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The U.S. Federal Trade Commission's Line of Business Program and Innovation Research*

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Abstract: This paper examines how the resources of the Line of Business (LB) Program of the U.S. Federal Trade Commission (FTC) leveraged academic research to develop understanding of science and technology policy and to point to new directions for both research and policy. The paper provides an overview and discussion of the birth and death of the FTC LB Program and its unique LB data, the innovation research using the LB data, and the legacy of the program.

Keywords: diversification; innovation; inter-industry technology flows; line of business; productivity; research and development (R&D)

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I. Introduction

This paper examines how the resources of the Line of Business (LB) Program of the U.S. Federal Trade Commission (FTC) leveraged academic research to develop understanding of science and technology policy and to point to new directions for both research and policy.[1] The FTC LB Program facilitated research in many areas, but this paper will focus on the area of science and technology policy issues.[2] The FTC LB data made possible many important contributions to our understanding of knowledge flows, innovation and technology, and productivity.

The FTC LB Program provided an unprecedented look into the diversified operations of the largest U.S. firms during the 1970s—a period when their diversification was exceptionally pronounced.[3] Data were initially gathered for 1973 with a test sample and test survey form, and then the sample of firms and the survey form for requesting information were put in place, and for the years 1974 through 1977, the LB Program gathered consistent, comparable information from a sample of large, diversified U. S. manufacturing firms—all among the largest 1000 U.S. manufacturing firms—about their operations in FTC industry categories.[4] The information included detailed breakdowns for each firm's operations across those categories, including, among many other things, information about sales and operating costs, advertising and other selling expenses and general and administrative expenses, assets, payrolls, materials, and R&D. Various breakdowns of these general categories and detailed information about them were

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[1] Scherer (1990) provides an informative and insightful history of the birth and death of the FTC's LB Program—a history that is much broader than the theme of this special section of *Science and Public Policy*.

[2] U.S. Federal Trade Commission (1985, Appendix I, pp. 346-361) provides a list of the FTC LB Program reports, research papers, and research in progress as of March 1985. Ravenscraft and Wagner (1991) provide an appendix with an augmented list of the publications and research papers using the FTC LB data at the time of their paper, and their Appendix provides the broader context of papers using the FTC LB data, as compared with the papers about the economics of innovation reviewed in the present paper. Cohen (2010) provides a review that places many of the innovation studies using the FTC LB data in the context of the larger empirical literature about the economics of innovation.

[3] Long, et al. (1982, pp. 27-44) carefully reviewed the available alternative sources of LB-related data and explain why they were at best weak substitutes for the types and quality of data gathered by the FTC LB Program.

[4] The categories, in part designed to maximize technological commonality, were the FTC's "4-digit" categories that were somewhat broader than the "4-digit" industry categories used by the old Standard Industrial Classification (SIC) industries and somewhat narrower than the SIC "3-digit" industries. A listing of the complete set of FTC industry categories used is available in U.S. Federal Trade Commission (1985, Appendix E, pp. 309-320). The concordance matching the FTC industry categories to the various SIC industries or parts of industries is also provided there.

provided. For example, there was information about gross and net plant, property, and equipment, about inventories, and about other assets. R&D was reported in categories for R&D billed to the Federal government, R&D billed to other outsiders, and the cost of company R&D.[5]

From the data gathered, the LB Program could assemble and researchers could use information about a line of business (i.e., the operations of a particular firm in a particular industry category), about a firm (i.e., the collection of a particular firm's activities across all of its activities), or about an industry (i.e., the collection of the line of business activities for the firms with operations in that industry). Table 1 shows the numbers of firms, the numbers of industry categories, and the numbers of lines of business over the years in the sample. As seen in Table 1, including their non-manufacturing industry categories, the average number of lines of business for a firm in the sample was about nine. Using just the manufacturing lines of business, the average number was about eight.[6]

Table 1. U. S. Federal Trade Commission Line of Business Sample: Number of Observations by Year and Level of Aggregation

	Year			
Level of Aggregation	1974	1975	1976	1977
Industry Categories:				
Manufacturing	259	260	259	259
Non-manufacturing	14	14	14	14
Firms	437	471	466	456
Lines of Business	3992	4198	4243	4337

Source: U.S. Federal Trade Commission (1985, p. 3)

The FTC published a description of the data gathered and industry aggregates for the various items in a series of annual line of business reports, one for each of the years 1974, 1975, 1976, and 1977. The process of assembling the data was slowed by controversy and litigation because many respondents did not want to provide the information. In 1984, the FTC decided

[5] U.S. Federal Trade Commission (1985, Appendix B, pp. 270-283) has the FTC Line of Business Form; it shows all of the items about which information was gathered. Federal Trade Commission (1981) also provides much useful information about the historical background, reporting methodology including discussion of the industry categories and firm segmentation procedures, accounting procedures, data items collected, firm sample selection, and much more including discussion of the procedures used to ensure the confidentiality of the data.

[6] Scott (1993, p. 12).

that after the Program completed the gathering and processing of the data for 1977, no additional LB data would be gathered (U.S. FTC, 1985, pp. 1-2).[7] The FTC LB data for the lines of business, firms, and industries as described in Table 1 were linked to other data for research purposes (U.S. FTC, 1985, p. 3):

> The Program's resources include other data files both public and nonpublic that can be linked with line of business data for research purposes. These files include, for example, data on mergers and acquisitions, industry concentration, firm market shares, company-level financial data from Standard and Poor's Compustat file, and Census input-output data.

Table 1 shows the essential structure of the FTC LB data set—a structure that made the data so unique. However, at the outset of our discussion, we need to be clear that economists have differed about the usefulness of the LB data. Among the substantive economic reasons for disagreement, there is concern about joint costs, and there is concern with the transfer pricing procedures used by firms.

Regarding joint costs, firms responding to the FTC LB Program reported various items—say R&D expenditures—in amounts traceable to the various industry categories and then also the non-traceable amounts. Non-traceable amounts could be allocated to industry categories in various ways—by sales, for example. But the information about what was traceable and not, and any method of allocating non-traceable amounts, was maintained, allowing, as Long (1981a) explains, analysts to examine the robustness of their conclusions to the use of only traceable data or to various methods of allocating the non-traceable data.[8]

Ravenscraft (1981) examined the transfer pricing issue in the context of his FTC LB study of profitability (Ravenscraft, 1983). For diversified firms, intracompany transfers could of course arbitrarily reallocate the profits among the company's various lines of business by choosing arbitrarily high or low transfer prices. Fortunately, the firms in the FTC LB sample "report both the amount of transfers and the pricing method used (i.e., market, cost plus markup,

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[7] Scherer (1990, pp. 481-483) provides important discussion of the FTC's decision to end the Program's collection of LB data.

[8] The allocation of costs or assets common to multiple activities is discussed in U.S. FTC (1985). For the LB sample of firms with more than one LB, the simple and weighted averages, for the ratio of non-traceable to the sum of traceable and non-traceable total selling, general and administrative expenses, were 14 percent or less. For total assets, the simple and weighted averages were less than 13 percent (U.S. FTC, 1985, pp. 62-63).

cost, or "other")" (Long, et al., 1982, p. 380). With the information about the amount of transfers and the transfer pricing method in hand, Ravencraft could analyze very carefully the sensitivity of results to alternative treatments for transfer pricing by reallocating sales and costs when transfers had been made at nonmarket prices. He carefully reports the amount of sensitivity he observes; the results are quite robust to the reallocations when control variables for the amounts of transfers and transfer pricing mechanisms are included in his model.[9]

Now, to many, having the LB information as provided by the FTC LB Program is better than not. Long, et al. (1982, pp. 44-69) provide an excellent, insightful discussion of the measurement problems with segmented data reporting, consider the criticisms of the LB data, and indeed explain clearly why having such data is better than not having it. They have much to say, and I shall not attempt to summarize it all, but instead make some simple observations. First, the industry categories (set in part to maximize commonality of technologies) are not all that narrow, being typically broader than the SIC 4-digit industry categories that themselves were quite broad. Second, the analyst's model could incorporate the distinction between traceable and the non-traceable information, treating the two types of data differently. If the issues about traceable and non-traceable data are well articulated in the model, there is either a systematic issue that can be controlled, or there is a randomness for which an accounting can be made with appropriate treatment in the econometrics.[10] Third, as Long (1981a) explained and illustrated, if the treatment cannot model the traceable and non-traceable information directly, when the analysis uses allocated non-traceable information, the robustness of any conclusions to alternative ways of

[9] Typically, transfers are a fairly small proportion of total sales and transfers (U.S. FTC, 1985, pp. 48-52). For example, for the manufacturing lines of business for which the data were reported in U.S. FTC (1985), the simple and weighted averages of transfers to other lines of business, as a percentage of total sales and transfers, are less than six percent (U.S. FTC, 1985, p. 50).

[10] For example of a systematic distinction, in their model of a firm's market value, Scott and Pascoe (1984) have earnings associated with industry categories and firm-level earnings in separate pieces of information that are discounted separately to form market value. With randomness, the random error may be an error in equation, for example, error for the model's dependent variable such as for R&D intensity in Scott (1984). Or, the random error may be error in the explanatory variables, for example, error for each of the various categories of earnings that are discounted to form a firm's market value in Scott and Pascoe (1984) who model the errors in variables for their analysis. Stephen Martin observes (personal correspondence, March 16, 2013): "My own approach [see Martin (1982, 1983)] was to model non-traceable costs as an overhead cost, which becomes a fixed cost from the point of view of any one line of business operated by the firm. All the familiar relationships of standard oligopoly models appear in the equilibrium conditions of such a model; nontraceable expenses enter into what we would now call the participation constraint, the amount of revenue below which the firm would lose money. But if expenses are genuinely not traceable to the operations of any LB, then it is an error to allocate them according to arbitrary accounting rules."

allocating the non-traceable information to industries can be examined.[11] Finally, as Ravenscraft (1981) explained and showed, the information about intra-company transfers and the method of transfer pricing that is included in the FTC LB data allow an analyst to develop controls for the effects such transfers can have in the context of a particular analysis.

The foregoing thoughts notwithstanding, in the end, there are those who will not be happy with LB data. As Scherer (1990, p. 477) observed, for the opponents of the FTC LB Program, the intrinsic difficulties of Line of Business reporting were said to be so great that the data received would have little or no economic meaning, and his (Scherer, 1990) discussion and the literature that he cites make clear that for the critics of the FTC LB Program, arguments for the usefulness of the data fell, proverbially, on deaf ears.[12] Scherer (1990) cites and discusses the prominent literature expressing the views of opponents of the FTC LB Program, and he does so in the context of the history of the FTC from its founding through the first couple of decades after the FTC's leadership during the early years of the Reagan administration decided to end the program.

II. FTC LB Research about the Economics of Technological Change

William F. Long arrived at the FTC after specializing in both industrial organization and econometrics in the Ph.D program of the University of California Berkeley and then teaching graduate industrial organization courses at Cornell University. At Berkeley, his teachers included Richard E. Caves, Joe S. Bain, and Dale Jorgenson. Long (personal correspondence, April 17, 2013) says, "I remember comments early on by Bain that the major deficit in doing IO work was the terrible state of the data we had to use. That stuck." Long led the FTC's LB program as Manager from 1974-1986 and also as Research Director from 1980-1986. As Manager, he designed the Program's large-scale financial data collection, publication, and overall research effort aimed at mitigating the problems of doing research with data that did not

[11] Long (1981a) finds that the results of studies of economic performance using LB data and substantial numbers of observations are essentially unaffected by the various methods of allocating or not the non-traceable information and emphasizes the larger point that such sensitivity studies can be done. See also Martin (1982, 1983) who provides evidence of the reliability of the cost allocations in the FTC LB data and also shows that conclusions reached using the FTC LB data are quite robust to the great variety of alternative measures—equally sensible a priori—that one can construct as measures of important concepts such as LB profitability or LB capital intensity.

[12] See Scherer (1979) and the associated discussion collected in the volume, for additional information about the history and rationale of the FTC LB Program.

have information about the underlying lines of business of large and diversified firms. He supervised the collection and auditing of the data, interpreted it, defended it when scores of large firms brought a civil suit hoping to stop the Program's data collection, published the reports about the data, and provided a cost-benefit evaluation of the Program. As Research Director, he developed the environment—including the acquisition of complementary data sets and provision of advice about the data and methods—that enabled the research papers using the FTC LB data.

Long (personal correspondence, April 17, 2013) describes the beginnings of the FTC LB Program as follows:

> I started at FTC in July 1971, having been recruited by [then Director of the Bureau of Economics] Mike [H. Michael] Mann. Late in 1973 he asked me to take over the development of a project under which the Commission would collect line of business data. The project had been started in 1969-70. Over the next several months, starting with the earlier work, I addressed all the issues that needed to be addressed: sample companies, definition and procedures for identifying lines of business, industry level (somewhere between 3 & 4-digit SIC), critical expense items (advertising, other marketing, and R&D), allocations of non-traceable expense & asset items, transfer prices. All this work was completed by late 1973, so everything could be vetted within the Commission, from both economic and legal perspectives. The Commission submitted the 1973 form and all supporting documentation to GAO in March 1974.
>
> GAO approved the 1973 Form in May 1974. Many companies objected, filing Motions to Quash the form with the Commission. It took several months for the Commission to assess all the objections . . ., so the 1973 LB Form was mailed to companies in September 1974 . . . .
>
> When Mike [F. M. Scherer] came as Director of the Bureau of Economics in July 1974, he became very involved in the LB Program. He was familiar with it already, having consulted for me on the Industry Category definitions in 1973; I had earlier asked for help on the industry level question from three economists: Richard Caves, Mike, and Len [Leonard W.] Weiss.
>
> Once Mike arrived in 1974, it didn't take long for him to ask me to take on the role of Manager of the LB Program. I thought long and hard about the request – it might shunt me aside from doing real economic analysis, one part of me said. What swayed me to accept was a comment I had heard from many IO researchers – 'well, the data are always not anywhere close to what we need, but we are stuck with them, since some government people decided what they would collect and publish, usually for uses not related to the study of Industrial Organization'.

> So I said yes, knowingly stepping into the role as a government person who would collect data that the FTC and the community of IO researchers needed, and the rest is history.

Paramount was creating good data to address what Bain viewed as the major impediment to doing good industrial organization research—research that would of course inform the FTC's mission of enforcing antitrust laws. A subset of the goal of having data for research was having the data needed to develop understanding of science and technology policy. F. M. Scherer participated in the discussions of the LB program at its incipiency, and subsequently as Director of the FTC's Bureau of Economics, he played an important role in developing the FTC's response to the intense litigation opposing the LB Program. He explains that from the outset there was an expectation that better understanding of the economics of technological change and related public policy would come from the ability to have detailed information about the largest firms broken down into their activities in various industries. Scherer (personal correspondence, January 2, 2013) observes:

> The program started through a policy planning initiative . . . . I was in Berlin at the time and was asked to comment. . . . I identified some of the key burning issues in industrial organization that could be illuminated by better data, and I saw [research about industrial organization] as a principal use of the data, as well as a guide to resource allocation decisions by business decision makers. . . . My personal thoughts were more in the area of technological innovation.

As the FTC LB Program's data became available for research, the productivity slowdown of the 1970s attracted the attention of researchers and policy makers. Scherer (personal correspondence, January 2, 2013) observes:

> It was recognized by some that something peculiar was happening in the American economy; productivity growth had slowed drastically. But why? [There were prominent arguments] that it was the oil shock. I suspected something more Schumpeterian. There had been a fair number of studies relating productivity growth to R&D, but in my view, they were misguided. From my discussions with Jacob Schmookler in the 1960s, I knew that the industry that originated an innovation was very frequently not the industry that used it and benefitted from it. That we also knew from work by Eric Gustafson and some surveys in *Business Week*. So how to trace the Schmooklerian technology flows? I saw that LB data linked to patent data would be ideal for this, and that was my

> first big research project after leaving the Commission. . . . I also took advantage of the data to test some Schumpeterian market structure tests . . . .

Indeed, very fundamental questions about the economics of R&D and technological change could be addressed with the FTC LB data. I shall in this paper focus on the use of the data for research about the economics of innovation and technology, focusing especially on the papers about inter-industry technology flows, about firm versus industry effects, about diversification of R&D, and about diversity of R&D within firms and across industries. I shall spend less time with the very important and extensive literature using FTC LB data to study more specifically the Schumpeterian issues of market structure, because those studies are part of a much larger literature, and they, and the larger literature they inform, are comprehensively reviewed by Cohen (2010).

Two of the broadest questions addressed with FTC LB data are the importance of firm versus industry effects in R&D intensity and the importance of inter-industry technology flows. The FTC LB data made it possible to address both of these fundamental issues in new ways. Thus, it is not by chance that in the landmark book, *R&D, Patents, and Productivity* (Griliches, 1984), Griliches discussed the use and findings of FTC LB data to address the issues.

Firm versus Industry Effects. Regarding firm versus industry effects, Griliches (1984, pp. 6-7) observed:

> Scott [1984] uses the newly collected FTC line of business level data to investigate several interesting hypotheses below the firm level. Given the fact that many of the major R&D performing firms in the United States are large, diversified, and conglomerate, it is interesting to ask: Is their R&D behavior primarily determined by the industrial location of their "lines of business" (division or establishment) or does a common "company" R&D policy exist? Without an affirmative answer to the last part of this question there would be grave doubts about the applicability of various R&D optimizing models which relate to such firmwide variables as the cost of capital or their managerial style. Luckily Scott does provide an affirmative answer. In his data (473 companies, 259 different four-digit level FTC lines of business, and a total N of 3387) he can observe the variation in the R&D to sales ratio (R/S) within firms across their various lines of business. He finds that approximately half of the overall variance in R/S can be accounted for by common company effects, common industry effects, and their interaction, in roughly equal parts. Thus, there appear to be significant differences in company R&D policy above and beyond what would have been predicted just from their differential location within the industrial spectrum.

The firm and industry effects discussed by Griliches are observable because of the unique structure of the FTC LB data. The observation of each firm's activities in each of the industries in which it operates allows the estimation, for the analysis of the dependent variable (in Griliches' discussion, the R&D intensity observed for a line of business), of the firm effects—i.e., the effects of firm-wide variables—in a general linear model. Those firm effects capture all of the firm effects that are linear in the parameters estimated, whatever are the actual firm-wide variables that are in the underlying true model. Similarly, for the general linear model, the industry effects—i.e., the effects of industry-wide variables—capture all of the industry effects that are linear in the parameters estimated for all of the industry-wide variables in the underlying true model.[13]

Inter-industry Technology Flows. Regarding inter-industry technology flows, Griliches (1984, p. 13) observed that the role for spillovers from the R&D efforts of other firms and industries:

> . . . motivates Scherer's [1984a] important contribution. His paper describes in detail a major and valuable data construction effort whose basic purpose was to reallocate R&D expenditures from an industrial "origin" classification (where they are done) to a classification of ultimate "use" (where they will have their major productivity-enhancing impact). This was accomplished by examining over 15,000 patents in detail and assigning them to both industrial origin and industrial use categories and categorizing them into product and process patent categories. The detailed R&D by line of business data collected by the FTC were then reallocated from industry of origin to industries of use in proportion to the "use" distribution of their patents, thereby generating a kind of technological flow table. The many conceptual and practical difficulties in such an enterprise are discussed by Scherer in some detail. The appendix to his paper presents the most detailed data on R&D by three- and four-digit Standard Industrial Classification (SIC), by origin, and by use ever made available. These data will prove invaluable in future studies of productivity growth and differential industry R&D activity. Scherer reports briefly on an analysis of productivity growth in which, once the quality of the output growth data is controlled for, the newly generated R&D by industry of use data prove superior to the industry of origin data in the explanation of interindustry productivity growth differences.

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[13] The firm or industry variables could be the squares or cubes or natural logarithms of a given variable, so the true model could be highly nonlinear in the variables, yet the structure of the FTC LB data allow capturing the firm and industry effects for all of the variables, whatever they may be, in the underlying true model—which for example could be a Taylor's series approximation of the function determining the dependent variable. For a more complete statement of this structure of the FTC LB data and an application, see Scott and Pascoe (1986).

The research described in Scherer's (1984a) 1981 conference paper led to many other prominent papers, including Scherer (1982a, 1982b, 1982c, 1983a) and Scherer (1984b, chapters 3, 15, and 16).

Diversification of R&D. Mansfield (1984, p. 463) observes that when measuring interindustry technology flows, a "very difficult problem arises because the transfer of technology from industry A to industry B may result in a higher rate of productivity increase in industry C or D." He emphasizes the difficulty in "an attempt to carry out more than a 'second-order flow correction' [and] . . . wonders whether there are not many cases where technology transferred from industry A to B has an impact on productivity in industries several stages downstream in the economy."[14] Link (1984, pp. 246-247) observes that a firm's R&D in one line of business will at times generate knowledge that is "adaptable to a second line of business"—the R&D will "spill over to other lines of business within the firm and thus augment the efficiency of that [R&D]."

Indeed, the detailed information provided by the FTC LB data about the industry locations of each firm's R&D activity—i.e., about the diversification of the firm's R&D—allows ways to identify the inter-industry flow of knowledge and technology and the resulting effects on productivity. In addition to Scherer's approach, Scott and Pascoe (1987) and Scott (1990, 1993, chapter 9) exploit the unique information in the FTC LB data to describe differences in R&D, including its productivity impacts, that result because of the diversification of R&D and associated spillovers of technological knowledge. The literature reviewed by Scott (1993, chapter 8) provides several reasons—improving appropriation of returns because of recognizing applications, lowering risk, achieving economies of scope, lowering the probability of preemption by rivals by increasing the speed of finding innovative solutions—that diversification of R&D may reflect the attempt by firms to escape the low expected profits from innovation with free-entry Nash equilibrium in R&D. Diversification of R&D is a strategy that a firm could use to gain an edge over rivals and increase its expected profits from R&D.

Thinking of R&D diversification in that way yields several hypotheses, all of which are confirmed using FTC LB data (Scott and Pascoe, 1987, and Scott, 1993, chapter 9). Given the theoretical motivation about why diversification should matter for R&D investment, if there are

[14] Scherer (2003) addresses this issue, among others, and concludes that with suitable adjustments to the diagonal elements to reflect the proportion of all R&D that is taken by internal process R&D, the combined first-order transactions and capital flows matrices give the best results.

complementarities in R&D investment across industry categories—opportunities for realizing economies of scope or reducing risk, for example—more than one firm would be expected to recognize those possibilities and exploit them, causing the set of firms recognizing the opportunities to meet in the group of complementary activities more than would occur by chance given random diversification. R&D investments—in a given industry category—of purposively diversified firms would be systematically different from the investments of randomly diversified or undiversified firms. Systematic differences in the R&D investments for diversified versus undiversified firms would be systematically related to the pursuit of profits. Spillovers of R&D across related industries would affect productivity. If the benefits of R&D spill across industry categories, we would expect to find a higher correlation between R&D intensity and the rate of growth in total factor productivity when the R&D investment and the productivity are observed for the sets of related industry categories—categories where the R&D investments of firms have been found to meet more than would be expected if the diversification had *not* been purposively pursuing complementarities for R&D across the industry categories. Examining the link from R&D to total factor productivity growth for the sets of technologically close industry categories, rather than for the industry categories themselves, Scott and Pascoe (1987) find that the estimated marginal product of R&D is somewhat more than two and a half times as large and the proportion of variance explained by the regression of total factor productivity growth on R&D intensity increases by almost four times.

Exploiting the FTC LB data's information about firms' diversification, Scott (1982) also found evidence consistent with economies of scale in R&D. As explained by Long, et al. (1982, pp. 396-397),

> . . . Scott discovered that multimarket contact is far above what could be expected by chance. However, this purposeful, as opposed to random, contact may not be motivated by the desire of firms to collude across several markets. Rather it may be efficiencies which attract firms of similar endowments into similar industries. . . . Scott discovered strong evidence for the existence of such common efficiency gains.

Diversity. Scott (1991 and 1993, chapter 11) uses FTC LB data and the work about the propensity to patent developed by Scherer (1983c), also using FTC LB data, to examine the hypothesis that rivals will pursue diverse strategies aimed at producing unique innovations unlikely to be considered mere substitutes for competing innovations. Each rival aims for an

innovation with a decisive advantage that would drive other innovations from the post-innovation market. Since joint-profit-maximizing R&D is so unlikely, rather than slug it out for the prospect of low profits as firms compete in the post-innovation market with substitutable innovations, each firm may decide to pursue something very different. A monopolist would not have an incentive to incur the costs of ensuring diverse outcomes for research trials in order to increase the likelihood of just one dominant product, since regardless of the number of research trials producing successful, substitutable innovations, the monopolist gains the same expected benefit. Although the specter of Schumpeter's creative destruction always lurks, at least the monopolist does not have to worry about the substitutes, created by the competitors already in the innovation market—present and obvious, competing in the post-innovation market and eroding profits.

The evidence developed with the FTC LB data shows that more competitive market structures are associated with more significant differences among firms, as measured by firm effects in R&D intensity. The paradoxical fact is that different firms in the same industries pursue different R&D strategies. There are two possible explanations; in the first explanation, firms are fundamentally different in their capabilities, while in the second, the competitive R&D environment would lead to asymmetric strategies even if all firms were identical. Using Scherer's (1983c) data for the fraction of an LB's patents pertaining to systems or subsystems, the absence of any identifiable variables that explain the variance in the systems orientation of LB patent portfolios supports the second explanation, because without such variables it appears that different strategies are chosen by firms otherwise identical, not differing in any LB, firm, or industry variables other than those like the systems orientation of their patents that reflect the deliberate choice of a different strategy in order to avoid profit-destroying competition.

Schumpeterian Market Structure Tests. The FTC LB data were used in several studies examining and advancing understanding of the Schumpeterian hypotheses about market structure. Advances could be made using the FTC LB data because firm size and LB size and diversification of innovative activities and of production could be distinguished. The studies include Scherer's (1984b, chapter 11; 1984c; Scherer and Ross,1990, chapter 17, pp. 657-660) study of relationships between firm size and diversification and firm inventive inputs and outputs, and Scherer's (1983b, 1984b, chapter 13) examination of the nexus among seller concentration, R&D, and productivity change. Also using the FTC LB data to study the

Schumpeterian market structure hypotheses are Long (1981b), Scott (1984, 1993, chapters 7 and 10), Levin et al. (1985), Lunn and Martin (1986), Cohen et al. (1987), and Cohen and Klepper (1992, 1996a, 1996b), and Sutton (1998). The importance of "absorptive capacity" was explained in prominent papers by Cohen and Levinthal (1989, 1990). Cohen (2010) provides a very comprehensive review of the studies of the Schumpeterian hypotheses that use FTC LB data and places the studies in the context of the very large literature on the topic.[15]

Related to the Schumpeterian hypotheses about market structure is the issue of how mergers and acquisitions affect the R&D investments of the firms growing because of the acquisitions. Ravenscraft and Scherer (1987) use the FTC LB data to examine "how merger history and intensity affected R&D" and find there is "no support for the hypothesis that R&D was *stimulated* by the parent-subsidiary relationships following merger. If acquired lines achieved more rapid growth, it did not happen because of extraordinary technological effort" (Ravenscraft and Scherer, 1987, pp. 120-121, italics in original).

III. The Legacy of the FTC LB Program

This paper focuses on the contributions of the FTC LB Program to the understanding of the economics of R&D and innovation and science and technology policy. Section II, with the recollections of F. M. Scherer, pointed up that the topic issue for this paper played a role in the birth of the program. Ironically, that very issue of innovation policy was at the crux of the FTC's decision to cease the gathering of the LB data with the year 1977. Scherer (personal correspondence, January 2, 2013) observes:

> Early in the Jim Miller administration at FTC, a review was made whether to continue with the LB program. Actually, the decision was pretty much pre-ordained. In any event, the Bureau of Economics submitted a so-called benefit-cost analysis of the program. Contrary to our assertion that better data would lead to better resource allocation decisions in industry, the B/C analysis argued that by highlighting industries of superior profitability as a result of innovation, the data would encourage imitation and, by eroding innovators' rents, discourage

[15] Wesley Cohen observes (personal correspondence, March 17, 2013): "I actually believe that without the FTC's LB data, many of my own contributions would not have been possible. It would not have been possible, for example, to really sort out the relationship between firm (or business unit) size and R&D, nor the implications for policy, etc. Nor would my work on absorptive capacity and spillovers have been possible. Nor my work with Steve [Klepper] on R&D intensity distributions. I always say these were the best R&D data ever."

> innovation! No consideration was given to time lags, first mover advantages, or any of that.
>
> Much earlier, when I was Bureau of Economics head, we got a wave of protests about how much the program would cost. I had grave doubts, since the VP for accounting of one of the noisiest complainers . . . [told me] (privately, of course) that the report could easily be filled out by a bright new MBA in less than a week. This led the commission to request a wave of formal affidavits, duly sworn, about the costs. They showed the costs of reporting to be modest indeed.

In addition to marshaling the idea that the LB Program's data would erode profits necessary for innovation and would thereby impose large costs on the economy, the FTC leadership supported its decision to end the collection of LB data by undermining the benefits side of the equation. As Scherer (1990, pp. 482-483) observed[16]:

> A Line of Business staff analysis estimating Jenks-like benefits from better-informed entry decisions was turned on its head by the Bureau of Economics leadership. They argued that by encouraging entry into high-profit situations, better information was likely to discourage potential innovators from taking risks, thereby reducing economic growth and imposing costs on the private sector . . . . In dismissing the claims that Line of Business data permitted valuable basic research, the Bureau leadership relied largely upon a singularly negative survey from a consultant hired by three law firms leading the opposition to the Line of Business program.

The FTC's decision to end the collection of LB data came despite the well-reasoned recommendation of the LB Program's manager to resume collection of the data with some adjustments to reduce compliance burdens (Long, 1983). The FTC voted to end the data gathering, emphasizing concern that innovation would be stymied, even though there was, as Scherer observes above, no consideration of first-mover advantages or time lags. The LB Program staff itself had examined the issue carefully and found (Long, et al., 1982, p. 26),

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[16] Scherer (1990, pp. 462-463, 474, 482) discusses Jeremiah Jenks's views that secrecy fostered the worst abuses of the trusts and that good information is important for efficient allocation of resources. Scherer (1990, p. 483, footnote 101) provides the reference for the prominently published negative survey (and for the response to it) discussed in the quotation. The conflict of interest discussed was not acknowledged in the survey. Interestingly, the American Economic Association's recently announced disclosure rules, for revealing potential conflicts of interest in articles, can arguably be traced to the circumstances of the publication of the survey.

> We are not convinced . . . that theoretically possible negative dynamic efficiency effects are significantly large enough in fact to outweigh any static efficiency gains from profit disclosure. There are serious conceptual difficulties for the position, and empirical support for it is lacking. The evidence from the economics literature is buttressed by the failure of even one company to include such an effect as a potential cost of the program in comments filed in 1982.

However, over three decades later, the FTC's decision to stop gathering the LB data has in a very real sense been overturned. In 2008, the U.S. National Science Foundation (NSF) introduced the new Business R&D and Innovation Survey (BRDIS), the successor to the Survey of Industrial Research and Development. The BRDIS uses a nationally representative sample of about 40,000 firms, in both manufacturing and nonmanufacturing industries. Response to the survey is mandatory and confidential.[17] As described by NSF (italics added):[18]

> Unlike its predecessor, which was sent to a single respondent within a company, the new BRDIS questionnaire was structured to allow and encourage different experts within a single business to provide responses in their areas of expertise. *Respondents are asked to allocate their domestic and worldwide sales and R&D totals among multiple business codes.* Core R&D expenditure questions are intended to provide a bridge between the historical time series and BRDIS, and a variety of new questions address data needs identified by users and by businesses themselves. These questions relate to the following:
>
> • A company's domestic and worldwide R&D relationships, including R&D agreements, R&D "outsourcing," and R&D paid for by others
>
> • The strategic purpose of a company's worldwide R&D activities and their technology applications
>
> • Patenting, licensing, and technology transfer activities, and companies' innovative activities
>
> In addition, a limited number of questions are asked on activities related to new or improved products or processes. These are intended to serve as a platform for collecting an expanded set of innovation metrics in the future.

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[17] F. M. Scherer (personal correspondence, March 4, 2013) emphasized that the companies complaining about the FTC LB Program were very concerned about confidentiality, fearing that the data would be used in litigation.
[18] Accessed on February 28, 2013 at http://www.nsf.gov/statistics/srvyindustry/

> The results of the survey are used to assess trends in R&D performance and funding of R&D. Government agencies, corporations, and research organizations use the data to investigate productivity determinants, formulate tax policy, and compare individual company performance with industry averages. Individual researchers in industry and academia use the data to investigate a variety of topics and in preparing professional papers, dissertations, and books. Total R&D expenditure statistics are used by the Bureau of Economic Analysis for inclusion in their System of National Accounts and Foreign Direct Investment programs.
>
> Further, BRDIS statistics make it possible to evaluate more fully the status of R&D in the United States and to offer comparisons between the R&D and innovation activities of our country and those of other nations. The usefulness of the information collected in this survey is enhanced by the linkage of the data file to the Census Bureau's Longitudinal Establishment Data file, which contains information on the outputs and inputs of companies' manufacturing plants.

The reporting form for the BRDIS shows (U.S. Department of Commerce, 2012, pp. 42-43) that the multiple business codes for the segmented reporting of R&D activities include 116 manufacturing and nonmanufacturing categories dispersed over aerospace and defense, automobiles and motorcycles and components, capital equipment, chemicals and materials, consumer goods, energy and mining, finance and insurance and real estate, healthcare, information technology—goods and services, professional, scientific, and technical services, telecommunications and utilities, and other services.

Reflecting on the course of events—that created the solution for the loss of LB data when the FTC LB Program was ended, and also created the Program's legacy of excellent line of business data—Scherer (personal correspondence, January 2, 2013) provides both pertinent history and a fitting conclusion for this paper:

> First, a small NSF committee of which I was a member in the early 1980s proposed establishing a social research unit in Census under which appropriately cleared and monitored academics could get access to Census data. . . . The effort has been enormously successful. . . . [W]e have a branch office at the NBER in Cambridge. . . . That still didn't solve, however, the problem that R&D data were collected by Census at the whole firm level, whereas for diversified corporations, one needs R&D data disaggregated to the line of business level. During the late 1990s, the combined academic advisory committees to the Census Bureau (economics, statistics, and demographics) had a meeting with the NSF people who sponsored the R&D survey. I believe it was the year I was co-chair of the committee. We strongly urged that the Census folks try to obtain R&D data at the line of business level.

With the introduction in 2008 of the NSF's new BRDIS and the ability to combine the NSF's new segmented R&D data with the information about the outputs and inputs of companies' manufacturing plants in the Census Bureau's Longitudinal Establishment Data file, we now have again—and this is an important legacy of the FTC LB Program—the type of information necessary for sound research and policy. Scherer (1990, p. 486) explains limitations of the Census data vis-à-vis the FTC LB data. However, he does offer a perspective that supports the view that the NSFs new segmented R&D data in combination with the Census data and other sources of data may ultimately, with further development, provide a good solution for the need for data to inform public policy. He concludes (1990, p. 487)[19]:

> It is questionable whether Congress should try to rebuild that FTC function, since the agency's performance has been erratic, biased by the mixing of analysis with enforcement, and peculiarly vulnerable to delay tactics by fearful business firm targets. Also, the government's need for sunlight activities sweeps much more widely than the fields of antitrust and consumer protection. The best course of action would be to start with a clean slate, creating a new independent agency like the old Bureau of Corporations, free of law enforcement responsibilities and charged with spreading sunlight for the benefit of all government branches, not just one, and for the broader public interest.

The FTC LB Program made important contributions to innovation and technology policy and, not unrelatedly, to the academic literature about the economics of innovation and technology.

• First, the Program contributed to policy the understanding—now vindicated with what in effect is an overturning of the ill-conceived decision to abandon gathering line of business data—that line of business data gathered by government are needed for proper understanding of the workings of the economy to inform public policy. As Scherer (1990, p. 487) observed:

[19] In the quoted material, Scherer refers to the Bureau of Corporations which, Scherer (1990, pp. 462-467) explains, was the predecessor of the FTC, and when formed in 1914, the FTC inherited both the office space and the personnel of the Bureau of Corporations.

> Having a systematic, current, analytic, and critical body of knowledge on the structure, conduct, and performance of U.S. industries is, I believe, important to the effective functioning of government. For better or worse, the Federal government intervenes importantly in the operation of individual industries hundreds of times each year-in safety, environmental, and economic regulatory matters, in decisions to grant or withhold protection from import competition, in special tax questions, in procurement functions, in fostering technological innovation, and even in antitrust.

• Second, one can make the argument that (ironically given the respondents' concerns that the data would be used against them in antitrust litigation) the research that the FTC LB data made possible had a direct policy impact during the years of the Reagan administration, playing a role in the relaxation of antitrust policy that began with the revisions, during that administration, of the merger guidelines used by both the Department of Justice and the Federal Trade Commission. The Chicago school of economics challenged the view that the coordination of prices by concentrated sellers caused the high prices in markets where a few sellers dominated the market. Instead, the Chicago school view was that innovative firms with better products and lower costs grew to dominate markets, and the very seller concentration of concern to policy (toward mergers and also research joint ventures) reflected dynamic efficiencies.[20] Somewhat before the publication of the Reagan administration's revised merger guidelines that relaxed the antitrust standards for mergers, and a few years before the National Cooperative Research Act of 1984 (NCRA) lessened antitrust liabilities for cooperative R&D ventures among firms, *Business Week* (1981, pp. 151-152) observed:

> Economist Scott says a company's larger market share may simply be the result of greater efficiency. . . . New FTC data give a more detailed view of how industries work. . . . Before working with the data at the FTC, Dartmouth's Scott believed that there was little empirical evidence to support the "Chicago school's" efficiency theory. But after a year of doing research with the FTC figures, he

[20] For discussion of the Reagan administration's relaxation of antitrust policy toward mergers and toward research joint ventures, see Scott (1989; 1993, Chapter 13, pp. 187-202).

thinks that the Chicago theory “deserves at least as much attention as the traditional view.”

• Third, the innovation research using the Program’s data provided advances in the understanding of many things, including inter-industry flows of technology and their productivity impacts, firm versus industry effects in innovative activity, diversification of innovative activity within firms, diversity of research within industries, Schumpeterian issues about innovation and market structure (including examination of the impacts on innovative activity of the size distribution of the lines of business within an industry, the overall sizes of firms, the concentration of resources within industries, and the impacts of mergers and acquisitions), and the importance for innovation of firms’ absorptive capacity.

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