance. (One reason for emphasizing ownership change studies here is that they are essential in understanding the evolution of the sampling frame for most economic statistics. They are also extremely important for many policy issues.) Since the establishment is often the site for particular sets of products and processes, it provides the natural unit for understanding the nature and interrelationships of the activities of the firm. As a geographically fixed production unit, the establishment makes it possible to identify the role of "the firm" -- as distinct from such factors as geographical and product markets -- in the establishment's operating characteristics and behavior. In turn, this provides insight into the functions and boundaries of the firm.

For example, Streitwieser (1991) shows that the pattern of secondary products produced by establishments owned by the same firm is much more closely related than those produced by other establishments with the same primary products. As another example, Gollop and Monahan (1991) show that while the structure of production has become more specialized over time, the structure of the activities of the firm become more diversified. While the focus of these inquiries is the nature of the firm, the data required are from the establishment.

Finally, I note that with the exception of the job creation and destruction example, each of these examples involved linking of data from more than one source. In fact, a substantial number of economic problems require that data from a variety of sources be linked. For example, not all plants classified in particular SIC industries are unionized. Therefore, to assess the performance of union and non-union establishments the individual establishment data are required. **Linkages between data sets require work with the micro establishment data.**

#### V. CONCLUDING COMMENTS

Given the extensive use of cross-section aggregates in economic and policy analysis, it is no wonder that the 1993 International Conference on Establishment Surveys (Buffalo, New York, June 1993) would focus its efforts on improving estimates of these establishment-based aggregates. **While the quality of these aggregate estimates is of considerable importance, recent work at CES using establishment microdata shows that establishment behavior is often idiosyncratic with respect to aggregation categories (e.g., industry).** These findings are reinforced by new work with data from many other countries -- (e.g., Canada (Baldwin and Gorecki, 1989, just one of many examples); England (Millward, 1993); Germany (Wagner, 1992, Gerlach and Wagner, 1993, and Boeri and Cramer, 1991); France

(Abowd, Kramarz, and Margolis, 1993); Ireland (Keating and Keane, 1989); and Israel (Griliches and Regev, 1992).

This means that statistical agencies must begin to seriously rethink the way they view establishment data products. Two possibilities exist for increased microdata access. First, statistical agencies can expand opportunities for access to their establishment microdata. For a description of one such approach, a plan for regional research data centers, see McGuckin (1992). A second and complementary approach is to start to develop new data products that allow researchers to better describe the evolution of the distribution of establishments. This approach is suggested by Caballero (1992), and Haltiwanger (1993) and is now beginning to be explored seriously as part of the CES research program. For example, the possibilities of capturing the economic behavior of individual establishments using models of aggregated behavior, supplemented with higher-order moments of the distribution of certain variables, is a primary objective of several new CES projects. While this work is in its infancy, it has the potential to redefine the way statistical products are produced and substantially increase the usefulness of establishment-based aggregations.

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