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ON THE ACCURACY OF PRODUCER PRICE INDEXES FOR PHARMACEUTICAL PREPARATIONS: AN AUDIT BASED ON DETAILED FIRM-SPECIFIC DATA

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ABSTRACT

This paper reports preliminary results of a detailed audit of one component of the Producer Price Index (PPI), using data from a large multiproduct company. We compare price indexes constructed in a variety of ways from the universe of products of a large pharmaceutical manufacturer in the US, with price indexes constructed from the particular products of this firm sampled by the BLS, using BLS and alternative index number procedures. A principal finding is that price indexes based on the BLS sample of this firm grow similarly to the published PPI's for SIC 28341, but in contrast, price indexes computed using the universe of products manufactured by the firm grow much more slowly. Although some variations emerge depending on how one undertakes the calculations, our typical finding is that, employing monthly data from January 1984 through December 1989, the BLS sample price index rises at nearly the same rate as the PPI, but at roughly twice the rate of indexes based on the universe of products shipped by this pharmaceutical firm. We also report results of a preliminary attempt to uncover the source of this disparity, we provide some evidence on the "new goods" problem, and we implement a procedure to mitigate the problem of "drift" associated with the Tornqvist approximation to the Divisia chained index.

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"The probability selection now used ensures that the PPI will not be biased in its sample of commodities; in the past, there was a tendency to choose mainly volume-selling items made by large firms....Of course, the voluntary nature of the PPI program places the entire burden of index accuracy on the companies that participate in the survey."

U. S. Department of Labor [1989], p. 3.

I. INTRODUCTION

Producer price indexes (PPI's) are used extensively by analysts in the private sector, in government, and by academic researchers. For example, their use in decomposing the value of sales into price and quantity components provides the basis for analyses of price-cost markups, rates of inflation, investment, real output growth, and productivity changes. Given the essential identity between value and a price index times a quantity index, any errors in the PPI have important implications for the accuracy of measured rates of inflation, real output changes, real investment, and growth in productivity.

The procedures by which the data underlying the producer price indexes are gathered and assimilated are complex, and numerous opportunities for systematic errors exist. Among the more often cited potential problems are differences between list and transactions prices, the use of fixed weight rather than chained indexes, the effects of quality change, and the speed with which new goods are introduced into the PPI calculations, particularly in industries characterized by rapid technological change. In addition, the participation of firms in providing information to the U.S. Bureau of Labor Statistics (BLS) for the PPI is entirely voluntary, and this raises issues of sample selectivity.

Not much is known on how accurately in practice the PPI portrays representative transactions of firms in an industry. One reason for this lack of knowledge is that to perform research on such an issue, analysts would require specific price and quantity data on the universe of products for that firm over time, as well as on the particular products sampled from it by the BLS. Preferably, such data would be available for all firms in the industry. However, the confidential nature of firm-specific price and quantity data by product over time creates an important barrier to undertaking such research.

In this paper we report preliminary results of a detailed audit of one component of the PPI, using data from a large multiproduct company. In particular, we compare price indexes constructed in a variety of ways from the universe of products of a large pharmaceutical manufacturer in the US, with price indexes constructed from the particular products of this firm sampled by the BLS, using BLS and alternative index number procedures. Our principal finding to date is that a substantial disparity exists between price indexes based on the BLS sample of this firm, and price indexes computed using the universe of products manufactured by the firm. Although some variations emerge depending on precisely how one undertakes the calculations, a typical finding we obtain is that over a six-year period, based on monthly data from January 1984 through December 1989, the BLS sample price index rises at roughly twice the rate of indexes based on the universe of products manufactured and shipped by this pharmaceutical firm. We also report results of a preliminary attempt to uncover the source of this disparity.

We start our paper in Section II with an overview of the PPI, outlining sampling procedures for establishments and particular products, and also considering weighting and index number issues. In Section III we provide a limited summary of the anonymous pharmaceutical manufacturer, which is sketchy

to ensure confidentiality. The results of our empirical analysis are presented in Section IV, and additional discussion of potential sources of disparities is given in Section V. Finally, in Section VI we summarize our findings and describe our agenda for further research.

II. THE BLS PRODUCER PRICE INDEX FOR SIC 2834

The PPI is one of the oldest continuous statistical data systems published by the BLS, although until 1978 it was known as the Wholesale Price Index (WPI). The WPI originated from an 1891 U.S. Senate resolution authorizing the Senate Committee on Finance to investigate the effects of the tariff laws "upon the imports and exports, the growth, development, and prices of agricultural and manufactured articles at home and abroad."[1]

The first WPI, published for the base period 1890-1899, was an unweighted average of price relatives for about 250 commodities. Since that time, many changes have been made, including alterations in the sample of commodities, the base period, and the method of calculating the index. According to the U.S. Department of Labor [1988, p. 125], the 1978 name change from WPI to PPI "...was intended to reemphasize that the industrial price program continues to be based on prices received by producers from whoever makes the first purchase, rather than on prices paid to wholesalers by retailers or others further removed in the distribution chain." Currently the PPI program at BLS encompasses the construction of aggregate price indexes for almost 500 mining and manufacturing industries, including approximately 8,000 indexes for specific product categories.

The BLS computes and publishes an overall price index for pharmaceutical preparations (Standard Industrial Classification [SIC] code 2834), for prescription pharmaceuticals (SIC 28341), and for roughly 50 sub-groups from

the seven to nine-digit SIC level. In Table 1 we provide a complete list of product classes reported by the BLS in SIC 2834 from 1984 to 1989.[2]

Table 1

Industries in SIC 2834 for which the BLS Publishes Monthly Price Indexes 1984-89

Industry	SIC Code	Industry (continued)	SIC Code
Pharmaceutical Preparations	2834	CNS stimulants	2834 123
Pharmaceutical preparations, prescriptions	2834 1	Contraceptives	2834 124
Analgesics	2834 102	Cough & cold preparations	2834 125
Narcotics analgesics	2834 1021	Nasal decongestants	2834 12512
Codeine and Combinations	2834 10211	Dermatological preparations	2834 126
Non-narcotic analgesics	2834 1022	Acne preparations	2834 12611
Aspirin, APC & related	2834 10229	Fungicides	2834 12619
Antiarthritics	2834 105	Topic antiinfectives	2834 12631
Anticoagulants	2834 106	Antipruritics	2834 12641
Anticonvulsants	2834 107	Diabetes therapy	2834 127
Systemic antihistamines	2834 109	Diuretics	2834 128
Systemic antiinfectives	2834 111	Hormones	2834 135
Broad and medium spectrum antibiotics	2834 1111	Hospital solutions	2834 136
Cephalosoporins	2834 11111	I.V. solutions 50 ml and under	2834 13604
Broad spectrum penicillins	2834 11112	Muscle relaxants	2834 139
Erythromycins	2834 11113	Nutrients and supplements	2834 141
Tetracyclines	2834 11114	Opthalmic and otic preparations	2834 142
Other broad and medium spectrum antibiotics	2834 11119	Psychotherapeutics	2834 144
Systemic penicillins	2834 11129	Tranquilizers	2834 1441
Urinary antibacterials	2834 11139	Major tranquilizers	2834 14411
Antispasmodic/antisecretory	2834 116	Minor tranquilizers	2834 14412
Bronchial therapy	2834 118	Antidepressants	2834 1442
Cancer therapy products	2834 119	Sedatives	2834 145
Cardiovascular therapy	2834 121	Vitamins	2834 148
Antihypertensive drugs	2834 12119	Multivitamins	2834 14819
Vasodilators	2834 12129	Miscellaneous prescription pharmaceutical preparations	2834 198
Other cardiovasculars	2834 12191		

The PPI for the various pharamaceutial products are based on prices for a fixed basket of products, drawn from monthly voluntary reporting to the BLS by selected manufacturing establishments. Several points are worth making here.

First, the fixed basket of products is chosen through a sampling procedure implemented at irregular intervals across industries, whose frequency depends, in part, on the perceived stability of the industry. Detailed surveys of pharmaceutical firms were conducted in 1980 and in 1987, and the fixed baskets were changed in 1981 and in January 1988; the BLS refers to the 1980 survey as "Cycle I", and that from 1987 as "Cycle II".

Second, in principle, the sample is drawn from the universe of all products from domestic establishments whose main production is in SIC 2834. A BLS field representative visits selected establishments during the detailed survey year, and uses a procedure called "disaggregation" to settle on which detailed products are to be sampled. Once this initial visit is completed, subsequent "repricing" for the selected commodities occurs on a monthly basis, typically by the respondent company filling out and returning forms sent to it by mail by the BLS; these forms are pre-printed with the detailed description of the chosen products, the reported prices over the previous three or four months, and a request for a price quote from the Tuesday of the week containing the 13th of the month. A sample blank copy of such a form, called Form 473P, is reproduced from U. S. Department of Labor [1988, pp. 136-137] in Appendix I.

Third, all PPI's are routinely subject to monthly revision every month for four months after original publication (usually on the second or third Friday of the month following the reference month), to reflect late reports and corrections by company respondents. After four months, indexes are considered final.

Fourth, once monthly data are in hand, the BLS calculates the PPI according to a modified Laspeyres formula in which the value of base period quantities at current period prices is divided by the value of base period quantities at (perhaps temporally different) base period prices, i.e.,

$$I_t = [\sum Q_a P_t / \sum Q_a P_0] \cdot 100 = [(\sum Q_a P_0 (P_t/P_0)) / \sum Q_a P_0] \cdot 100, \qquad (1)$$

where Q_a represents the quantity shipped during the weight-base period, P_t is the current price of the commodity, P_0 is the price of the commodity in the comparison period, the summation is over i goods, but i subscripts are omitted.[3] Note that this index is a weighted average of price relatives P_t/P_0.

Fifth, during the disaggregation process, products are defined in very specific detail. As the U. S. Department of Labor [1986a, 1989] manuals emphasize, any price-determining characteristic distinguishes one product from another. The U. S. Department of Labor [1988, p. 126] summarizes price-determining characteristics as follows:

> "If a company charges more for a red widget than a white one, color is one of the price-determining variables; if all widgets sell for the same price regardless of color, color is not a price-determining variable."

In the pharmaceutical context, if prices of bottles differ, a bottle of 100 pills each having 50 grams of a drug is not the same as a bottle of 50 pills of 100 grams, even though both bottles contain 5,000 grams of the same drug. Moreover, transaction-specific factors such as volume discounts or freight costs (if absorbed by the manufacturer) affect price, so these factors are included in the definition of the product.

Sixth, precisely how the BLS determines the total number of price quotations assigned to each establishment is not completely clear, but apparently this decision involves substantial judgment. According to the U. S. Department of Labor [1986b, pp. 42-46], the number of quotes taken from an establishment depends on industry concentration, price variations within and across establishments, establishment size, and the number of products produced

at each establishment. Moreover, discussions with BLS personnel suggest that for any sampled establishment in any industry, there is a minimum of two quotes and a maximum of sixteen.[4]

Finally, although the BLS manuals emphasize that transactions rather than list prices are desired, and Form 473P states clearly that "net transactions prices are the most desirable type of price," the BLS also accepts net list prices (with additional pricing terms listed separately, such as discounts for prompt payment), or other estimates of prices. Despite the BLS emphasis on transactions prices, our discussions with personnel at various pharmaceutical firms suggest that firms typically interpret this request as being one for net list rather than net transactions prices.

For our purposes it is important to note that once detailed products have been chosen by the disaggregation process, the BLS obtains a time-series of prices for highly defined products which stay constant over fairly long intervals -- indeed, the six years between re-sampling suggests that the list of commodities is dominated by mature, rather than innovative products.

To understand the sampling process better, we now follow the BLS procedure and discuss its two distinct stages, in which the overall aim is to make the probability of selection proportional to a product's value of shipments (VOS). The first stage consists of choosing a random sample of establishments, drawn from Unemployment Insurance files. In the second stage, specific products of that establishment are chosen with probability proportional to VOS, although in practice some products for SIC 2834 are certainty selected to ensure coverage of important items.[5] We now summarize these two stages.

The sampling frame for establishments is drawn from the Unemployment Insurance data files (as updated and refined by BLS personnel), and in almost all cases reported employment determines the probability of inclusion.[6]

Although use of VOS to choose the establishment sampling frame would be preferable, the BLS justifies using employment as a proxy for VOS in the first stage since employment figures are more widely available for establishments than are data on VOS;[7] moreover, BLS asserts that UI "...is used as a proxy in sampling since the number of employees tends to be correlated with the revenue of a Profit Maximizing Center within a particular SIC."[8] If prices for several establishments are set at one location (called a Profit Maximizing Center), then the establishments (referred to as a cluster) are considered to be one establishment, and the reported employment figures are appropriately summed.

It is worth noting that for two establishments with the same VOS, this first-stage procedure assigns higher probability of selection to the establishment with higher labor intensity, i.e. lower average labor productivity. What this implies for the pharamaceutical industry is not clear, although there is anecdotal evidence supporting the notion that generic drug manufacturers are likely to be less labor intensive than are manufacturers with large R&D facilities producing patent-protected products; if this were true, generic drug manufacturers would be undersampled in this first stage. On the other hand, some of the small genetic engineering companies that produce innovative products may be relatively labor (research personnel) intensive, and depending on how frequently the sampling frame is changed, use of the UI frame could result in oversampling for such firms.

Once an establishment has been selected, in the second stage a BLS field representative visits it and conducts an interview designed to select the items to be priced and to collect base prices and value weights. The probability with which a product is selected, given choice of the establishment and the number of quotes assigned to it, is proportional to its VOS over the twelve months prior to the interview. In this disaggregation process, in principle, VOS-based

sampling probabilities are employed, but detailed information on price-determining characteristics is required for only a small subset of products. This economy of required detail reduces the reporting burden on cooperating companies, and results in an initiation interview that is "usually completed within 2 hours."[9]

Within the disaggregation process, several additional steps occur. First, all products are categorized into broad product classes. A running total of the percent of VOS for each category is formed, and the number of price quotes to be taken from within each category is determined by randomly choosing a first percentile level and equally spacing the remaining quotes to be chosen.

For example, suppose there are three product categories and that five quotes are to be chosen for the establishment as a whole. Let the first category account for 50% of the VOS, the second for 30%, and the third for 20%; hence the running total is 50%, 80% and 100%. Since five quotes are to be chosen, a random percentile level from 1 to 20 is selected (note that 100%/5 = 20%). Suppose this random percentile level is 15.[10] Then the additional four quotes are equally spaced at intervals of 20; in this case, at 35, 55, 75 and 95. Because the 15th and 35th percentiles both fall within the first segment of the running total (0% - 50%), two quotes will be chosen from the first category. Similarly, 55 and 75 fall within the second segment, so two quotes will be chosen from the second category. Finally, one quote will come from the third category. This process of disaggregation is repeated within each category from the first stage until an individual product involved in a particular transaction is identified. The resulting unique transaction is then recorded in detail so that future price quotes can be accurately identified by the reporting establishment.

As was noted earlier, in some cases selected product categories are "certainty sampled" or "certainty selected". This can occur if it is felt by the BLS that some item is of particular importance, or may be so in the future. In the 1987 sample for specified companies, both diabetes and cancer therapies are certainty selected. In this type of certainty selection, one item from within the chosen category is selected using normal disaggregation procedures (e.g., within SIC 2834 119 for cancer therapies, or within SIC 2834 127 for diabetes therapies), the VOS for the entire category is subtracted from the VOS of the establishment, the number of remaining selections is reduced by one, and the disaggregation process is begun again from the beginning (without the certainty selected category). This procedure is repeated for any additional certainty selected items. A second type of certainty sampling occurs whenever the percentage of VOS for a product class exceeds the sampling interval at that level of disaggregation.

For the pharmaceutical and paper mill industries, the Cycle II disaggregation procedure differed from that for most other industries in two respects. First, rather than allowing the establishment to determine the classes of products for the first step of the disaggregation process, the BLS provided a table of product categories; such a BLS worksheet for SIC 2834 is reproduced as Appendix II. In most industries no more than eight categories are defined at each level of disaggregation, but in SIC 28341 there are 48 products within the prescription pharmaceuticals section. The other difference from normal disaggregation procedures is in the handling of the second type of certainty selection, mentioned at the end of the previous paragraph. The normal disaggregation procedure might result in "multiple hits", i.e. it might choose a given product more than once. To avoid this, if a category is wider than the sampling interval, then a product is chosen by disaggregation within the

category, the VOS is deducted from the overall VOS for the establishment, and the process is started again with the certainty selected item removed. Hence multiple hits are not possible.[11]

Once the initiation interview is completed and the items for which price quotes are to be obtained are determined, repricing occurs with reporting taking place through the mail. From this the BLS obtains a time series of monthly price quotes for each item sampled, defined in such a way so as to make the item transacted and the transaction constant over time.

To construct PPI's, the sampled products are classified into cells, typically at the seven to nine digit SIC level; the within cell index weights are the VOS for the establishment divided by the number of quotes from the establishment. Note that an item with a small VOS is given the same within-cell weight as an item with a larger VOS, but that this is consistent with probability sampling proportional to VOS, for the small item essentially represents many other small items which, when combined, have the same probability of selection as a single, larger item with the same VOS. As we understand it, the within cell index is a fixed-base Laspeyres index adjusted from month to month so as to show no change when product deletions occur. Aggregated between-cell indexes are then created by weighting within-cell indexes by VOS within the cells produced within the same industry; these VOS are taken from the U.S. Department of Commerce, Census of Manufacturers.[12] Thus, shipment values for the same products made in other industries do not enter the weighting structure.[13] The total value of shipments for each industry is then distributed among the products or other revenue sources produced by that industry, thereby eliminating the need for indirect weight imputations, a practice that was common under the pre-1978 methodology of the PPI.

As was noted earlier, the most recent detailed survey in pharmaceuticals occurred in mid-1987, and beginning in December 1987, the PPI was revised to reflect the new sample of products, within-cell weights, and between-cell weights from the 1982 Census of Manufacturers. Currently, PPI's for pharmaceutical products are typically based at 100 in June 1981.

Although in principle the PPI has been based on probability sampling since late 1978, in practice it is clear that a number of departures from ideal establishment selection and disaggregation occur. In addition to use of the Unemployment Insurance rather than VOS data to choose establishments and the judgmental manner in which the number of price quotes per establishment is determined, the voluntary nature of the PPI introduces problems for BLS field representatives. Not surprisingly, the U. S. Department of Labor [1986a,1989] data collection manuals provide extensive advice to BLS field representatives when the establishment employee interviewed by BLS personnel may not have or may refuse to provide sufficient information for complete disaggregation. In such cases, the BLS manuals provide fallback procedures, up to and including taking whatever information the establishment is willing to provide on the products of its own choice. Of course, the implications of such departures of practice from theory are not clear.

III. A BRIEF DESCRIPTION OF "COMPANY X" AND ITS DATA

The pharmaceutical preparations industry in the U.S. is a relatively unconcentrated one, with the concentration of sales being quite low; for example, based on 1982 value of shipments, the 4-firm concentration ratio in SIC 2834 was 26%, the 8-firm 41%, and the 20-firm 67%.[14] Confidential data have been provided us by "Company X", one of the 20 largest firms in the industry. For each of hundreds of prescription pharmaceutical products produced by Company

X, we have been supplied monthly data from January 1984 through December 1989 (72 monthly observations) on net revenues, quantity shipped, average revenue (revenue/quantity), and product identifiers. These data were provided us in printed form, and were then keypunched by us and our assistants. List price data have not yet been made available to us. Net revenues are close to accrual basis, implying that the computed average prices are close to the true average prices for sales in the given month. However, it is worth noting that such average prices could in principle be affected by the size and location of transactions, and that no information is available to us on whether such features of transactions have changed over time. The product identifiers allow unique products (down to the presentation level) to be followed over time. Hence products do not change over time, and presentation characteristics such as form (vial, capsule), dosage, package size (count) and type (bottle, blister pack) are known.

In addition to monthly series on these variables, Company X provided us xerox copies of the monthly reporting forms it filled out for pricing surveys in response to BLS requests. These forms indicate the list price and various discounts for a number of detailed products in the Cycle I and Cycle II surveys. The items selected by the BLS represent roughly a quarter of Company X's total revenues in both cycles.

Additional product details were provided us by Company X, and these were used to classify products into therapeutic classes as defined by the BLS. Although we succeeded in classifying only 83% of Company X's universe of products into specific BLS cell groups (see Table 1 for a list of these cells), these successfully classified products accounted for more than 99% of revenues over the sample period. Below, when we present price index data, we will refer to these two product sets as "universe" and "classified", respectively.

New products are of particular interest, for they may embody technological innovations which allow therapeutic actions for which there is no known price, and the speed with which these new products are introduced into price index calculations can substantially affect the measured overall rate of inflation. Many of the new products in Company X's data set are actually modifications of existing product lines (new packaging, etc.), but other products are truly new in the sense of being the first drug produced in a new class of pharmaceutical products. We have also examined products that exit. The extremely small revenue share of exiting products makes it difficult for them to have a substantial impact on aggregate measures of price, and therefore we do not explore exits in detail in this study.

IV. PRINCIPAL EMPIRICAL FINDINGS

We now present our empirical findings to date, comparing various price indexes based on Company X data with comparable BLS published price statistics. Our results, expressed in terms of annual growth rates by year (1984 thru 1989) and average annual growth rates (AAGR) over the entire January 1984 - December 1989 time period, are summarized in Table 2. Detailed monthly series are presented in Appendix III, Table A-1.

In the first row of Table 2 we show growth rates of the BLS published PPI for SIC 28341 (prescription pharmaceutical preparations); the AAGR over the entire time period is 9.09%.[15] Then in the next row, entitled "BLS Sample of X", we report a company-specific price index for Company X, based only on transactions prices of its particular products sampled by the BLS, and using BLS fixed weight Laspeyres price index procedures, with a splice occurring in January 1988 to account for the change in products sampled between Cycles I and II.[16] This BLS sample of Company X mirrors the aggregate industry PPI

Table 2

SUMMARY OF ANNUAL GROWTH RATES FOR ALTERNATIVE LASPEYRES PRICE INDEXES FOR PHARMACEUTICAL PREPARATIONS

	Time Period						
PRICE INDEX	1/85 / 1/84	1/86 / 1/85	1/87 / 1/86	1/88 / 1/87	1/89 / 1/88	12/89 / 1/89	AAGR 1/84-12/89
BLS PPI 28341	9.15%	10.02%	8.66%	8.86%	9.23%	8.59%	9.09%
Company X Laspeyres Indexes:							
BLS Sample of X	9.81%	5.98%	9.80%	7.42%	8.74%	4.36%	7.71%
X's Universe	5.25%	5.66%	7.74%	-0.52%	3.43%	8.02%	4.84%
X's Classified	5.26%	5.63%	7.74%	-0.58%	3.40%	8.01%	4.83%
Systemic Anti-infectives Only (Laspeyres indexes):							
BLS PPI 2834 111	4.17%	6.80%	7.27%	8.80%	5.33%	5.26%	6.27%
BLS Sample of X	6.61%	7.06%	10.44%	3.16%	7.86%	6.44%	6.91%
All Classified Anti-infectives in X	1.71%	3.92%	7.36%	-3.79%	1.60%	8.27%	3.03%

TABLE NOTES: The growth rate from 1/89 to 12/89 is the 11-month growth rate expressed at an annual rate. The average annual growth rate (AAGR) in the final column is computed as $100 \cdot \{\exp[\ln(I_t/I_{t-71}) \cdot (12/71)] - 1\}$, where t is the December 1989 monthly observation. The BLS producer price indexes are taken from various issues of the U. S. Department of Labor, Bureau of Labor Statistics monthly publication, Producer Price Indexes Data.

reasonably well, although the 1984-1989 AAGR of 7.71% AAGR for the sampled products is about 15% less than the 9.09% AAGR for the published industry-wide PPI 28341, due primarily to substantial divergences in 1985 and 1989.

If we limit the product category of pharmaceutical preparations to systemic anti-infectives, we find that the BLS sample of Company X matches

that for the aggregate BLS PPI for SIC 2834 111 a bit more closely; as is seen in the bottom panel of Table 2, while the 1984-1989 AAGR for the overall BLS PPI 7-digit is 6.27%, that based on the BLS sample of Company X is 6.91%.

Based on these calculations, it appears to us that price trends of products sampled at Company X are reasonably representative of those products sampled for the industry in total. (The various price trends are presented graphically in Figures I and II at the end of this paper.)

We now initiate an examination of the extent to which Company X price indexes based on the universe of its products match price indexes based on the BLS sample of Company X's products. This gives us a first look at how well the set of products sampled by the BLS at Company X portrays X's transactions.

To do this, we have examined a number of BLS manuals and publications, and have employed BLS index number procedures as we understand them (except we use Company X quantity weights rather than BLS weights), along with price and quantity data on the universe of products manufactured by Company X, to construct a BLS-like price index for Company X. To mimic the effects of Cycles I and II, our fixed weights are changed in January 1988, with the data spliced accordingly. The results of this calculation are given in Table 2 in the row entitled "X's Universe". There it is seen that the price index based on X's Universe grows about 60% as rapidly as the AAGR of the BLS sample of Company X (4.84% vs. 7.71%).

In the previous section of this paper we noted that we have been able to classify about 83% of Company X's products into BLS 7- and 9-digit SIC codes; these classified products account, however, for more than 99% of Company X's total revenues. Using data from these classified products and following our interpretation of BLS practices, we have computed a price index for all of Company X's classified products; results are given in Table 2 in the row

entitled "X's Classified". Not surprisingly, growth rates of price indexes based on X's Classified products are very similar to those constructed using X's Universe; the AAGR are 4.83% and 4.84%, respectively.

However, if we instead limit our focus to to systemic anti-infectives, the divergence between the BLS sample of Company X's products and the universe of all classified system anti-infectives at Company X is larger; as is seen in the bottom panel of Table 2, the 1984-1989 AAGR for all infectives at X is 3.03%, less than half the 6.91% AAGR for the systemic anti-infectives sampled by the BLS from Company X.

To this point, therefore, we conclude that although there are some variations, growth rates of the alternative price indexes we have computed tend to fall into two distinct groups; one group consists of the published industry PPI for the five and seven-digit SIC 2834-1 and 2834-111 plus the BLS sample of Company X, while the other is comprised of essentially the universe of products at Company X. These two sets of price indexes are displayed graphically in Figures I and II. Apparently, sampling procedures employed by the BLS do not yield an accurate portrayal of representative transactions at Company X.

It is worth emphasizing here that in our index number calculations discussed in the previous paragraphs, we have mimicked BLS procedures regarding the infrequent changes of product weights, keeping the January 1984 weights constant until the January 1988 Cycle II change. An implication is that differences in growth rates between the BLS sample of X and X's Universe or X's Classified price indexes cannot be attributed to the "new goods problem", for in essence new goods are overlooked in all these calculations, except for the January 1988 re-basing.

Nonetheless, it is of some interest to examine the sensitivity of computed price indexes to other procedures for introducing new goods into the price index calculations. Note that the definition of what constitutes a "new" good is somewhat ambiguous. In the calculations that follow, we classify as "new" not only obviously new products, but also novel presentations of old products, i.e., vial vs. capsule presentations, or different package sizes. We now briefly discuss results of several calculations we have undertaken that shed some light on the "new goods" problem.

First, using X's Classified products, we have employed a Divisia price index procedure with shifting revenue share weights over time, where new goods are introduced as quickly as possible into the price index, and revenue share weights are adapted accordingly. In particular, we employ the Tornqvist approximation to the continuous Divisia price index

$$\ln P_t - \ln P_{t-1} = \sum_{i=1}^{n_t} \bar{s}_{it}(\ln P_{it} - \ln P_{i,t-1}) \quad . \tag{2}$$

Here P_t is the aggregate price index for period t, P_{it} is the price of the i^{th} component pharmaceutical preparation at time t, $\bar{s}_{it}$ is the arithmetic mean of the revenue share of the i^{th} pharmaceutical preparation from periods t and t-1, $\bar{s}_{it} = .5*(s_{it} + s_{i,t-1})$, where

$$s_{it} = \frac{P_{it}Q_{it}}{\sum_{i=1}^{n_t} P_{it}Q_{it}} \quad , \tag{3}$$

and where Q_{it} is the quantity of the i^{th} pharmaceutical preparation at time t. Note that introducing a new good as quickly as possible here implies that the

first time the new good appears in a calculation with a non-zero revenue share weight is in the first month after introduction, when data on $P_{i,t-1}$ becomes available; also, because of new goods, the summation over i in (2) and (3) is to n_t since n varies over time. Finally, once the log-changes are computed using (2) and (3), we normalize the logarithm of the January 1984 observation to zero, cumulate the log-changes in (2) over time, and then exponentiate; this yields a Divisia price index normalized to unity in January 1984. The results from this computation are presented in Table 3 in the row entitled "New Goods Included - Traditional". A number of results merit comment.

First, as is seen in the row marked New Goods Included - Traditional, the AAGR of the Divisia index over the 1984-1989 time period is but 1.50%, less than one third that for the Laspeyres index for X's Classified products over the same time period (4.83% -- compare with the top row of Table 3, which reproduces information from Table 2). Differences between these two indexes could be due to the effects of varying index number formulae, shifting weights, and the impacts of new goods. To isolate these effects, we first re-compute the Laspeyres fixed weight index, but do not incorporate the effects of re-sampling in the Cycle II survey beginning in 1988. Comparing the top two rows in Table 3, we see that not resampling would have generated slightly larger growth rates in 1988 and 1989, and that instead of being 4.83% over the 1984-1989 time period, the AAGR of the Laspeyres index with a fixed basket of goods over the entire time period would have been 5.14%.

Next, to isolate the effects of shifting weights, we retain the same set of goods used in the previous Laspeyres calculation (we fix the basket of goods to that existing in January 1984), but we now employ the Tornqvist approximation to the Divisia index (2) with traditional changing share weights

Table 3

SUMMARY OF ANNUAL GROWTH RATES FOR PRICE INDEXES EMPLOYING ALTERNATIVE PROCEDURES FOR SMOOTHING WEIGHTS AND FOR INTRODUCING NEW GOODS

	Time Period						
COMPANY X PRICE INDEXES	1/85 / 1/84	1/86 / 1/85	1/87 / 1/86	1/88 / 1/87	1/89 / 1/88	12/89 / 1/89	AAGR 1/84-12/89
Laspeyres Indexes:							
X's Classified (spliced in 1988)	5.26%	5.63%	7.74%	-0.58%	3.40%	8.01%	4.83%
X's Classified (not spliced)	5.26%	5.63%	7.74%	-0.58%	5.07%	8.22%	5.14%
Divisia Indexes (all using X's Classified data):							
New Goods Excluded -							
Traditional	-2.36%	1.20%	7.58%	-0.74%	3.72%	6.96%	2.60%
4-Month Weights	3.70%	5.58%	7.38%	2.29%	5.23%	10.76%	5.72%
6-Month Weights	4.96%	6.25%	7.65%	2.08%	5.72%	9.83%	6.00%
12-Month Weights	5.24%	5.44%	7.02%	1.90%	5.16%	9.77%	5.67%
New Goods Included -							
Traditional	-2.38%	0.96%	6.96%	-1.66%	-0.36%	6.28%	1.50%
4-Month Weights	3.66%	5.29%	6.82%	0.70%	1.22%	9.64%	4.44%
New Goods Only -							
Traditional	-28.79%	-8.26%	-4.41%	-7.58%	-8.57%	6.45%	-9.37%
4-Month Weights	-28.76%	-8.88%	-3.30%	-7.08%	-6.44%	6.98%	-8.78%
Divisia Indexes (Only Company X data sampled by the BLS)							
Traditional	-8.81%	-6.51%	12.15%	2.12%	7.44%	12.19%	2.62%
4-Month Weights	5.62%	4.92%	14.90%	8.36%	7.21%	11.65%	8.68%

(3). Results of this calculation are given in the row entitled New Goods Excluded - Traditional. There it is seen that the effects of moving toshifting weights and a traditional chained Divisia index are considerable, almost halving the AAGR from 5.14% to 2.60% per year, with particularly sharp differences occurring in 1984 and 1985. Clearly, allowing for changing shares has a substantial impact -- the Laspeyres and traditional Divisia index computed over the same basket of goods differ considerably. But this very sharp difference, particularly in 1984 and 1985, raises another issue.

Within the index number literature it has been known for some time that, based on a variety of theoretical criteria, chained indexes such as the Tornqvist approximation to the Divisia are in most cases preferable to fixed weight procedures. However, one potential theoretical problem with the chained index is that of drift, a term coined by Ragnar Frisch [1936].

To understand the notion of drift, it is useful to envisage a chained index between time periods 0 and t as the product of t price relatives, i.e.

$$P_t/P_0 = (P_1/P_0)\cdot(P_2/P_1)\cdot(P_3/P_2)\cdot\cdots\cdot(P_t/P_{t-1}). \qquad (4)$$

Although the Tornqvist approximation to the Divisia has a number of desirable theoretical properties, one important property it fails to satisfy is that of circularity.[17] Suppose, for example, that although prices within an aggregate changed in periods 1 through t-1, all prices within the aggregate in period t were the same as that in period 0; in such a case, the property of circularity implies that the aggregate price index P_t should be the same as P_0. It is well-known that the chained Divisia index fails this circularity property, and instead is subject to drift; an empirical example where circularity also fails with a chained Laspeyres index is given in Bohdan Szulc [1983, pp. 540-542].

Szulc notes that for chained indexes, if the price of some particular commodity "bounces" and the price and quantity of that good are strongly negatively correlated, then the rapid transitory change in the weight employed in the index number procedure can result in relatively permanent error or bias, yielding an index that is subject to drift. Moreover, the earlier in the sample that a price "bounce" occurs, the greater is the drift in the index over time.

In our context, when we examined the BLS sample of Company X, we found that the sharp drop in the 1984-1985 Divisia price index with traditional weights could be traced to the sharp "bounce" of one commodity, whose price and revenue are highly negatively correlated. Thus there is reason to be cautious with the chained Divisia index, for it may well reflect drift, particularly since the price bounce occurs near the beginning of the sample.

One way in which the adverse effects of drift in chained indexes can be mitigated is to smooth the weights. In the spirit of extending the Tornqvist approximation to the Divisia index but smoothing the share weights, one can smooth the weights by employing a centered moving average share with a greater length. Define a series of several new smoothed centered moving average approximations to the Divisia index by replacing $\bar{s}_{it}$ just above (3) with s^{T}_{it} for T = 4, 6 and 12 months, where

$$\bar{s}^{4}_{it} = [s_{i,t-2} + s_{i,t-1} + s_{it} + s_{i,t+1}]/4 \qquad (5)$$

$$\bar{s}^{6}_{it} = [s_{i,t-3} + s_{i,t-2} + s_{i,t-1} + s_{it} + s_{i,t+1} + s_{i,t+2}]/6 \qquad (6)$$

and

$$\bar{s}^{12}_{it} = [s_{i,t-6} + \cdots + s_{i,t-1} + s_{it} + s_{i,t+1} + \cdots + s_{i,t+5}]/12. \qquad (7)$$

We have computed alternative Divisia prices indexes using these various approximations.[18] Summary results from these calculations with new goods excluded are presented in the middle panel of Table 3, and selected series are reproduced in Figure III; detailed monthly series are given in Appendix III, Table A-2.

One striking result seen in the middle panel of Table 3 is that the 1984-89 AAGR increases substantially when the shares are smoothed, regardless of the length of the centered moving average; although the AAGR based on the traditional Divisia index is 2.60%, that obtained using 4, 6 and 12 month moving average weights increases to 5.72%, 6.00%, and 5.67%, respectively. Note that the relationship between the overall 1984-89 AAGR and T is not monotonic, although montonicity occurs in 1984.

Moreover, most of the smoothing is captured with relatively short moving averages, say, when 4-month moving average revenue weights are employed. Thus, stabilization of growth rates is attained quite quickly, and the effects of drift are correspondingly mitigated. Price index movements for the Divisia indexes with alternative smoothing weights are presented in Figure III; the effects of drift are particularly visible, for the vertical distance between traditional and moving average Divisia price indexes occurs at the beginning of the sample, and tends to increase with time.

Having digressed briefly to consider effects of index number formulae and the use of smoothed weights, let us now return to our attempt to isolate the effects on AAGR's of introducing new goods from that of changing weights. Our principal result so far is that when the basket of goods used in the index number calculations is fixed, moving from the Laspeyres price index to a

Divisia with smoothed weights increases the AAGR slightly from 5.14% to about 5.7%.

To isolate the effects of introducing new goods, we can compare various smoothed Divisia indexes with new goods excluded to analogous ones with new goods included.[19] Using traditional weights, as is seen in Table 3 (and in Figure IV), the impact of including new goods is initially very small in 1984, it increases in 1985 and 1986, and becomes quite large in 1987 and 1988; over the entire 1984-1989 time period, the difference between including and excluding new goods is substantial, resulting in a decrease in the 1984-1989 AAGR from 2.60% to 1.50%.[20] However, the effects of excluding new goods are not nearly as large when 4-month smoothed weights are employed; with new goods excluded, the 1984-89 AAGR with 4-month weights is 5.72%, while with new goods included it falls about 22% to 4.44%.[21] We conclude that how one introduces new goods into the price index calculations has a significant empirical impact, but that with this data to mitigate the effects of drift, using smoothed rather than traditional weights in the Divisia index is even more critical.

It is also of interest to compute a price index confined only to new goods. Divisia price indexes using traditional Tornqvist and 4-month moving average weighting procedures are presented toward the bottom of Table 3 (and in Figure IV). There it is seen that the aggregate price index of new goods declines over time, having a 1984-1989 AAGR of -9.37% using traditional weights and -8.78% with 4-month weights; moreover, the growth rates are negative in every year except 1989.[22] Interestingly, there is little difference here between traditional and smoothed weights, unlike that for indexes based on incumbent products at Company X. Apparently, for this sample of new goods only, the negative correlation between price and revenue is not as strong as it is with incumbent goods.

In summary, while smoothing is important for computing Divisia indexes with new goods excluded, the results based on new goods only are not affected much by smoothing. Our preferred price indexes for the set of all classified products, including new goods, is therefore the 4-month smoothed Divisia index in the middle of Table 3, having a 1984-89 AAGR of 4.44%.

As a final set of comparisons and check on the robustness of our findings, we have also calculated Divisia indexes using traditional and smoothed weighting procedures, limiting the products to those sampled by the BLS at Company X. As is seen in the bottom panel of Table 3, with the traditional Divisia weights, the 1984-89 AAGR is but 2.62% (due to price bouncing accompanied by negatively correlated revenues in 1984-1985, resulting in drift), whereas with 4-month smoothed weights the AAGR is a much larger 8.68%;[23] recall that AAGRs of the corresponding Divisia indexes for all classified goods at Company X (including new goods) are 1.50% and 4.44%. Note that the effects of smoothing are very large for this BLS sample, reflecting perhaps the fact that the BLS sampled goods are relatively mature products, whereas newer products in this sample do not require smoothing.

We conclude, therefore, that our finding that the sampling procedures employed by the BLS do not yield an accurate portrayal of representative transactions at Company X is robust to the use of various chained vs. fixed weight price indexes, and to the manner in which new goods are introduced into the price index.

In addition to doing price index calculations for the entire universe of products at Company X, to all those classified into specific products, and for goods classified as systemic anti-infectives, we have performed a number of calculations based on other disaggregated product classes, to assess whether the aggregate results masked considerable heterogeneity among distinct product

classes. For reasons of confidentiality, we cannot provide details on such calculations for each product class. What we can say is that the general pattern reported for the entire set of Classified X products was also exhibited in many, but not all of the detailed product class disaggregations; opposite results obtained in several smaller classes. In this sense as well, therefore, our findings are quite robust.

V. AN HYPOTHESIS ON THE SOURCE OF THE DISPARITY

Having established that price indexes based on the BLS sample of Company X products appear to be substantially different from price indexes based on the universe (or classified universe) of Company X's products (regardless of which index number procedure is employed), we now attempt to provide evidence on possible sources of this disparity.

The first hypothesis that comes to mind is that this difference simply reflects the effects of random sampling; the sample taken from Company X just happens to be somewhat different, but that is not surprising given the random nature of probability sampling. At this point, we cannot pursue this hypothesis further in a meaningful way, for any examination of it requires data from more than one company, and such additional data are not yet available to us. Note that in principle, it is of course possible that the sample of products taken from Company X is based on a truly random sample.

However, we can take further advantage of our unique data base by examining the particular products sampled by the BLS more closely, and perhaps comparing them with the universe of X's products. Using specific product identifier information for about 40% of Company X's products (accounting for over 93% of its revenues), we have computed the number of months since each product was originally introduced.[24] This allows us to compare the age of

products sampled by the BLS at Company X, with the average age of the universe of Company X's dated products. Our findings are presented in Table 4, and are displayed graphically in Figures V and VI.

Table 4

Average Age of All Dated Products at Company X Compared with the Average Age of Products Sampled by the BLS at Company X, Cycles I and II

Date/Product List	Arithmetic Mean Age in Years	Sales-Weighted Mean Age in Years*
June 1981:		
All Company X Dated Products	16.009	11.606
Cycle I Products Sampled by BLS	11.463	7.131
January 1988:		
All Company X Dated Products	19.956	14.870
Cycle II Products Sampled by BLS	18.907	18.294

*NOTE: The revenue shares used to weight products in June 1981 are those prevailing in 1984, the first year of our sample. For January 1988, we use 1987 revenue shares to be consistent with Cycle II survey timing.

In June 1981 when results from the BLS Cycle I survey were introduced, the arithmetic (unweighted) mean of all dated products at Company X was 16.009 years, while that for the Cycle I products sampled by the BLS at X was 11.463 years. The sales-weighted means were slightly closer, however, being 11.606 years for all dated products at X compared with 7.131 years for the Cycle I products sampled at X by the BLS. Cycle I products sampled by the BLS were therefore somewhat younger than the universe of Company X's products.

Matters changed considerably, however, by January 1988 when results from the BLS Cycle II survey were introduced. Although unweighted means for all of

Company X's dated products were slightly larger than those sampled by the BLS in Cycle II at Company X (19.956 vs. 18.907 years), the sales-weighted averages differed sharply. In particular, the sales-weighted average of all of Company X's dated products was 14.870 years, whereas the sales-weighted average of the products sampled by the BLS at X was much larger, 18.294 years. Had there been no new products introduced at X, had no exits occurred, and had all products retained their market shares from 1981 to 1988, the sales-weighted average would have increased with time -- a total of 6.417 years from June 1981 to January 1988. In fact, however, the sales-weighted average of products sampled by the BLS at Company X increased 11.163 years -- from 7.131 years at the beginning of Cycle I (June 1981) to 18.294 years at the beginning of Cycle II (January 1988). This suggests that unlike the case during Cycle I, in Cycle II the BLS sample covers products that on average are more mature and further along in the product life cycle than is representative of Company X's product transactions.[25]

Although the above evidence is suggestive, our analysis has revealed what we believe is a more convincing piece of evidence. Specifically, if the Cycle II set of products was based on probability sampling, then one would expect that the set of products sampled in Cycle II would likely be rather different from that set of products sampled in Cycle I. However, the data reveal that 50% of the specific products at Company X in the BLS sample during Cycle I were again chosen for sampling by the BLS in Cycle II. Our impression is that the probability of this occurring when probability sampling is in fact being employed is very, very small, particularly since half of the products retained from Cycle I to Cycle II each accounted for less than 0.25% of Company X's VOS. The share of all re-sampled products as a proportion of revenues of all products at Company X in the Cycle II sample in 1987 is about 50%, and the

revenue share of all Cycle II sampled products in total Company X revenues in 1987 is about 25%; these numbers do not change much from comparable figures for the Cycle I products in 1984.

It is worth noting that there are good reasons why one might want to continue resampling the same set of products, in order to provide comparability over time. But it must also be emphasized that this re-sampling of a large proportion of the same products in Cycles I and II is very likely to be inconsistent with probability sampling procedures that are proportional to VOS.

Finally, at this point we can only conjecture why this peculiar pattern of product re-sampling by the BLS occurred at Company X. Like other government statistical agencies, the BLS has been under stringent financial budgetary conditions for some time, and it is well-known that initiation surveys and product disaggregation procedures are costly to implement. Moreover, relations between BLS field representatives and company officials can easily become strained when monthly time series on detailed product-specific price and quantity data are requested. Given budget constraints and costly, perhaps unpleasant interviewing procedures, it simply may have been convenient for BLS field representatives to keep a substantial proportion of the same products in the samples constituting Cycles I and II.

VI. CONCLUDING REMARKS

Our purpose in this paper has been to compare price indexes constructed in a variety of ways from the universe of products of a large multiproduct pharmaceutical manufacturer in the US, with price indexes constructed from the particular products of this firm sampled by the BLS, using BLS and alternative index number procedures. We have found a rather substantial disparity in that, employing monthly data from January 1984 through December 1989, the BLS sample

price index rises at almost twice the rate of indexes based on the universe of products manufactured and shipped by this pharmaceutical firm. In contrast, the BLS sample index from Company X rises similarly to SIC 2834 price indexes published by the BLS.

We have also examined possible sources of this disparity, and have explored one hypothesis. Our preliminary result here is that the choice of products sampled by the BLS in Cycle II overlaps considerably those chosen in Cycle I, a result that is possible, but rather unlikely to occur were probability-based sampling procedures followed in practice. We are also struck by the fact that the sales-weighted average age of products included at the beginning of the Cycle I survey (June 1981) was somewhat younger than all dated products sold by Company X (7.131 vs. 11.606 years), but that in the Cycle II sample of Company X beginning in January 1988 the sales-weighted average was about 40% greater than a sales-weighted average of all of Company X's dated products at that time (18.294 vs. 14.870 years). Hence from Cycle I to Cycle II, a major shift has occurred in the age distribution of products sampled by the BLS relative to those sold by Company X.

A second major set of findings concerned the "new goods" problem. Our results suggest that the manner in which new goods are introduced into price index calculations has a substantial empirical impact, in our case, reducing the rate of growth of the price index. However, our empirical results based on the traditional Tornqvist approximation to the Divisia index suggested that this index was subject to drift, consistent with the theoretical result that this chained index does not satisfy the circularity property. Using alternative centered moving average weights to approximate the Divisia index, we discovered that in our data base, coincidentally, accounting for drift almost offsets the effects of introducing new goods more rapidly. In fact, the

1984-1989 AAGR of the Laspeyres index spliced in 1988 over all classified goods at Company X was 4.83%, while that based on a 4-month weighted moving average was 4.44%.

This research suggests a number of important issues that should be pursued. First, since the pharmaceutical preparations industry is rather unconcentrated, there is a clear possibility that data from Company X, one of the twenty largest firms in the industry, are simply quite different from that of other firms, and are not representative of the industry as a whole. The fact that growth in the CPI for this industry's products is similar to that of the PPI is perplexing. It is worth noting that anecdotal evidence on price index comparisons provided us by officials at another large pharmaceutical manufacturer are consistent with results reported here. Nonetheless, without further data, we cannot rule out the possibility that Company X is simply an outlier, and that the CPI and PPI adequately portray transactions in this industry's products. Therefore, since the plural of anecdotes is data, we are currently exploring possibilities of obtaining and then processing confidential data from one or more additional companies, or from an industry-wide data gathering company.

Second, although we have presented results on the new goods problem and have also found evidence suggesting the presence of drift with Divisia indexes, these issues are very important and clearly merit much additional attention.

Third, due to delays in obtaining appropriate data, we have not yet been able to undertake a thorough comparison of list vs. transactions prices. However, since Company X reported list rather than transactions prices to the BLS for its sampled products, we have been able to compare list and transactions prices for a small set of products, although even here the record is incomplete. Based on a preliminary analysis of this data, we have found for

those products sampled in both Cycles I and II, overall AAGRs of list and transactions prices are very similar, but for products observed only in short periods within Cycle I or Cycle II, list prices have grown more rapidly than transactions prices. In all cases, however, list prices change less frequently than transactions prices.

Fourth and finally, we have ignored entirely the issue of accounting for quality change. In future research, we plan to assess the possibility of employing laboratory test data on the efficacy of certain pharmaceutical preparations in hedonic price regression equations, and the usefulness of such hedonic price equations in computing quality-adjusted price indexes.[26]

FOOTNOTES

[1]See U.S. Senate Committee on Finance [1893].

[2]Some products were deleted from or added to this list during the 1984-89 time period.

[3]Note that the summation counter is not specified in (1), and generally requires an additional subscript. Also, the BLS Handbook (BLS, Bulletin 2285 [1988], p. 130) states that "The expression (Q_aP_0) represents the weight in value form, and the P and Q elements (both of which originally relate to period "a" but are adjusted for price change to period "0") are not derived separately."

[4]In U. S. Department of Labor [undated, b, p. 2], it is stated that "The quote allocation scheme for pharmaceuticals assigned sixteen quotes to the twenty-six largest sample units (in terms of employment), ten quotes to the twenty-five next largest companies and six quotes to the remaining establishments. This allocation scheme was based on the number of quotes needed for publication purposes, balanced against the possible affects [sic] of overburdening the respondents."

[5]In U. S. Department of Labor [undated, a], it is stated that "For specified companies, both cancer therapy and diabetes preparation drugs are being certainty selected."

[6]Discussions with BLS personnel indicate that in some cases where value of shipment data is intact and complete for establishments, VOS rather than UI data are used to compute probabilities of inclusion.

[7]As Hill [1987, p. 583] notes, "By law, every employer in the U.S. is required to report the number of people employed and to purchase insurance which will cover the employer's unemployment benefit liability. As a result the UI file data are fairly complete. The continued existence of the UI file is also assured, thereby ensuring continued availability of a consistent frame for sampling. The UI file contains such information as the establishment's name, the SIC in which it is classified, the county and state in which it is located, and its number of employees. This file is explicitly stratified according to industry classification and thus provides individual industry frames which form the basis for the PPI frames."

[8]Hill [1987], p. 584.

[9]U. S. Department of Labor [1988, p. 128].

[10]Random numbers are presented on the bottoms of pages in the forms filled out by BLS field representatives.

[11]However, there is some ambiguity here. Although the wording in the BLS discussion of special disaggregation procedures (U. S. Department of Labor [1986a, undated a]) explicitly states that the entire cell is discarded once the certainty selection occurs, our sample from Company X contains multiple selections from individual cells.

[12]An adjustment is made for inter- and intra-industry transfers to remove non-final product values from the weights, thereby obtaining net output values of

shipments as weights. Currently the adjustment factor is based on the 1977 Input-Output tables from the Bureau of Economic Analysis, U. S. Department of Commerce.

[13]For further discussion, see U. S. Department of Labor [1988, p. 129].

[14]The 1982 Herfindahl-Hirschman index for the 50 largest companies is 312. These data are taken from U. S. Department of Commerce[1982, Table 6, p. 7-101].

[15]The Consumer Price Index for prescription preparations shows a very similar price trend as the PPI. Annual growth rates for 1984 through 1989 are 9.70%, 8.40%, 9.02%, 8.08%, 7.98% and 7.84%; the AAGR over the entire 72-month time period is 8.75%.

[16]In particular, to mimic the BLS procedures, we employ equal weighting within cells, and Census value weights between cells, the latter provided us by personnel at the Bureau of Labor Statistics, Office of Prices and Living Conditions.

[17]For discussions of index number properties, historical references, and some empirical illustrations, see, inter alia, W. Erwin Diewert [1988], Charles R. Hulten [1973], and Yoram Barzel [1963].

[18]At the endpoints of our January 1984 and December 1989 sample, it is not possible to include all the lags or leads, respectively. For T = 4, 6 and 12, for up to the first (T/2 + 1) and down to the last (T/2 - 1) observations, we fixed the share weights (5) - (7) at the $\bar{s}^{T}_{i,T}$ and $\bar{s}^{1}_{i,t-T}$ values, respectively.

[19]In each case, new goods are introduced as soon as is possible, i.e. they enter in the second month they are present. Specifically, for weights from time periods for which data are not observable, we inflate the observable weights to make them comparable to T, if only two months of weights are observable and T = 4, we double values of the observed weights.

[20]The share of post-1984 new goods in total Company X revenues was less than 1% in 1984 and 1985, but by 1989 this share increased to around 35%.

[21]To conserve on space, results from 6 and 12-month smoothing are not presented. The 1984-89 AAGR with 6 month smoothing is 4.42%, while that for 12 is 4.12%.

[22]Using 6 and 12-month weighting procedures, the 1984-89 AAGR are -10.30% and -10.52%.

[23]When 6 and 12-month weights are used, the 1984-89 AAGR is 10.20% and 8.88%, respectively.

[24]Alternative presentations of the same product are all treated as being introduced at the time the initial presentation was brought to market.

[25]Preliminary calculations relating the real price of a product to its age (defined as years since the presentation of the product was first sold) suggest that real price declines typically occur in the first five years of a product's life at Company X, price increases occur until about age 12, it

falls until about age 16, and then rises with age. The price decline after age 12 might reflect the effects of patent expiration, whereas the subsequent price increase may be due to survivor bias and inelastic demand.

[26]For a discussion of quality-adjusted price indexes for microcomputers based on hedonic regression methods, see Berndt and Griliches [1990].

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APPENDIX I
BLS PRODUCT CODE-CYCLE II

PRODUCT CLASS			SAR VALUE	ROUND SELECTED	$	RUNNING TOTAL	SAMPLING PATTERN	QUOTA #
PRESCRIPTION PHARMACEUTICALS								
Diabetes therapy			THIS IS A CERTAINTY SELECTION					
Analgesics	Narcotic	Codeine and combinations						
		Other						
	Non-narcotic	Synthetic						
		Aspirin, APC and related						
Antiarthritics								
Anticoagulants								
Anticonvulsants								
Systemic antihistamines								
Systemic anti-infectives	Broad & narrow spectrum antibiotics	Cephalosporins						
		Broad spectrum penicillins						
		Erythromycins						
		Tetracyclines						
		Other						
	Systemic penicillins							
	Urinary antibacterials							
	Trimethoprim							
	Systemic sulfonamides							
Antiseptics								
Antispasmodic/antisecretary								
Bronchial therapy								
Cancer therapy products								
Cardiovascular therapy	Antihypertensive							
	Vasodilators							
	Digitalis preparations							
	Other							
CNS stimulants								
Contraceptives								
Cough and cold preparations								
Dermatological preparations	Fungicides							
	Antipruritics							
	Other							
Diuretics								
Enzymes								
Hormones								
Hospital Solutions	I.V. solutions	Over 50 ml.						
		50 ml. and under						
	Other							
Muscle relaxants								
Nutrients and supplements								
Opthalmic and otic preparations								
Psychotherapeutics								

APPENDIX I (CONTINUED)

PRODUCT CLASS		SAR VALUE	ROUND SELECTED	$	RUNNING TOTAL	SAMPLING PATTERN	SUCCESSIVE
Sedatives							
Tuberculosis therapy							
Vitamins	Multivitamins						
	B-Complex						
	Other						
Other prescriptions pharmaceuticals							
NON-PRESCRIPTION PHARMACEUTICALS							
Analgesics, internal	Aspirin/aspirin-salicylate compounds						
	Non-aspirin (including effervesent)						
Antacids	Liquid						
	Other						
Antidiarrheals							
Antiasthmatics							
Antiseptics and antibacterials							
Contraceptive agents							
Cough and cold preparations	Cough syrups, elixirs, expectorants						
	Cold tablets, capsules						
	Decongestants						
	Decongestant/antihistamine mixtures						
	Other						
Dermatologicals	Acne preparations						
	Burn remedies						
	Other						
External analgesics and counterirritants							
Hematinics							
Hemorroidal preparations							
Laxatives							
Sedatives							
Vitamins	Adult multivitamins						
	B-Complex						
	Other						
Other non-prescription pharmaceuticals							
VETERINARY PHARMACEUTICAL PREPARATIONS							
Prescription							
Non-prescription	Antibiotics						
	Other						
SECONDARY PRODUCTS							
Biological products (2831)							
Medical chemicals and botanicals (2833)							
Other							
MISCELLANEOUS RECEIPTS							
Resales							
Contract work and other							

APPENDIX II
A BLANK COPY OF THE BLS FORM 473P

Bureau of Labor Statistics
Information for the Producer Price Indexes

U. S. Department of Labor

The information collected on this form by the Bureau of Labor Statistics will be held in the strictest confidence and will be used for statistical purposes only.

This report is authorized by law, 29 U.S.C. 2. Your voluntary cooperation is needed to make the results of this survey comprehensive, accurate, and timely.

Form Approved
O. M. B. No. 1220-0008

INSTRUCTIONS

ITEM DESCRIPTION
Please determine if the information your company previously provided is currently applicable or requires update. If revision is required, please indicate the changes in the open areas.

If you revise the description, indicate the date on which the change became effective and the estimated value of the change (change in cost plus standard markup.)

Please review the Adjustments to Price area to determine if the adjustments and related terms are current as shown.

Additional instructions appear on the reverse side of this form.

If you have any questions concerning completion of this form, please call:

REMARKS

PREVIOUS PRICE INFORMATION — Please review the Previous Price information below. Enter missing prices if available. Correct any incorrect prices that are shown. Net transaction prices are the most desirable type of price. If incorrect or if you change to a different type of price, indicate the current type of price.

Type of price you report ◂▸

Did the price change between

Have you made any changes to the Item Description or the Previous Price information described above?

Please enter the price in the boxes below if there has been a change. Use black pen or pencil only, writing the number as shown. Please do not type. DO NOT USE BLUE. If there was not a shipment, estimate the price that would have been charged on

1 2 3 4 5 6 7 8 9 0

Check if this is a CLOSEOUT price on an item which is being phased out.

APPENDIX II (CONTINUED)

Dear Respondent,

Thank you for your continuing participation in the Producer Price Index (PPI) program. The data which you provide are used in computing the Producer Price Indexes and consecute the base for analyzing industrial price changes.

Please use the enclosed postage free envelope to return the pricing forms. Your continued cooperation is greatly appreciated.

Commissioner of Labor Statistics

Instructions for completing a PPI pricing form:

The information contained on this form was furnished by your firm in previous pricing periods. Review the information carefully to verify that it remains current. Cross out any incorrect information and write in all corrections and additions that are necessary. Any information concerning the item which exceeds the space limitation imposed by the form is continued on the subsequent page and should also be verified.

Item and Transaction Description

If the Item Description or the Transaction Terms, or both, no longer apply, a substitute item or substitute transaction terms should be selected by you. Item substitution should only occur when the item previously reported is no longer available because it is being or has been permanently discontinued. The substitute item should be as similar as possible to the current item and should be expected to remain available for some time. The substitute transaction terms should likewise be as similar as possible to the discontinued transaction terms.

Report these changes in the clearest open area and provide current price information.

Adjustments to Price

Following is a list of the more common adjustments to price. The specific adjustments on the pricing form were selected originally and should be changed only when either the level of an existing adjustment changes or a new adjustment becomes applicable to the product and transaction described.

Deductions from price include:
1. Standard discounts (Cash, Seasonal, Cumulative Volume, Quantity, and Trade)
2. Rebates
3. Other recurring discounts
4. Other nonrecurring discounts (Competitive and Negotiated)

Additions to price include:
1. Surcharges
2. Other recurring charges added to price
3. Other nonrecurring charges added to price

Taxes should always be excluded from the price. If this exclusion is not possible, note this in Remarks.

Freight charges should be excluded from the price unless delivery was selected originally as part of the product. Make changes if the currently described freight terms no longer exist.

QUESTIONS

Answer whether you have ("YES") or have not ("NO") made any changes or entries to the item description or previous price information.

Answer YES or NO depending on whether the shipment price of the item described changed ("YES") between the two dates listed or whether the shipment price did not change ("NO") during this time period.

If the answer is NO, the form has been completed and is ready for mailing. DO NOT ENTER A PRICE IF THE PRICE HAS NOT CHANGED. If the answer is YES, please enter the new price.

If there has been a change in the name or address to whom this form should be sent in the future, enter an (X) in the box. It is necessary to make the name and address change on only one form.

Please complete and return within 5 business days all of the pricing forms that are mailed to you even if there are no changes.

If you are anticipating a change in any of the information that you provide, please indicate in Remarks. List the anticipated change and when it will occur.

Any questions that you have regarding the pricing forms or their completion may be resolved by calling the Bureau of Labor Statistics, Division of Industrial Prices and Price Indexes, Washington, D.C., by using the telephone number at the top of the pricing forms.

REMARKS:

APPENDIX III

Table A-1

		Company X Laspeyres Indexes						
			All Product Classes			Systemic Anti-infectives only		
Month	Year	BLS PPI 28341	BLS Sample of X	X's Universe	X's Classified	BLS PPI 2834 111	BLS Sample of X	All Classified Anti-infectives
1	1984	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2		1.009	1.049	1.012	1.013	1.001	1.001	0.996
3		1.025	0.986	0.992	0.992	1.003	0.999	0.979
4		1.036	0.974	0.997	0.997	1.001	1.001	0.999
5		1.036	0.999	0.993	0.993	1.001	0.995	0.970
6		1.040	1.027	1.001	1.001	1.021	1.009	0.970
7		1.047	1.045	1.016	1.016	1.024	1.012	0.985
8		1.043	1.082	1.034	1.034	1.023	1.014	0.992
9		1.045	1.037	1.013	1.013	1.023	1.018	0.983
10		1.065	1.050	1.027	1.027	1.048	1.063	1.015
11		1.088	1.084	1.048	1.048	1.044	1.066	1.023
12		1.076	1.072	1.044	1.044	1.048	1.064	1.027
13	1985	1.092	1.098	1.052	1.053	1.042	1.066	1.017
14		1.106	1.127	1.056	1.056	1.057	1.063	1.015
15		1.123	1.079	1.029	1.029	1.058	1.058	0.980
16		1.123	1.074	1.044	1.044	1.058	1.061	1.002
17		1.151	1.093	1.051	1.052	1.048	1.059	1.000
18		1.133	1.141	1.057	1.056	1.068	1.080	0.988
19		1.160	1.150	1.080	1.079	1.078	1.085	1.018
20		1.149	1.137	1.074	1.073	1.092	1.092	1.018
21		1.164	1.147	1.083	1.083	1.116	1.133	1.037
22		1.154	1.186	1.102	1.102	1.114	1.135	1.047
23		1.192	1.168	1.092	1.092	1.114	1.136	1.040
24		1.169	1.230	1.130	1.130	1.115	1.141	1.064
25	1986	1.201	1.164	1.112	1.112	1.113	1.141	1.057
26		1.209	1.162	1.101	1.101	1.120	1.143	1.039
27		1.230	1.186	1.123	1.123	1.147	1.176	1.081
28		1.231	1.187	1.129	1.129	1.143	1.180	1.085
29		1.254	1.183	1.132	1.132	1.144	1.177	1.095
30		1.237	1.204	1.099	1.099	1.138	1.185	1.021
31		1.258	1.236	1.154	1.154	1.164	1.207	1.096
32		1.247	1.244	1.127	1.127	1.164	1.204	1.045
33		1.258	1.253	1.145	1.145	1.164	1.213	1.075
34		1.271	1.307	1.183	1.183	1.188	1.258	1.126
35		1.288	1.292	1.180	1.180	1.186	1.260	1.128
36		1.285	1.353	1.206	1.205	1.186	1.265	1.121
37	1987	1.305	1.278	1.198	1.198	1.193	1.261	1.135
38		1.312	1.308	1.192	1.192	1.208	1.255	1.107
39		1.336	1.348	1.203	1.203	1.242	1.272	1.128
40		1.344	1.308	1.191	1.190	1.238	1.290	1.129
41		1.369	1.295	1.182	1.181	1.245	1.287	1.118
42		1.355	1.343	1.198	1.198	1.245	1.287	1.111
43		1.367	1.320	1.176	1.175	1.248	1.283	1.096
44		1.372	1.342	1.186	1.185	1.244	1.283	1.094
45		1.396	1.328	1.201	1.200	1.253	1.287	1.123
46		1.376	1.382	1.214	1.214	1.272	1.316	1.112
47		1.404	1.371	1.210	1.209	1.284	1.319	1.112
48		1.410	1.492	1.279	1.279	1.285	1.314	1.131

APPENDIX III

Table A-1 (continued)

		Company X Laspeyres Indexes						
		All Product Classes				Systemic Anti-infectives only		
Month	Year	BLS PPI 28341	BLS Sample of X	X's Universe	X's Classified	BLS PPI 2834 111	BLS Sample of X	All Classified Anti-infectives
49	1988	1.420	1.373	1.192	1.191	1.298	1.300	1.092
50		1.427	1.369	1.189	1.188	1.307	1.286	1.079
51		1.452	1.384	1.193	1.192	1.296	1.315	1.110
52		1.462	1.426	1.167	1.166	1.327	1.313	1.051
53		1.471	1.436	1.179	1.177	1.321	1.323	1.062
54		1.465	1.440	1.203	1.202	1.323	1.326	1.079
55		1.476	1.468	1.246	1.245	1.342	1.363	1.146
56		1.485	1.464	1.222	1.221	1.343	1.366	1.102
57		1.503	1.469	1.244	1.243	1.371	1.375	1.139
58		1.509	1.471	1.247	1.246	1.359	1.398	1.120
59		1.531	1.473	1.229	1.228	1.379	1.389	1.106
60		1.525	1.476	1.283	1.282	1.367	1.383	1.108
61	1989	1.552	1.492	1.233	1.232	1.368	1.402	1.109
62		1.554	1.481	1.226	1.225	1.341	1.375	1.101
63		1.582	1.472	1.264	1.263	1.381	1.325	1.035
64		1.593	1.500	1.205	1.204	1.385	1.382	1.063
65		1.597	1.531	1.239	1.238	1.386	1.408	1.103
66		1.599	1.539	1.273	1.272	1.408	1.481	1.143
67		1.616	1.537	1.247	1.245	1.411	1.435	1.099
68		1.649	1.560	1.284	1.283	1.424	1.473	1.152
69		1.639	1.547	1.265	1.263	1.386	1.413	1.152
70		1.650	1.531	1.318	1.317	1.403	1.495	1.181
71		1.658	1.450	1.273	1.272	1.413	1.340	1.138
72		1.673	1.552	1.323	1.322	1.433	1.485	1.193
1/84 TO 1/85	% growth	9.154%	9.811%	5.247%	5.258%	4.167%	6.607%	1.711%
1/85 TO 1/86	% growth	10.021%	5.975%	5.664%	5.634%	6.800%	7.064%	3.916%
1/86 TO 1/87	% growth	8.656%	9.795%	7.737%	7.741%	7.266%	10.439%	7.355%
1/87 TO 1/88	% growth	8.858%	7.419%	-0.523%	-0.583%	8.799%	3.157%	-3.794%
1/88 TO 1/89	% growth	9.230%	8.743%	3.426%	3.405%	5.327%	7.857%	1.600%
1/89 TO 12/89	% growth	8.594%	4.357%	8.016%	8.007%	5.263%	6.435%	8.269%
1/84 TO 12/89	% AAGR	9.092%	7.712%	4.844%	4.826%	6.273%	6.911%	3.026%

APPENDIX III

Table A-2

		Laspeyres Indexes		Divisia Indexes (Co. X Classified, New Goods Excluded)			
Month	Year	X's Classified (Spliced in Jan. 1988)	X's Classified (Not Spliced)	Traditional	4-Month Weights	6-Month Weights	12-Month Weights
1	1984	1.000	1.000	1.000	1.000	1.000	1.000
2		1.013	1.013	0.999	1.013	1.008	1.009
3		0.992	0.992	0.969	0.991	0.993	0.993
4		0.997	0.997	0.967	0.994	0.998	0.998
5		0.993	0.993	0.959	0.991	0.991	0.992
6		1.001	1.001	0.966	0.998	0.998	0.999
7		1.016	1.016	0.976	1.010	1.014	1.015
8		1.034	1.034	0.985	1.025	1.027	1.028
9		1.013	1.013	0.955	1.003	1.011	1.013
10		1.027	1.027	0.961	1.015	1.025	1.028
11		1.048	1.048	0.977	1.038	1.045	1.048
12		1.044	1.044	0.976	1.036	1.042	1.044
13	1985	1.053	1.053	0.976	1.037	1.050	1.052
14		1.056	1.056	0.971	1.035	1.046	1.049
15		1.029	1.029	0.940	1.009	1.023	1.024
16		1.044	1.044	0.951	1.026	1.042	1.043
17		1.052	1.052	0.956	1.035	1.049	1.050
18		1.056	1.056	0.953	1.033	1.053	1.051
19		1.079	1.079	0.974	1.056	1.076	1.073
20		1.073	1.073	0.967	1.051	1.072	1.068
21		1.083	1.083	0.975	1.061	1.084	1.080
22		1.102	1.102	0.989	1.081	1.101	1.097
23		1.092	1.092	0.985	1.075	1.091	1.089
24		1.130	1.130	1.000	1.100	1.117	1.117
25	1986	1.112	1.112	0.988	1.095	1.115	1.110
26		1.101	1.101	0.981	1.085	1.105	1.100
27		1.123	1.123	1.002	1.106	1.127	1.120
28		1.129	1.129	1.009	1.113	1.133	1.127
29		1.132	1.132	1.009	1.112	1.133	1.127
30		1.099	1.099	0.985	1.075	1.097	1.090
31		1.154	1.154	1.036	1.128	1.153	1.145
32		1.127	1.127	1.010	1.103	1.126	1.116
33		1.145	1.145	1.016	1.110	1.132	1.124
34		1.183	1.183	1.051	1.147	1.168	1.161
35		1.180	1.180	1.058	1.154	1.172	1.164
36		1.205	1.205	1.062	1.168	1.188	1.184
37	1987	1.198	1.198	1.063	1.176	1.201	1.188
38		1.192	1.192	1.059	1.164	1.189	1.177
39		1.203	1.203	1.073	1.180	1.206	1.192
40		1.190	1.190	1.062	1.166	1.189	1.179
41		1.181	1.181	1.054	1.160	1.183	1.173
42		1.198	1.198	1.071	1.177	1.202	1.190
43		1.175	1.175	1.060	1.157	1.180	1.171
44		1.185	1.185	1.066	1.163	1.185	1.176
45		1.200	1.200	1.075	1.176	1.200	1.190
46		1.214	1.214	1.096	1.199	1.218	1.209
47		1.209	1.209	1.106	1.209	1.224	1.218
48		1.279	1.279	1.115	1.244	1.260	1.256

APPENDIX III

Table A-2 (continued)

		Laspeyres Indexes		Divisia Indexes (Co. X Classified, New Goods Excluded)			
Month	Year	X's Classified (Spliced in Jan. 1988)	X's Classified (Not Spliced)	Traditional	4-Month Weights	6-Month Weights	12-Month Weights
49	1988	1.191	1.191	1.055	1.203	1.225	1.210
50		1.188	1.194	1.055	1.195	1.218	1.202
51		1.192	1.201	1.069	1.193	1.217	1.207
52		1.166	1.157	1.049	1.169	1.194	1.180
53		1.177	1.180	1.062	1.186	1.212	1.197
54		1.202	1.207	1.082	1.208	1.234	1.218
55		1.245	1.257	1.121	1.241	1.265	1.250
56		1.221	1.232	1.099	1.215	1.238	1.228
57		1.243	1.261	1.135	1.259	1.284	1.274
58		1.246	1.265	1.142	1.267	1.288	1.280
59		1.228	1.248	1.134	1.254	1.270	1.265
60		1.282	1.332	1.134	1.285	1.308	1.306
61	1989	1.232	1.251	1.094	1.265	1.296	1.273
62		1.225	1.239	1.084	1.247	1.276	1.254
63		1.263	1.313	1.078	1.296	1.325	1.289
64		1.204	1.219	1.046	1.252	1.272	1.255
65		1.238	1.258	1.077	1.294	1.316	1.300
66		1.272	1.298	1.078	1.302	1.324	1.309
67		1.245	1.287	1.075	1.297	1.321	1.301
68		1.283	1.306	1.102	1.329	1.354	1.329
69		1.263	1.299	1.092	1.320	1.348	1.322
70		1.317	1.289	1.104	1.332	1.360	1.338
71		1.272	1.287	1.102	1.326	1.344	1.318
72		1.322	1.345	1.164	1.390	1.412	1.386
1/84 TO 1/85	% growth	5.258%	5.258%	-2.357%	3.697%	4.965%	5.243%
1/85 TO 1/86	% growth	5.634%	5.634%	1.203%	5.575%	6.254%	5.436%
1/86 TO 1/87	% growth	7.741%	7.741%	7.575%	7.382%	7.646%	7.017%
1/87 TO 1/88	% growth	-0.583%	-0.583%	-0.740%	2.291%	2.075%	1.899%
1/88 TO 1/89	% growth	3.405%	5.074%	3.718%	5.230%	5.720%	5.160%
1/89 TO 12/89	% growth	8.007%	8.215%	6.957%	10.763%	9.830%	9.772%
1/84 TO 12/89	% AAGR	4.826%	5.141%	2.600%	5.720%	6.003%	5.673%

APPENDIX III

Table A-2 (continued)

		Divisia Indexes (all using Co. X Classified Data)					
		New Goods Included		New Goods Only		BLS Sample of Co. X	
Month	Year	Traditional	4-Month Weights	Traditional	4-Month Weights	Traditional	4-Month Weights
1	1984	1.000	1.000	1.000	1.000	1.000	1.000
2		0.999	1.013	1.000	1.000	1.024	1.065
3		0.969	0.991	0.979	0.979	0.927	0.983
4		0.967	0.994	0.896	0.896	0.898	0.964
5		0.959	0.991	0.861	0.862	0.927	1.000
6		0.966	0.998	0.751	0.751	0.934	1.010
7		0.976	1.010	0.735	0.737	0.938	1.016
8		0.985	1.025	0.836	0.838	0.961	1.057
9		0.955	1.003	0.732	0.734	0.882	0.991
10		0.961	1.015	0.654	0.655	0.880	1.011
11		0.977	1.038	0.811	0.812	0.910	1.054
12		0.976	1.036	0.823	0.822	0.906	1.046
13	1985	0.976	1.037	0.712	0.712	0.912	1.056
14		0.970	1.035	0.695	0.686	0.921	1.083
15		0.940	1.008	0.676	0.669	0.858	1.026
16		0.950	1.025	0.680	0.674	0.849	1.020
17		0.955	1.034	0.679	0.673	0.862	1.041
18		0.952	1.033	0.671	0.664	0.869	1.056
19		0.973	1.056	0.699	0.691	0.871	1.061
20		0.967	1.051	0.688	0.681	0.859	1.051
21		0.975	1.061	0.695	0.688	0.868	1.083
22		0.989	1.080	0.683	0.676	0.898	1.124
23		0.984	1.074	0.671	0.669	0.893	1.112
24		0.993	1.093	0.556	0.557	0.905	1.156
25	1986	0.986	1.092	0.653	0.649	0.852	1.108
26		0.978	1.082	0.643	0.638	0.854	1.109
27		0.999	1.102	0.643	0.639	0.900	1.164
28		1.005	1.108	0.635	0.632	0.901	1.165
29		1.005	1.108	0.631	0.629	0.899	1.162
30		0.980	1.071	0.605	0.609	0.906	1.165
31		1.029	1.122	0.621	0.625	0.918	1.185
32		1.004	1.098	0.611	0.612	0.927	1.197
33		1.010	1.104	0.608	0.610	0.933	1.207
34		1.044	1.140	0.624	0.626	0.975	1.262
35		1.050	1.146	0.621	0.623	0.974	1.256
36		1.052	1.158	0.620	0.623	0.990	1.299
37	1987	1.054	1.166	0.625	0.628	0.956	1.273
38		1.051	1.155	0.623	0.626	0.986	1.294
39		1.062	1.170	0.620	0.627	1.007	1.334
40		1.051	1.156	0.613	0.620	0.968	1.273
41		1.045	1.151	0.616	0.623	0.949	1.255
42		1.060	1.167	0.620	0.626	0.995	1.309
43		1.052	1.151	0.622	0.628	0.985	1.282
44		1.052	1.151	0.607	0.614	1.006	1.310
45		1.061	1.164	0.611	0.618	0.983	1.294
46		1.076	1.179	0.599	0.607	1.045	1.376
47		1.083	1.188	0.597	0.606	1.049	1.374
48		1.089	1.212	0.593	0.597	1.068	1.448

APPENDIX III
Table A-2 (continued)

		Divisia Indexes (all using Co. X Classified Data)					
		New Goods Included		New Goods Only		BLS Sample of Co. X	
Month	Year	Traditional	4-Month Weights	Traditional	4-Month Weights	Traditional	4-Month Weights
49	1988	1.037	1.174	0.577	0.583	0.976	1.380
50		1.035	1.167	0.572	0.582	0.974	1.376
51		1.046	1.165	0.572	0.579	0.978	1.382
52		1.028	1.146	0.567	0.576	0.985	1.391
53		1.037	1.158	0.567	0.576	0.987	1.395
54		1.020	1.142	0.521	0.533	0.991	1.400
55		1.067	1.187	0.556	0.568	1.003	1.417
56		1.045	1.167	0.542	0.561	1.009	1.425
57		1.066	1.190	0.536	0.554	1.036	1.463
58		1.066	1.190	0.528	0.545	1.039	1.467
59		1.062	1.182	0.529	0.546	1.040	1.469
60		1.059	1.201	0.527	0.545	1.011	1.425
61	1989	1.033	1.189	0.528	0.546	1.049	1.479
62		1.029	1.182	0.534	0.553	1.042	1.469
63		1.016	1.203	0.518	0.538	1.046	1.475
64		0.998	1.180	0.521	0.542	1.049	1.480
65		1.019	1.208	0.523	0.545	1.094	1.546
66		0.997	1.181	0.493	0.508	1.091	1.542
67		1.005	1.195	0.505	0.527	1.066	1.504
68		1.029	1.221	0.516	0.535	1.097	1.550
69		1.009	1.194	0.498	0.512	1.114	1.573
70		1.032	1.242	0.521	0.559	1.115	1.573
71		1.040	1.239	0.536	0.561	1.114	1.566
72		1.092	1.293	0.559	0.581	1.166	1.636
1/84 TO 1/85	% growth	-2.382%	3.664%	-28.790%	-28.759%	-8.813%	5.615%
1/85 TO 1/86	% growth	0.963%	5.294%	-8.257%	-8.878%	-6.513%	4.917%
1/86 TO 1/87	% growth	6.961%	6.824%	-4.407%	-3.303%	12.152%	14.901%
1/87 TO 1/88	% growth	-1.656%	0.701%	-7.576%	-7.075%	2.119%	8.356%
1/88 TO 1/89	% growth	-0.358%	1.223%	-8.572%	-6.435%	7.437%	7.213%
1/89 TO 12/89	% growth	6.275%	9.637%	6.448%	6.980%	12.191%	11.653%
1/84 TO 12/89	% AAGR	1.503%	4.441%	-9.367%	-8.780%	2.624%	8.680%

TABLE NOTES: The growth rate from 1/89 to 12/89 is the 11-month growth rate expressed at an annual rate. The average annual growth rate (AAGR) in the bottom row is computed as 100{exp[ln(I[t]/I[t-71])] - 1), where t is the December 1989 monthly observation. The BLS producer price indexes are taken from various issues of the U.S. Department of Labor, Bureau of Labor Statistics monthly publication, "Producer Price Indexes Data."

Figure 1

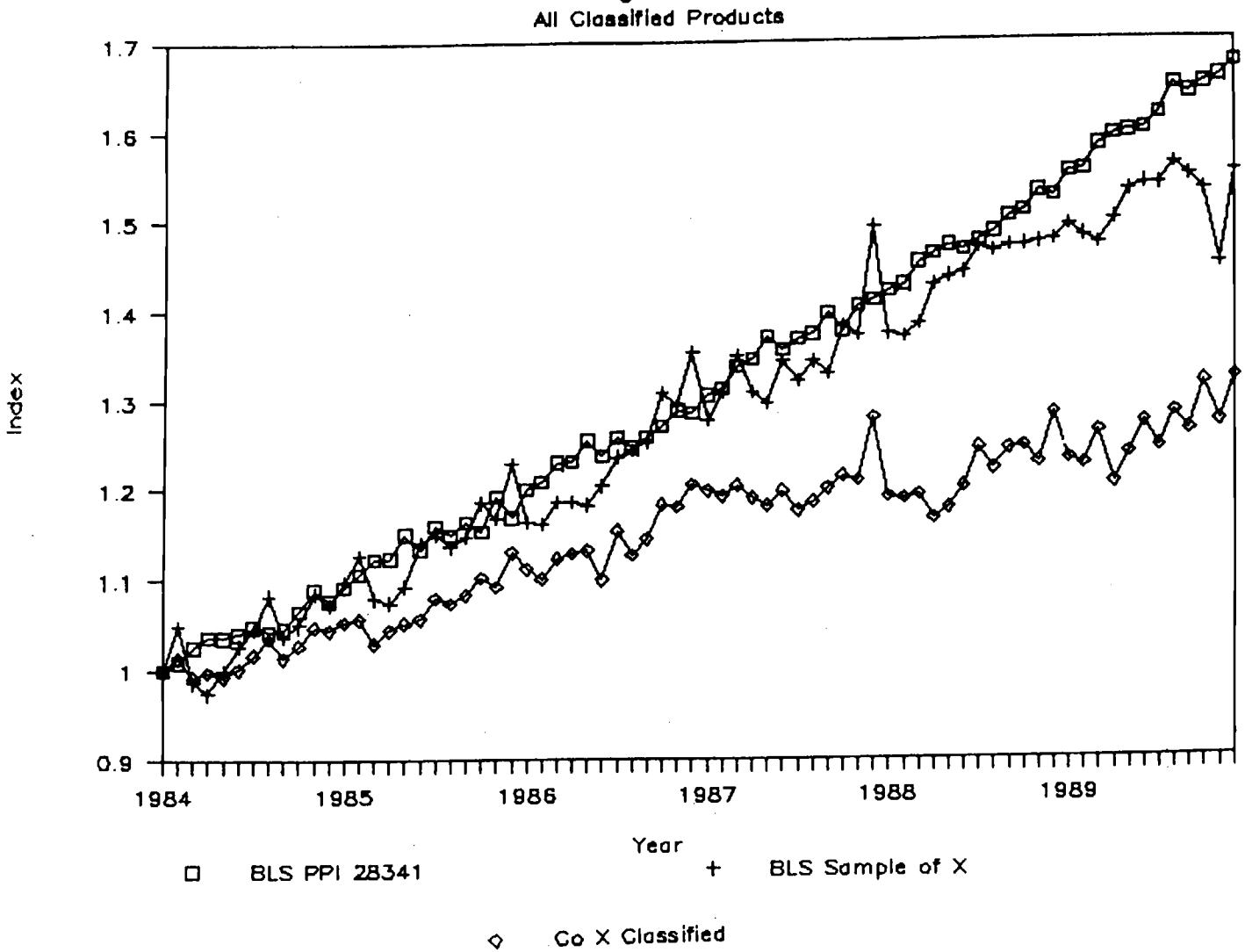

All Classified Products
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
Index
1984
1985
1986
1987
1988
1989
Year
BLS PPI 28341
BLS Sample of X
Co X Classified

Figure II

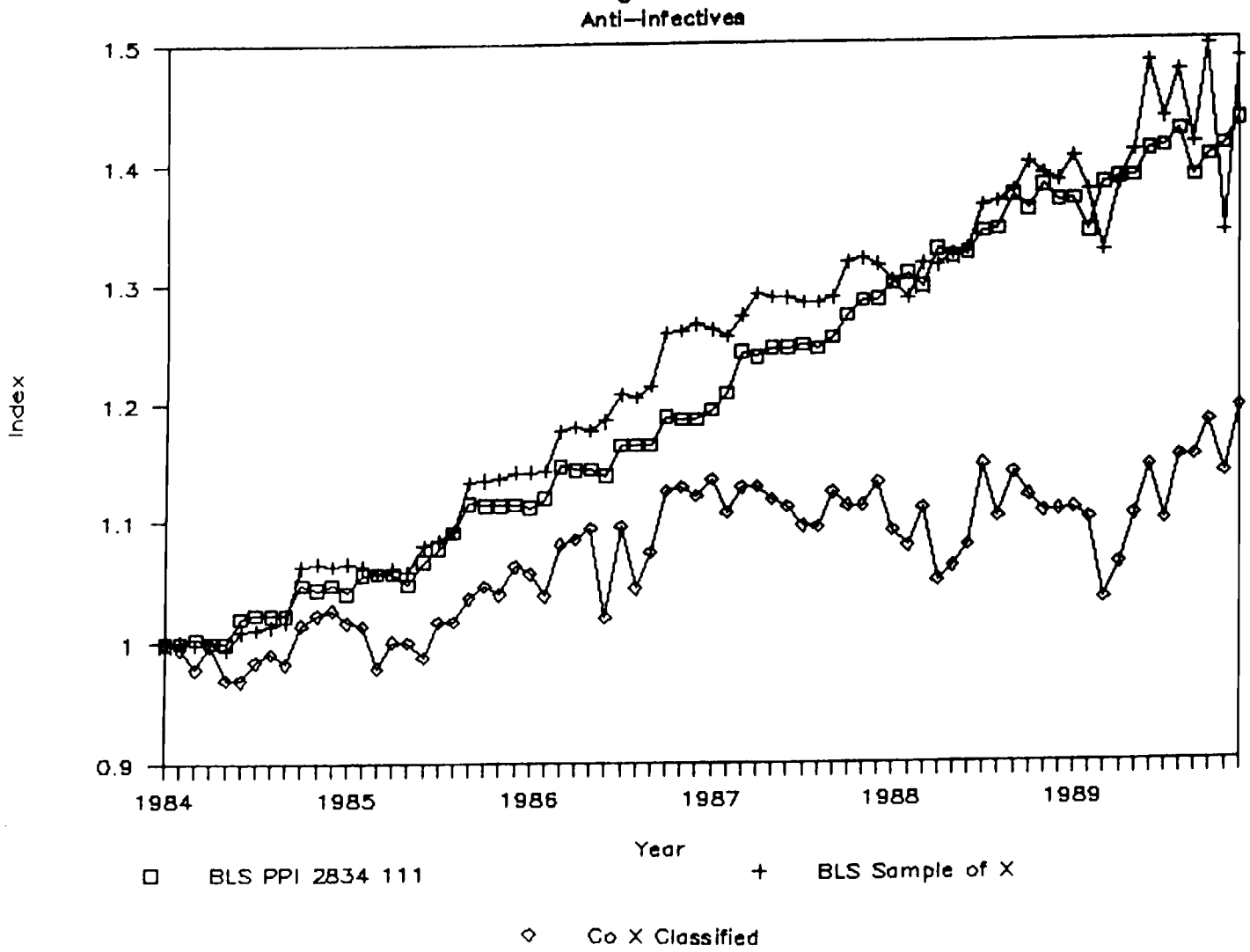

Anti-Infectives
1.5
1.4
1.3
1.2
1.1
1
0.9
Index
1984
1985
1986
1987
1988
1989
Year
BLS PPI 2834 111
BLS Sample of X
Co X Classified

Figure III

Divisia With MA Revenue Weights, Excluding New Goods

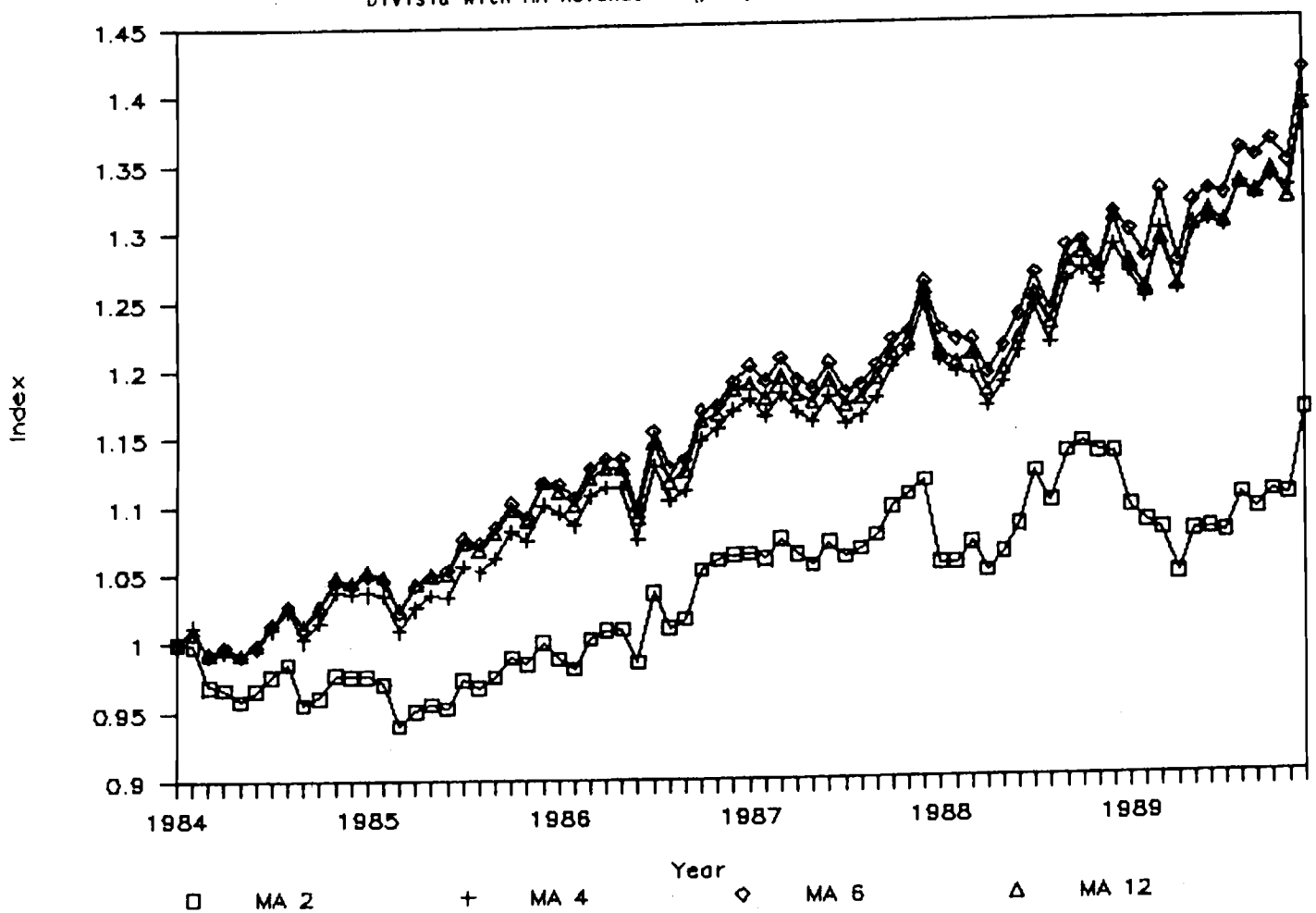


Figure IV

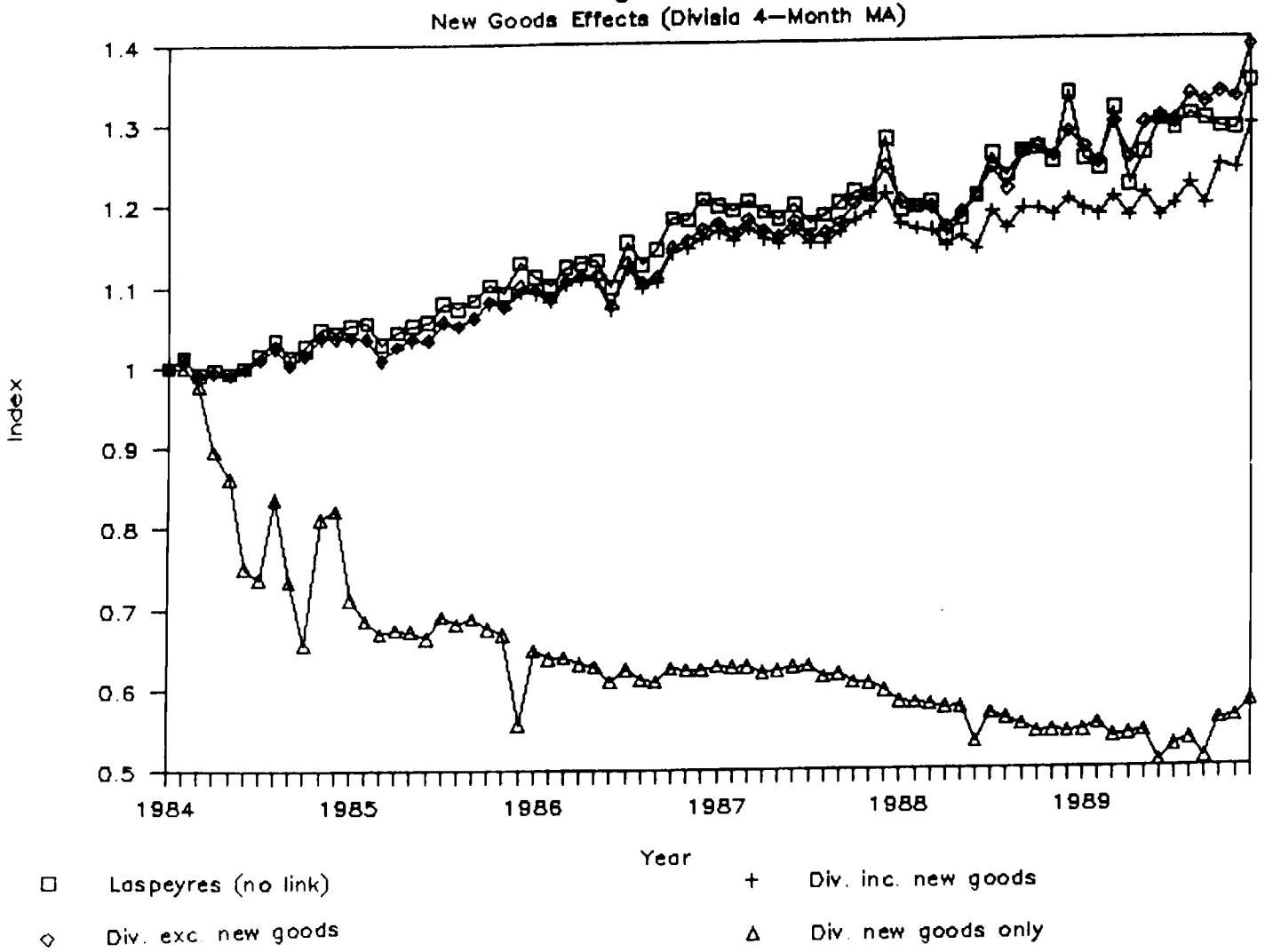

New Goods Effects (Divisia 4—Month MA)
Index
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
1984
1985
1986
1987
1988
1989
Year
Laspeyres (no link)
Div. exc. new goods
Div. inc. new goods
Div. new goods only

Figure V

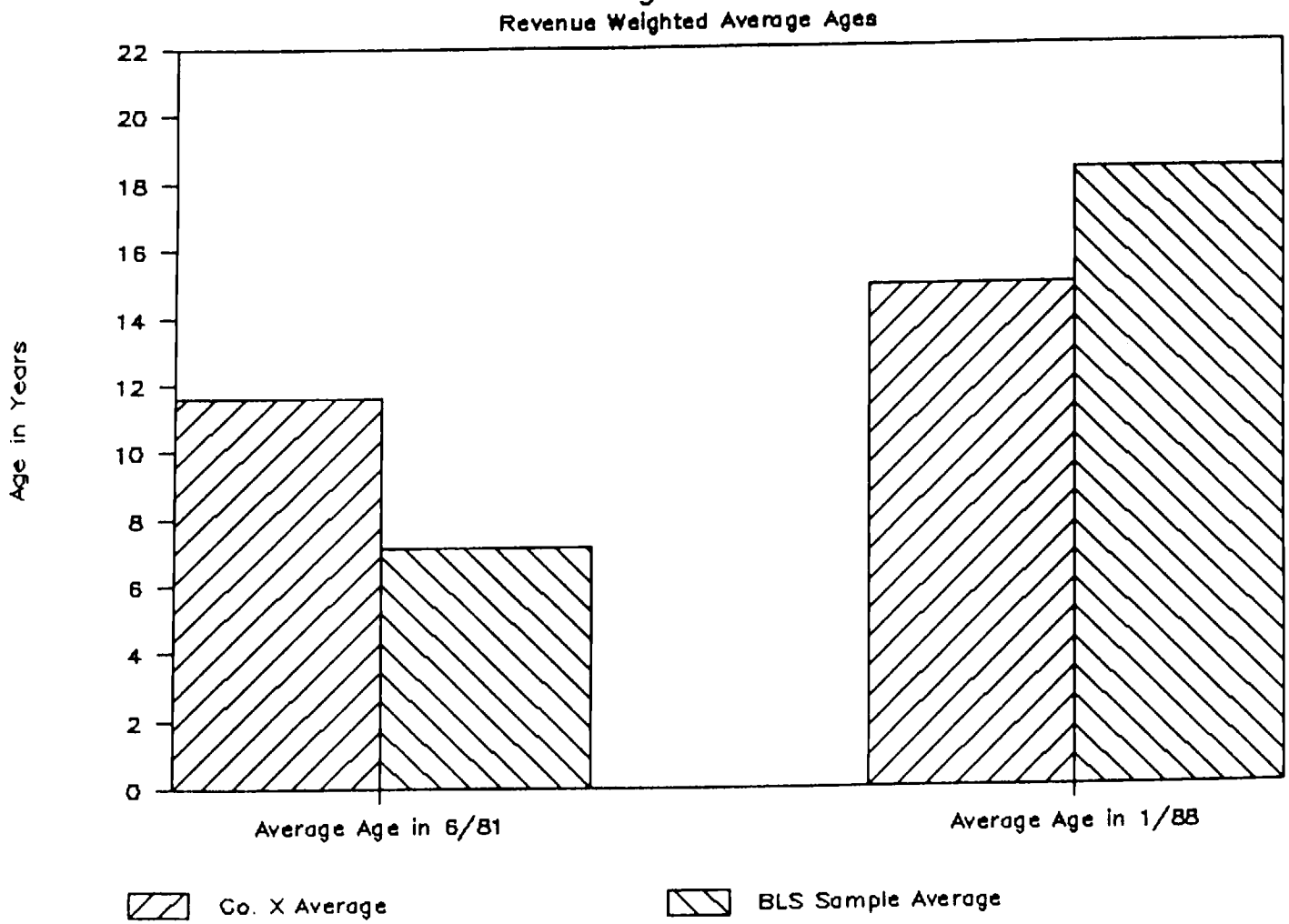
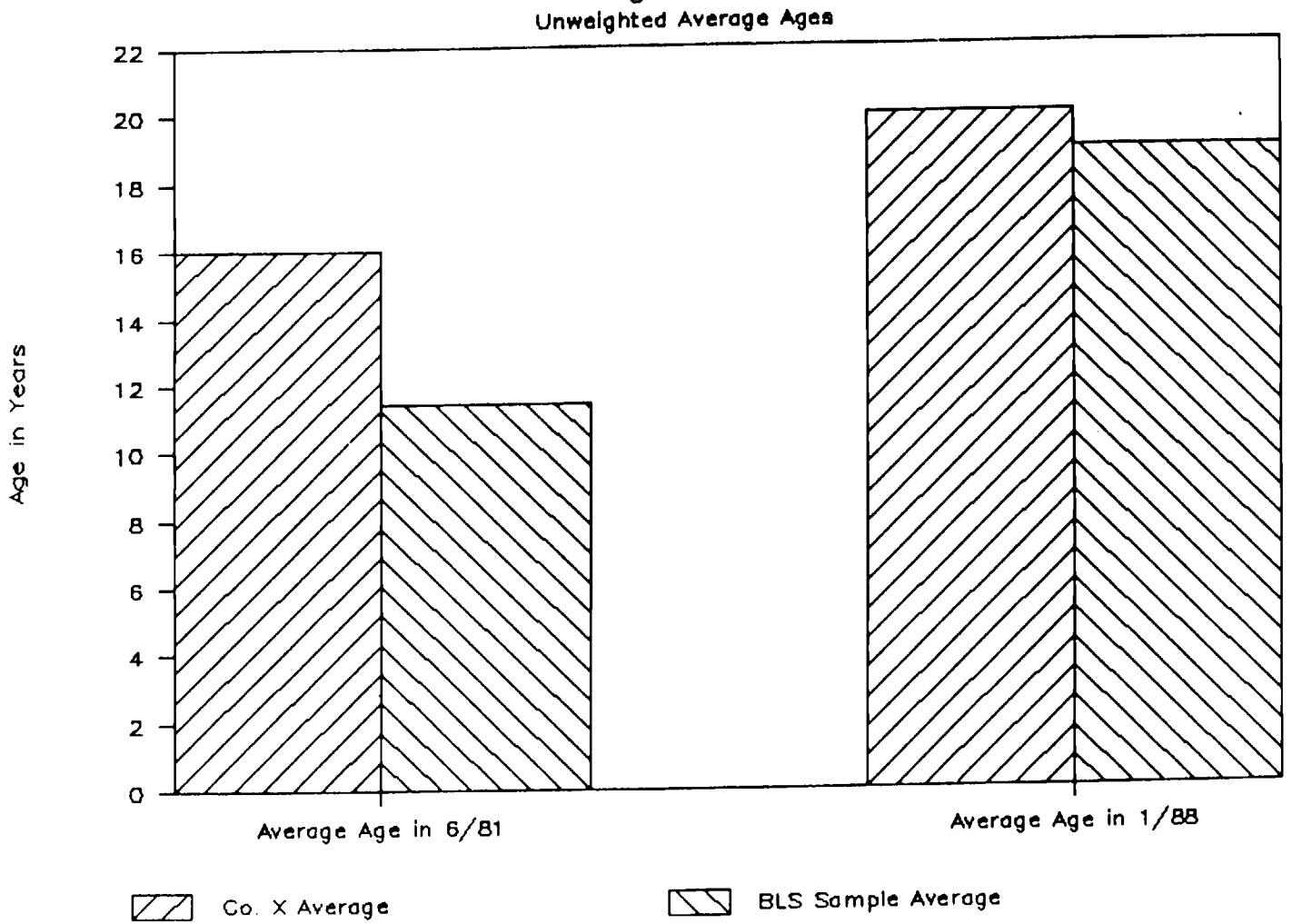

Revenue Weighted Average Ages
Age in Years
22
20
18
16
14
12
10
8
6
4
2
0
Average Age in 6/81
Average Age in 1/88
Co. X Average
BLS Sample Average

Figure VI


Unweighted Average Ages
Age in Years
22
20
18
16
14
12
10
8
6
4
2
0
Average Age in 6/81
Average Age in 1/88
Co. X Average
BLS Sample Average