Price indexes for pharmaceuticals used by the elderly

by Joseph Thomas, III and Stephen Schondelmeyer

The analysis presented in this report was undertaken to identify those drug entities that account for a significant proportion of the retail expenditures for prescription drugs used by the elderly. Commercial data bases were used to develop fixed weight Laspeyres price indexes based specifically on drugs used in the elderly population. The indexes provide the capability to analyze price trends for drug groupings that are not possible with the producer price index (PPI) or the Consumer Price Index (CPI). From 1981 through 1988, the average annual rate of increase in manufacturers' prices was 9.1 percent, and retail prices increased at an average annual rate of 6.6 percent. The indexes represent potentially powerful tools in analyzing drug price trends, an important component of drug program expenditure forecasting and management.

Introduction

The elderly population, comprised of persons 65 years of age or over, is growing rapidly in number and as a percent of the total U.S. population. As a result, the utilization and cost of health care in this population segment has become of increased interest. Prescription drugs represent a significant part of health care for the elderly as well as a significant expense item for most elderly persons. In fact, it was estimated that elderly persons incurred average annual prescription drug expenditures of $385 in 1987 (Berk, Schur, and Mohr, 1990).

In the summer of 1988, when Congress passed the Medicare Catastrophic Coverage Act of 1988 (Public Law 100-360), coverage of catastrophic expenditures for outpatient prescriptions was included. Although the legislation was repealed by the fall of 1989, efforts to develop budget estimates for the prescription benefit and other preparations for its implementation highlighted the need for detailed pharmaceutical price trend data at both the manufacturer and retail levels.

In a report to Congress on manufacturers' prices and pharmacists' charges, the Consumer Price Index (CPI) and the producer price index (PPI) were used to analyze trends in manufacturers' prices and retail charges for prescription pharmaceuticals (Health Care Financing Administration, 1989). However, that analysis was limited by the small number of drugs covered in the CPI and PPI. Additionally, the CPI and PPI are based on a market basket of prescription pharmaceuticals used by the U.S. population as a whole and could not be used to identify drugs that represent the mix (or market basket) of prescription drugs used by the Nation's elderly. Estimation of future prescription expenditures for defined beneficiary groups such as the elderly requires trend data for forecasting changes in prices for drugs used in that population as well as forecasting changes in prescription drug utilization rates within the population. Indexes that characterize changes in manufacturers' prices and retail prices for prescription drugs used by special populations such as the elderly could fill this need. This article describes the construction of indexes that include a much broader mix of drug products than are found in the CPI or PPI and can measure price changes for drugs used by a specific beneficiary group, the elderly.

Study objectives

The overall goal was to determine changes in manufacturers' prices and pharmacists' charges for outpatient prescription drugs used by the elderly. Specific objectives established to accomplish this goal included:

- Identifying and ranking, in descending order by expenditures, outpatient prescription drugs that account for 80 percent of total expenditures for prescription drugs used by persons 65 years of age or over.
- Developing fixed-weight indexes that reflect the relative change in manufacturers' prices and retail prices from January 1981 through December 1988 for prescription drugs used by the elderly in each of the following groups:
  All prescription drugs.
  Single-source drugs.
  Multiple-source drugs.
  Originator multiple-source drugs.
  Non-originator multiple-source drugs.
  Pre-1981 multiple-source drugs.
  Post-1981 multiple source drugs.
- Determining the relative change in pharmacies' margins (average dollar margin per prescription, average dollar margin per unit, and average dollar margin as a percent of the average retail prescription price) from January 1981 through December 1988.

Methods

Data sources

Data used to accomplish the study objectives were obtained from commercial data bases maintained by IMS America, Ltd, and a data base maintained by MediSpan, Inc. IMS utilized special programming support to create an extracted file of pertinent data elements from three of its data bases: (1) the National

Disease and Therapeutic Index (NDTI), (2) the U.S. Pharmaceutical Market—Drugstores (USD) and, (3) the National Prescription Audit (NPA).

NDTI, begun in 1956, is a continuing compilation of statistical information about the patterns and treatment of diseases encountered by physicians in office-based practice in the continental United States. The number of patient visits along with the number and types of drug therapy are recorded in association with a variety of patient and physician characteristics including patient age. NDTI was used in this project to determine the outpatient drug therapies used most frequently by the elderly population.

The USD data base is a monthly report on the volume, in terms of dollars and units (i.e., tablets, capsules, or milliliters), of both prescription and over-the-counter pharmaceutical products purchased for resale by retail outlets in the continental United States. These estimates are based on information collected from drug wholesalers, independent and chain pharmacies, and discount houses or mass merchandisers. The audit's universe of measurement does not include supermarket, department store, or mail-order pharmacies. This data base was used to measure the purchases of prescription products into retail pharmacies.

The NPA data base has been maintained since 1952 as a measure of the rate at which drugs move by means of formal prescriptions out of retail pharmacies to consumers in the continental United States. Data from the NPA data base included the number of prescriptions, the price per prescription, and the number of dosage units per prescription dispensed for each drug.

The Master Drug Data Base (MDDB), a drug price data base maintained by MediSpan, Inc., since 1978, was also used in the analysis. This data base was used to verify data values and to identify the multiple-source status of various drug products. (For additional detail, see Thomas and Schondelmeyer, 1990.)

Expenditures analysis

Because NPA data do not record prescription activity by consumer age, NDTI data on drug mentions was used to estimate the proportion of retail expenditures on each drug product that was accounted for by the elderly. This proportion of prescription mentions accounted for by individuals 65 years of age or over was multiplied by NPA expenditures for each drug product to estimate the retail prescription expenditures accounted for by drugs used by the elderly. The total retail expenditures on drugs used by elderly consumers was estimated by summing the expenditures for the elderly across all products. The drugs were then sorted by expenditures in the elderly population, and cumulative totals were calculated to find which drugs accounted for 80 percent of 1988 total drug expenditures for drugs used by the elderly.

Price-trend analysis

Price indexes

Several price indexes were developed to allow analysis of trends in drug prices. Because the objective was to assess the magnitude of price changes over time apart from changes in the mix of drugs dispensed, Laspeyres price indexes were developed. Laspeyres indexes are fixed weight price indexes in which quantities of items purchased in a chosen base year are employed as weights. The indexes are based on comparing the cost of purchasing fixed quantities, those identified in the base year, of a fixed set or (market basket) of items at prices in different time periods with the cost of purchasing that same market basket in the comparison or base period (Cagan and Moore, 1981). In this case, the quantities used were the numbers of capsules, tablets, or milliliters of liquids for each product dispensed by pharmacies in the base year.

Choice of the base year for product quantities to be used as weights in the index was influenced by several factors. Use of fixed-weight price indexes meant that products not marketed in the base year would be excluded from the index. After examining the number of products that would have been excluded if each alternative base year had been selected, 1984 was chosen to balance exclusion of products not marketed before the base year and inclusion of products for which very few data points were available.

Only drugs included in the list of drug entities accounting for 80 percent of retail prescription expenditures by consumers 65 years of age or over and those drugs for which 1984 expenditure data existed were included in the indexes. Manufacturer and retail level product costs were estimated at semi-annual intervals from January 1981 through December 1988. Products were required to have valid data for at least 11 of 16 possible observation periods for manufacturer prices and 11 of 16 possible observation periods for retail prices. Each product's contribution, or weight in an index, was based on the total quantity of the item purchased at the retail level from July through December 1984.

A composite retail drug price index was developed to represent the changes in prices of all the relevant drugs. To calculate the value of the index in a given time period, NPA-based unit retail price for each drug product during that time period was multiplied by the NPA estimate of the quantity of the product sold at retail in the 1984 base year. After multiplying the period's prices by the base period quantities for each drug product, the results were summed to yield the cost of purchasing the market basket of drugs at that period's prices. The estimate of the total cost of the market basket of drugs in the given time period was divided by the total cost of the 1984 base period quantities of each product at 1984 prices to yield the index value for the chosen time period. After calculation of index values for each period, index values were multiplied by a constant that adjusted the January through June 1981 period to a value of 100 (Technical

note). This adjustment was for convenience in comparing the relative magnitude of price changes in various price indexes and for ease in presenting graphical trends in the value of the indexes over time. The composite manufacturers' drug price index was calculated in a similar manner. However, to maximize comparability of the manufacturer and retail level indexes, the same weights, i.e. the quantities used in the retail price index, were multiplied by manufacturers' unit prices for each item as calculated from USD data.

Because of the hypothesized impact on prices of differences in the level of competition for single-source and multiple-source drugs, separate retail and manufacturer level price indexes were calculated for single-source and multiple-source drugs. In order to analyze price trends for products that were recently available from multiple sources with those that had been multiple source for long periods, price changes were analyzed separately for pre-1981 and post-1981 multiple-source drugs. Price changes for originator and non-originator products for multiple-source drugs were also analyzed to detect whether those differences affected changes in prices (Technical note).

Pharmacy margin analysis

To evaluate the relative contribution of pharmacists' charges to changes in retail prescription prices, the difference (or margin) between what pharmacists paid for pharmaceuticals and the retail prices paid by consumers was analyzed. This margin does not represent pharmacies' profit. It represents the fraction of sales revenue left to pay operating costs such as rent, utilities, and employees' wages after product costs have been subtracted. Pharmacies' profit would consist of any residual margin left after all other expenses have been paid. Such a measure allows the analysis to focus purely on the differential between what pharmacies must pay for drug products and the total charge to their retail customers.

Two approaches were taken in this analysis. The first approach focused on analysis of the average dollar margin received by pharmacies on each prescription dispensed. The second approach was based on analysis of pharmacies' average dollar margin on each unit of drug product sold. The definition of unit used was the IMS defined "extended unit," which is generally equivalent to one capsule or tablet for solid dosage forms or one milliliter for liquid drug products. Analysis of margin per unit removed the effect of changes in the number of units dispensed per prescription.

The estimate of manufacturers' unit price for each drug during each period was multiplied by the total number of units of the drug dispensed at the retail level during the corresponding period. This provided an estimate of the total manufacturers' price for the number of units dispensed at retail. In other words, this represented pharmacies' product acquisition costs for the number of units dispensed in a given period. This aggregate product acquisition cost was subtracted from the NPA-based estimate of total revenue received from retail prescription sales of each drug. This provided a

measure of pharmacies' charges, or margin, on each drug during each time period. A pharmacy charge, or margin, was calculated at both the per prescription and the per unit levels.

Results

Expenditures

The estimate of total 1988 retail prescription drug expenditures based on NPA data was $26.5 billion. Expenditures for prescription drugs used by the elderly population were estimated at $9.1 billion, or 34.3 percent of total retail expenditures on prescription drugs. A total of only 104 drug entities, 41 single source and 63 multiple source, accounted for 80 percent of retail drug expenditures by the elderly population. The 104 entities represented 11.4 percent of the 913 total drug entities in the data base.

The 63 multiple-source drug entities accounted for 44.2 percent of the elderly's total retail prescription drug expenditures, and the single-source drugs accounted for 35.9 percent of such expenditures. The remaining 809 drug entities that accounted for 19.9 percent of the elderly's total retail prescription drug expenditures were not classified.

Drugs accounting for the highest proportion of retail expenditures for drugs used by the elderly were not necessarily those used most frequently by elderly individuals. For example, ranitidine was ranked number one based on proportion of expenditures. However, when the drugs were ranked by percent of total dosage units used by the elderly, ranitidine was ranked 70 out of the 104 drugs accounting for 80 percent of expenditures by the elderly. Patients 65 years of age or over received 35.6 percent of all the units of ranitidine dispensed. This is in contrast with 89.1 percent of all ergoloid dosage units that were dispensed to elderly patients. Similarly, chlorthalidone was ranked 104 based on expenditures in the elderly but was ranked 33 in terms of percentage of units used by the elderly.

These findings can be explained by differences between the elderly and the general population with respect to use of individual drugs as reflected in the number of total units used. Wide differences in cost per dosage unit across individual drugs also explain differences in percent of units used and percent of elderly drug expenditures accounted for by various drugs.

Pharmaceutical price changes: 1981-88

A total 85 of the 104 drug entities accounting for 80 percent of retail expenditures by the elderly were included in the price indexes after applying the exclusion criteria previously described in the methods section. Single-source drug entities accounted for 24 of the 85 drugs included, and the other 61 drug entities were classified as multiple-source drugs. A total of 1,122 drug products were included in the index when drug entity, dosage form, dosage strength, and

Figure 1
Manufacturer and retail price indexes: All drugs, single-source drugs, and multiple-source drugs, 1981-88

NOTE: Data are for Jan.-June and July-Dec. for each of the years 1981-88.
SOURCE: Thomas, J., and Schondelmeyer, S.: Purdue University, West Lafayette, Indiana, 1990.
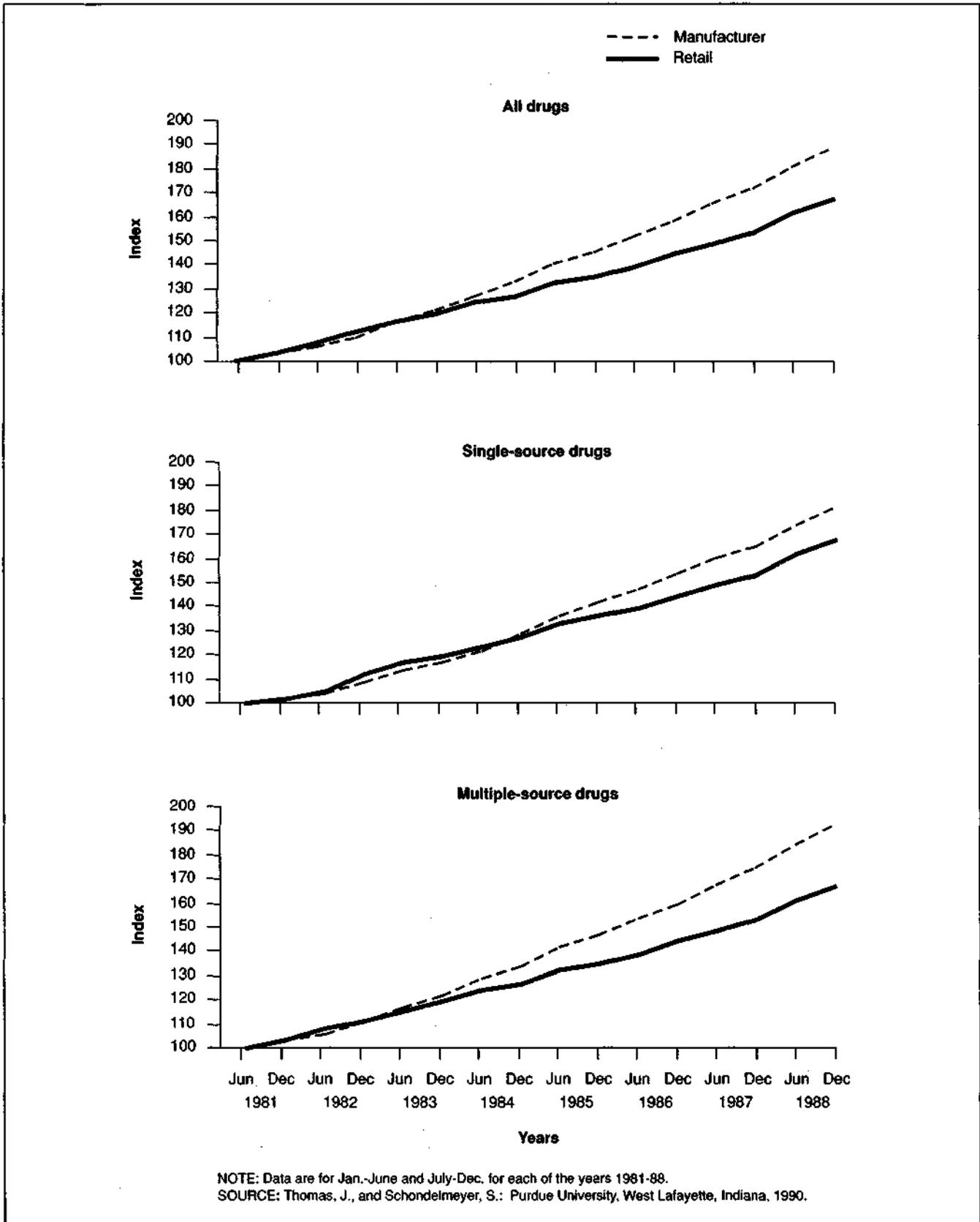
Table 1
Annual change and total change in manufacturer and retail drug price indexes: 1982-88

Category	Percent change December 1981 through December 1988[1]	Average annual percent change	1982	1983	1984	1985	1986	1987	1988
Manufacturer indexes					Annual	percent	change		
All drugs	83.5	9.1	7.3	9.5	9.6	9.6	8.7	8.7	10.1
All single-source drugs	78.1	8.6	7.6	7.3	9.8	10.2	8.1	7.3	9.9
All multiple-source drugs	85.8	9.3	7.2	10.4	9.5	9.3	9.0	9.4	10.1
Multiple-source originator[2]	105.0	10.8	8.9	12.9	11.5	10.5	10.4	10.2	10.9
Multiple-source non-originator[2]	20.0	2.7	2.1	0.7	-0.5	3.3	2.1	4.7	6.3
Pre-1981 multiple source	77.2	8.5	6.9	9.1	8.8	8.6	8.8	8.4	9.1
Post-1981 multiple source	103.0	10.6	7.9	13.0	10.7	10.6	9.2	11.2	11.9
Retail indexes									
All drugs	62.6	7.2	8.7	6.3	6.6	6.8	6.5	6.5	9.0
All single-source drugs	64.4	7.4	10.3	5.9	6.7	7.5	5.9	6.2	9.1
All multiple-source drugs	61.9	7.1	8.1	6.5	6.5	6.5	6.8	6.6	9.0
Multiple-source originator[2]	76.3	8.4	9.2	8.3	8.1	7.9	7.9	7.5	10.1
Multiple-source non-originator[2]	20.3	2.7	5.8	1.1	1.6	1.1	3.2	2.2	3.8
Pre-1981 multiple source	55.3	6.5	8.1	5.3	6.0	5.7	6.6	5.5	8.3
Post-1981 multiple source	76.6	8.5	8.1	9.1	7.7	8.1	7.0	8.8	10.5

[1]The column presents changes in price indexes from June through December 1981 to June through December 1988.
[2]Four multisource drug entities (nitroglycerin, theophylline, potassium, and quinidine) included in the multisource categories were excluded from the originator and non-originator comparisons because data necessary to identify originators was unavailable or because the existence of different originators across dosage forms prevented calculation of summative data at the entity level.

SOURCE: Thomas, J., and Schondelmeyer, S.: Purdue University, West Lafayette, Indiana, 1990.

manufacturer were considered. The 85 drug entities represented in the index accounted for 66.7 percent of all drug expenditures by the elderly.

All drugs

The manufacturer drug price index for all drugs increased at an average annual rate of 9.1 percent from 1981 through 1988, and the retail prescription price index increased at an average annual rate of 7.2 percent (Figure 1). The manufacturer price index for all drugs experienced a total increase of 83.5 percent, and the retail price index increased 62.6 percent from 1981 through 1988 (Table 1). In other words, the percent increase in the retail prescription price index for all drugs was less than the percent increase in the manufacturers' price index during the same time period.

Single-source drugs

The manufacture price index for single-source drugs increased at an average annual rate of 8.6 percent from 1981 through 1988 as contrasted with a 7.4-percent average annual increase in the retail price index for single-source drugs (Figure 1). The July through December 1988 manufacturer price index for single-source drugs was 78.1 percent greater than its July through December 1981 value. The retail price index increased 64.4 percent during the same time period (Table 1).

Multiple-source drugs

Trends in the manufacturer and retail drug price indexes for multiple-source drugs are shown in Figure 1.

The manufacturer price index for multiple-source drugs increased 85.8 percent from 1981 through 1988. The retail price index increased 61.9 percent during that same period. The average annual increase in manufacturer and retail price indexes for multiple-source drugs was 9.3 percent and 7.1 percent, respectively (Table 1).

Originators and non-originators

From 1981 through 1988 the retail and manufacturer price indexes for originator multiple-source drugs increased much more than the corresponding indexes for non-originator multiple-source drugs (Figure 2). The average annual percent change in the retail price index for originator drugs was 8.4 percent from 1981 through 1988. Non-originator drugs had an average annual increase in the retail index of 2.7 percent during the same period.

The total increase in the retail price index for multiple-source originator drugs from 1981 through 1988 was 76.3 percent as compared with a 20.3-percent increase in the retail price index for non-originator multiple-source drugs during the same period (Table 1). The total change in the manufacturer price index for originator multiple-source drugs was 105.0 percent as compared with a 20.0-percent increase in the manufacturer price index for non-originator multiple-source drugs from 1981 through 1988 (Table 1).

The manufacturer price index had a greater cumulative increase than the retail price index for originator drugs. The manufacturer price index for originator multiple-source drugs increased 105.0 percent between 1981 and 1988 in comparison

Figure 2
Manufacturer and retail multiple-source drugs price indexes: Pre- and post-1980, originator and non-originator, pre-1981 originator and non-originator, post-1981 originator and non-originator, 1981-88
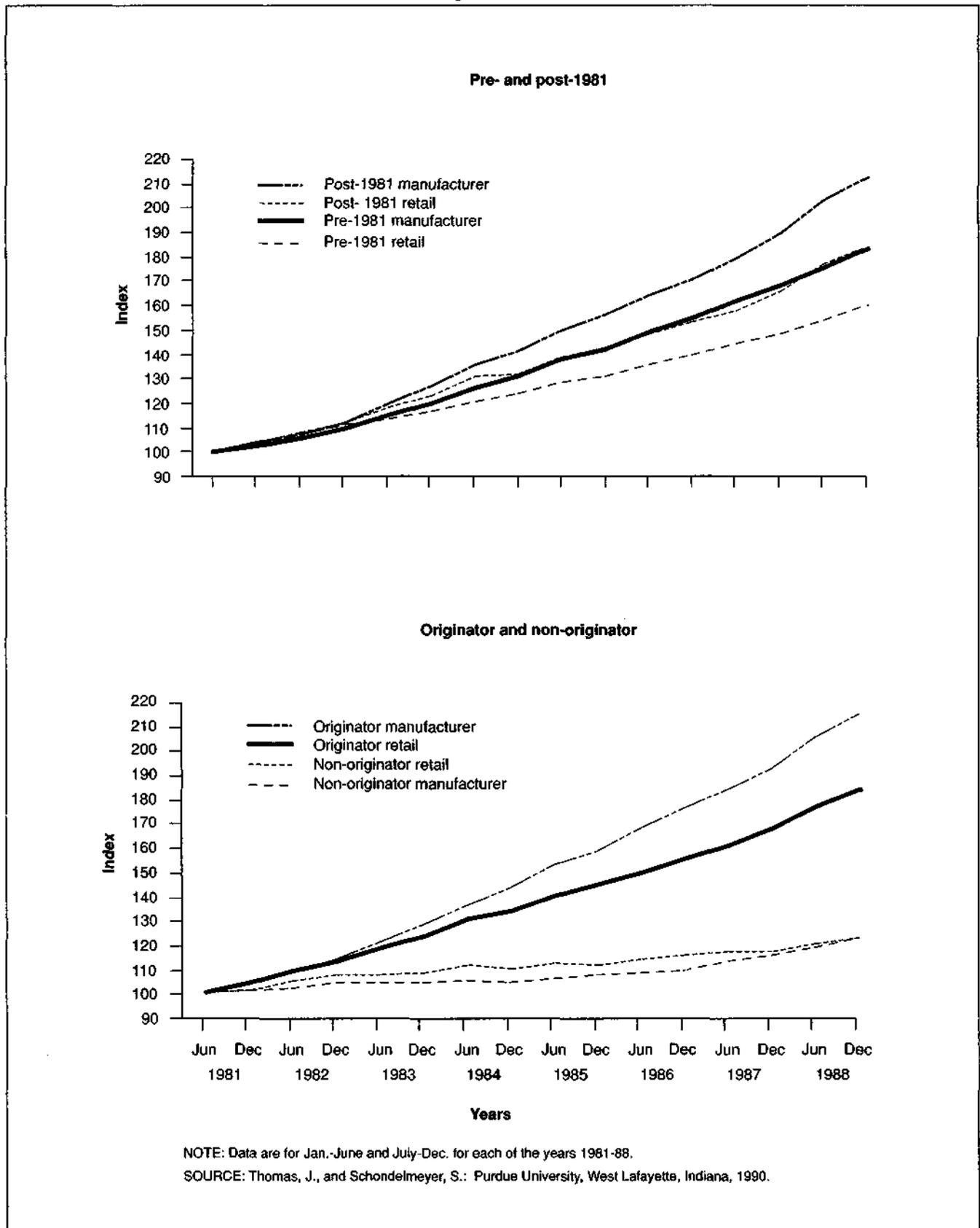
Pre- and post-1981

Legend:
- Post-1981 manufacturer
- Post- 1981 retail
- Pre-1981 manufacturer
- Pre-1981 retail

Originator and non-originator

Legend:
- Originator manufacturer
- Originator retail
- Non-originator retail
- Non-originator manufacturer

Years: Jun Dec 1981, Jun Dec 1982, Jun Dec 1983, Jun Dec 1984, Jun Dec 1985, Jun Dec 1986, Jun Dec 1987, Jun Dec 1988

NOTE: Data are for Jan.-June and July-Dec. for each of the years 1981-88.

SOURCE: Thomas, J., and Schondelmeyer, S.: Purdue University, West Lafayette, Indiana, 1990.

Figure 2 – Continued
Manufacturer and retail multiple-source drugs price indexes: Pre- and post-1980, originator and non-originator, pre-1981 originator and non-originator, post-1981 originator and non-originator, 1981-88

Pre-1981 originator and non-originator

Legend:
——-- Originator manufacturer
—— Originator retail
------ Non-originator retail
— — Non-originator manufacturer

Post-1981 originator and non-originator

Legend:
——-- Originator manufacturer
—— Originator retail
------ Non-originator retail
— — — Non-originator manufacturer
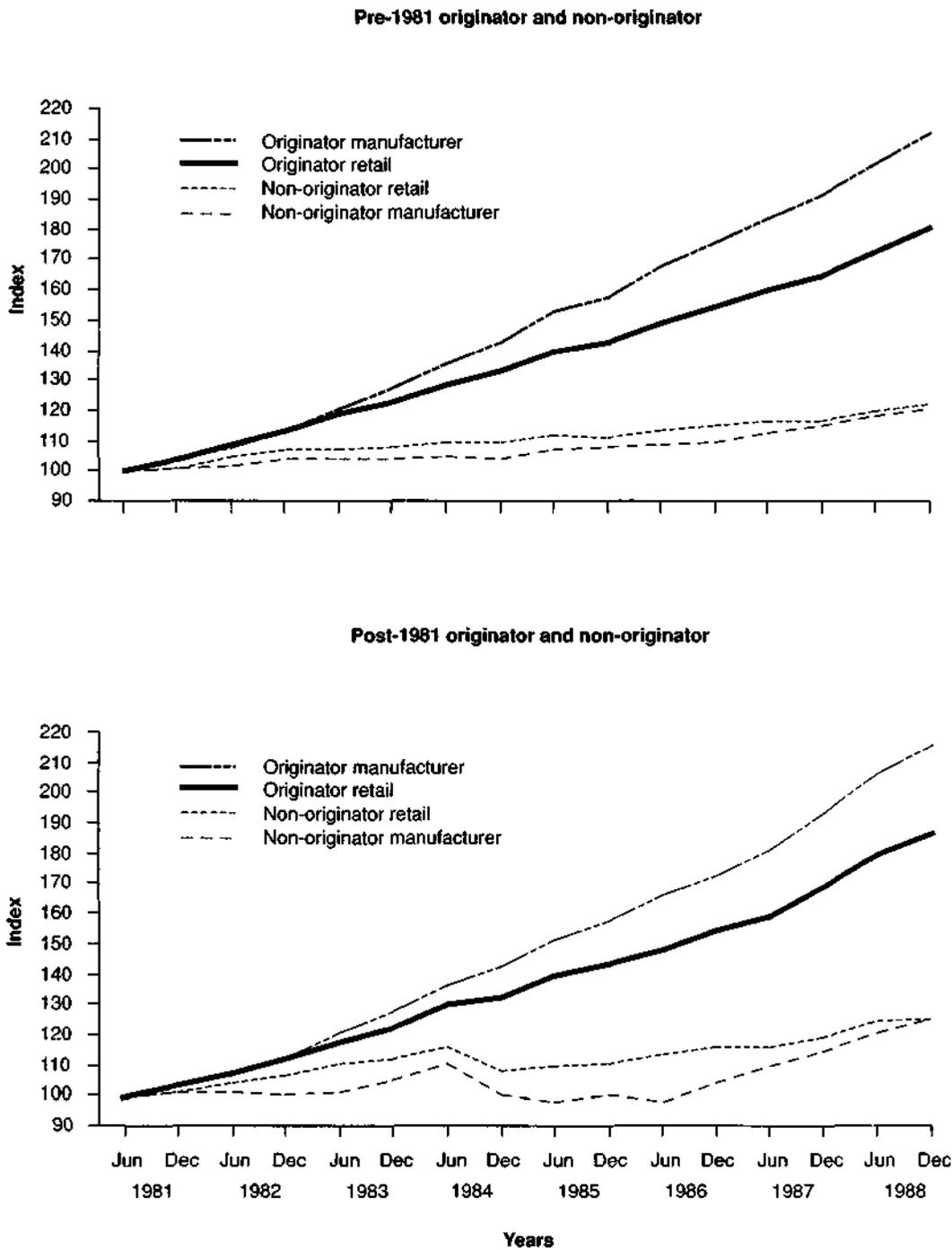
NOTE: Data are for Jan.-June and July-Dec. for each of the years 1981-88.

SOURCE: Thomas, J., and Schondelmeyer, S.: Purdue University, West Lafayette, Indiana, 1990.

with the 76.3-percent increase in the corresponding retail price index (Figure 2). For non-originator multiple-source drugs, there was a 20.0-percent increase in the manufacturer price index and a 20.3-percent increase in the retail prescription price index from 1981 through 1988.

A total of 32 multiple-source drugs had data for originator and non-originator products included in the Laspeyres indexes. The average annual change in prices for originator products was greater than that of non-originator products for 27 of 32 drugs based on both retail and manufacturer prices. Therefore, the tendency for originator multiple-source products to have higher increases in prices than non-originator products appeared to be a general one, although there were some exceptions.

Pre-1981 and post-1981 multiple-source drugs

Trends in the Laspeyres price indexes for pre-1981 and post-1981 multiple-source drugs are shown in Figure 2. The increase in the retail price index from 1981 through 1988 for drugs that were available from multiple sources prior to 1981 was 55.3 percent as contrasted with a 76.6-percent increase in the index for drugs that became available from multiple sources after 1981 (Table 1). The average annual increase in the retail price index was 6.5 percent for pre-1981 drugs and 8.5 percent for drugs that became available from multiple sources after 1981. The manufacturer price index again outstripped the retail index and showed a change for the 1981-88 period of 77.2 percent for pre-1981 multiple-source drugs and 103.0 percent for post-1981 multiple-source drugs.

Comparison of price change indexes

The CPI and PPI are price change indexes, maintained by the U.S. Bureau of Labor Statistics, that track price changes of a market basket of prescription drugs over time. A previous report (Health Care Financing Administration, 1989) analyzed and summarized prescription price change trends based on CPI for prescription drugs and PPI for prescription drugs.

The retail and manufacturer price indexes in this study are similar to CPI and PPI, respectively, but include prescription product transactions for drug products that account for 80 percent of the retail expenditures by persons 65 years of age or over. One should note that CPI and PPI reflect a different set of drugs than the indexes in this article.

The Laspeyres retail prescription price index was compared with CPI for prescription drugs for the 1981-88 period. A difference of more than 20 percentage points between the CPI for prescription drugs and the retail price index from this study was found for the period 1981-88. The weighted retail index prepared for this analysis increased 62.6 percent from 1981 through 1988. During this same period, CPI for prescription drugs increased 85.5 percent. Although a number of factors may have contributed to this difference, one major factor explaining this gap may

have been the difference in types of prescription transactions included in these two indexes. The retail prescription price index developed in this study included all types of prescription transactions in retail pharmacies including cash transactions and third-party transactions such as prescriptions covered by private insurance or the Medicaid programs.

CPI for prescription drugs, in contrast, includes only those prescription transactions paid for directly by the end consumer. In other words, the prescriptions covered by public and private third-party programs were not included in the set of prices evaluated by CPI for prescription drugs. In 1989, 41.5 percent of all retail prescriptions were paid directly by third-party programs, i.e., Medicaid and private insurance (Siegelman, 1990). The price paid by third-party prescription programs is often less than the price paid by the general public for a specific prescription. Therefore, inclusion of third-party prescriptions in the retail index developed may partly explain differences in its trend over time and trends in CPI for prescription drugs.

Although PPI for prescription pharmaceuticals increased 89.6 percent, the weighted manufacturer index increased a total of 83.5 percent for the 7-year period. These two manufacturer price indexes differed very little during the period 1981-88 in comparison with the difference found in CPIs. The type of manufacturer price transactions considered by this study's manufacturer price index and by PPI for prescription pharmaceuticals did not differ substantially.

Both the retail and manufacturer weighted indexes, based on the prescription drug products accounting for 80 percent of the retail prescription expenditures by persons 65 years of age or over, were found to have a lower overall percent increase from 1981 through 1988 than either the CPI or PPI for prescription drugs.

Pharmacy margins

Margin per prescription

Trends in average retail prescription price, ingredient cost, and margin received by retail pharmacies are shown in Figure 3. The average retail prescription price in nominal dollars for the drugs included in the analysis rose from $10.73 in 1981 to $20.78 in 1988. During the same period, the average cost to pharmacies for the drug product dispensed in each prescription increased from $6.94 to $15.29. The difference (margin) between the average retail prescription price and the cost to pharmacies for the dispensed ingredients increased from $3.79 in 1981 to $5.48 in 1988. Figure 3 shows the trends for the same variables when adjusted to 1981 constant dollars using CPI. In 1981 constant dollars, pharmacies' 1988 dollar margin per prescription equaled only $4.12 in 1981 dollars, an increase of only $0.33 from the $3.79 margin per prescription in 1981.

When only single-source drugs were considered, the average prescription price in nominal dollars increased from $18.64 in 1981 to $33.81 in 1988, an increase of 81.4 percent (Figure 4). Average ingredient cost to pharmacies for single-source prescriptions increased

from $14.13 to $27.60, an increase of 95.3 percent. Pharmacies' average margin on single-source prescriptions increased from $4.51 to $6.21, a 37.7-percent increase.

The average price of prescriptions for multiple-source drugs increased from $9.78 in 1981 to $15.40 in 1988. The average cost to pharmacies for the ingredients in the average prescription for a multiple-source drug increased from $6.08 to $10.21. The pharmacies' average margin on multiple-source prescriptions increased from $3.70 to $5.19. Overall, the average retail price for prescriptions for multiple-source drugs increased 57.5 percent, manufacturers' product prices for the ingredients in multiple-source prescriptions increased 67.9 percent from 1981 through 1988, and the average pharmacy margin increased 40.3 percent (Figure 4).

Margin per unit

The dollar margin on each pharmaceutical unit was also analyzed. In nominal dollars, the average pharmacy margin per unit for all drugs was $0.06 in 1981 and grew to $0.10 by the end of 1988. When adjusted to constant 1981 dollars, however, the margin was only $0.07 per unit in 1988 (Figure 5). The average pharmacy margin per unit for multiple-source prescriptions was consistently less than the average margin per unit for single-source prescriptions. In 1981, for example, the multiple-source products yielded a dollar margin per unit of $0.06, and single-source products yielded a $0.07 per unit margin. These dollar per unit margins had grown, respectively, to $0.09 and $0.12 by the end of 1988 (Figure 5).

Percent margins

Pharmacy margins as a percent of the average retail prescription price were also examined. This percent margin was calculated by dividing the average pharmacy dollar margin per prescription by the average retail prescription price. The pharmacy percent margins from 1981 to 1988 are shown in Figure 6. Pharmacies' margins as a percent of the average retail prescription price decreased from 35.3 percent during the first half of 1981 to 26.4 percent during the remainder of 1988. During this same period, the pharmacies' average dollar margin per prescription increased from $3.79 to $5.48, and the average retail prescription price increased from $10.73 to $20.78 (Figure 3).

When expressed as a percent of prescription price, pharmacies' average percent margin on prescriptions for multiple-source drug products tended to be greater than the percent margin on prescriptions for single-source drugs. Despite this finding, pharmacies' average dollar margin on the multiple-source prescriptions was less than their average dollar margin for single-source prescriptions. This can be explained by the fact that the average price of prescriptions for multiple-source drugs was much less than that of single-source drugs.

However, the trend in the pharmacies' margins as a percent of prescription sales was down in both cases. The percent margins on multiple-source prescriptions

decreased from 37.8 percent in 1981 to 33.7 percent in 1988. Percent margins on prescriptions for single-source drugs declined from 24.2 percent in 1981 to 18.4 percent in 1988 (Figure 6).

Study limitations

As in any research effort, various degrees of measurement error in data and/or practical constraints in sampling limit analysis. Several such limitations are described later so that they may be taken into consideration when interpreting the results described in this article.

NDTI mentions were used to estimate the proportion of expenditures made by the elderly for each drug product. The calculation is based on an assumption that the number of prescriptions written by physicians but not filled does not vary across age groups. Any differences across age groups in initial default rates would introduce some bias into the estimates.

The price data in the USD data base includes discounts reflected on invoices for products purchased by pharmacies. However, any post-invoice discounts or rebates would not be reflected in the data. However, if the percents of any such discounts are constant across the observation periods, the data should well reflect trends in prices.

The USD data base includes prescriptions paid for by third parties because of insurance coverage, whereas CPI includes only private pay prescriptions in which the individual purchasing the prescription pays the cost. This causes some difficulty in determining the reasons for the differences in price trends as reflected in the retail price indexes developed and trends in the CPI for prescription drugs. However, it was not possible to separate private pay and third-party prescriptions in the extracted data files used in this study.

As noted earlier, the data sources used do not include mail order or supermarkets. However, those two segments represented a very small part of the market. Also one recent report indicated that there was little difference between the prices paid by consumers for prescription drugs when purchased through mail order versus in community pharmacies (Horgan et al., 1989).

Summary and conclusions

The elderly population is particularly affected by the continuing rapid rise in drug prices noted in this analysis. As this analysis indicates, persons 65 years of age or over were estimated to account for approximately 34.3 percent of the $26.5 billion in total 1988 retail expenditures for prescription drugs. Additionally, a total of 104 drug entities (11.4 percent of all drug entities) accounted for 80 percent of expenditures for drugs used by the elderly population. Among the elderly's prescription expenditures, multiple-source drugs accounted for 44.2 percent, single-source entities accounted for 35.9 percent, and the remaining 19.9 percent were not classified for this analysis.
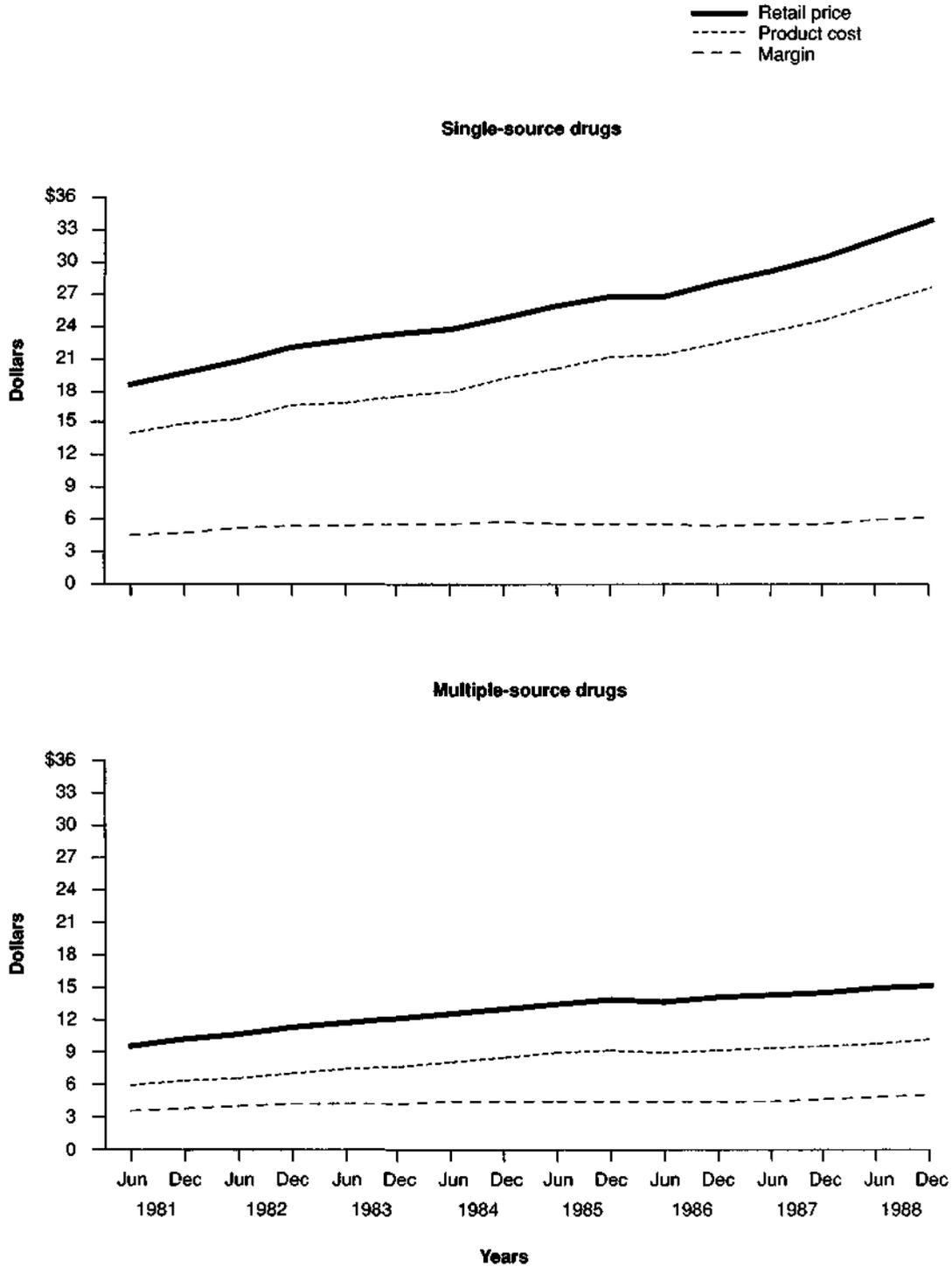
Figure 3
Average price, product cost, and dollar margin per prescription in retail pharmacies:
Nominal and constant dollars, 1981-88
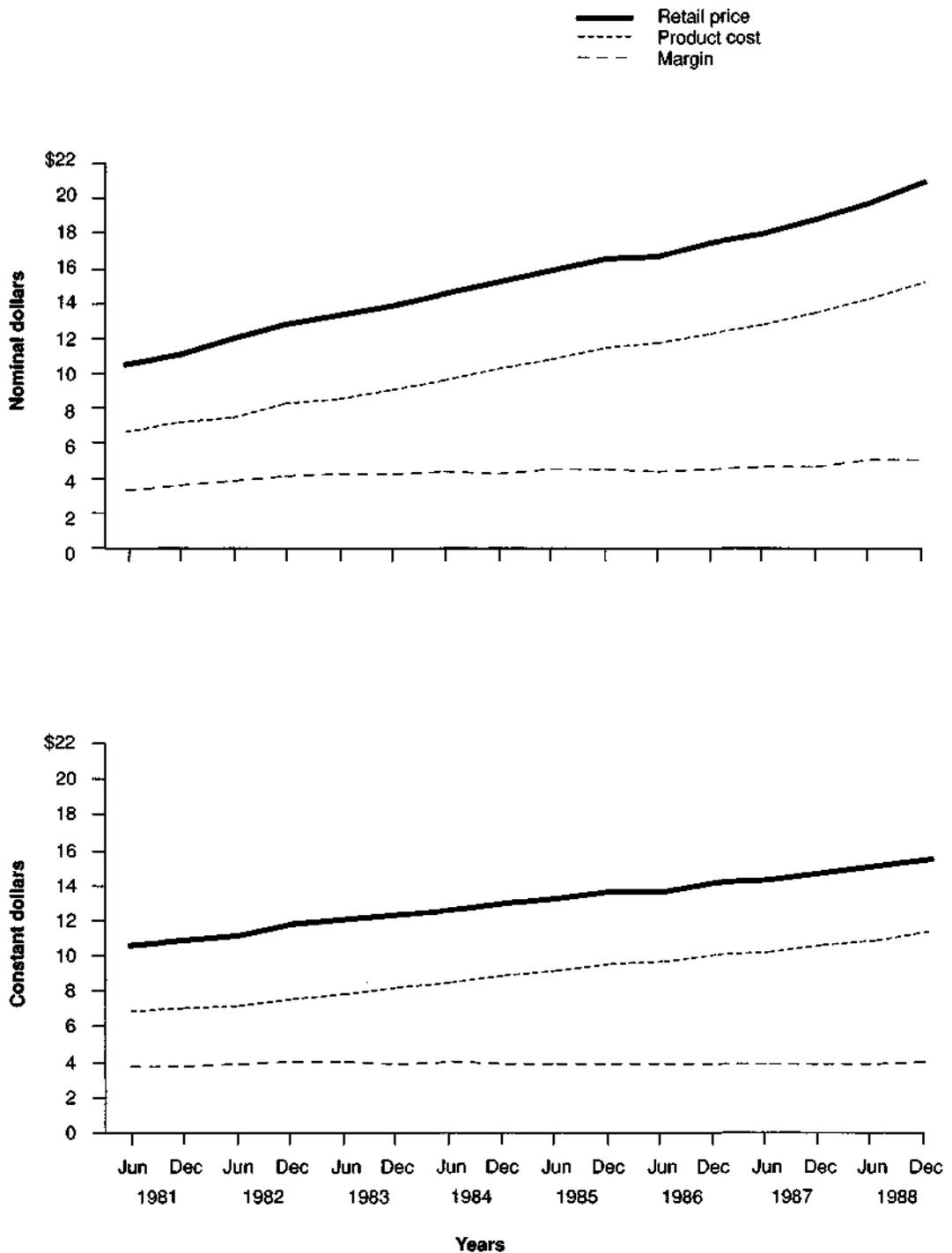
NOTE: Data are for Jan.-June and July-Dec. for each of the years 1981-88.

SOURCE: Thomas, J., and Schondelmeyer, S.: Purdue University, West Lafayette, Indiana, 1990.

Figure 4
Average price, product cost, and dollar margin per prescription in retail pharmacies:
Single-source and multiple-source drugs, 1981-88

Single-source drugs

Multiple-source drugs

NOTE: Data are for Jan.-June and July-Dec. for each of the years 1981-88.

SOURCE: Thomas, J., and Schondelmeyer, S.: Purdue University, West Lafayette, Indiana, 1990.

Figure 5
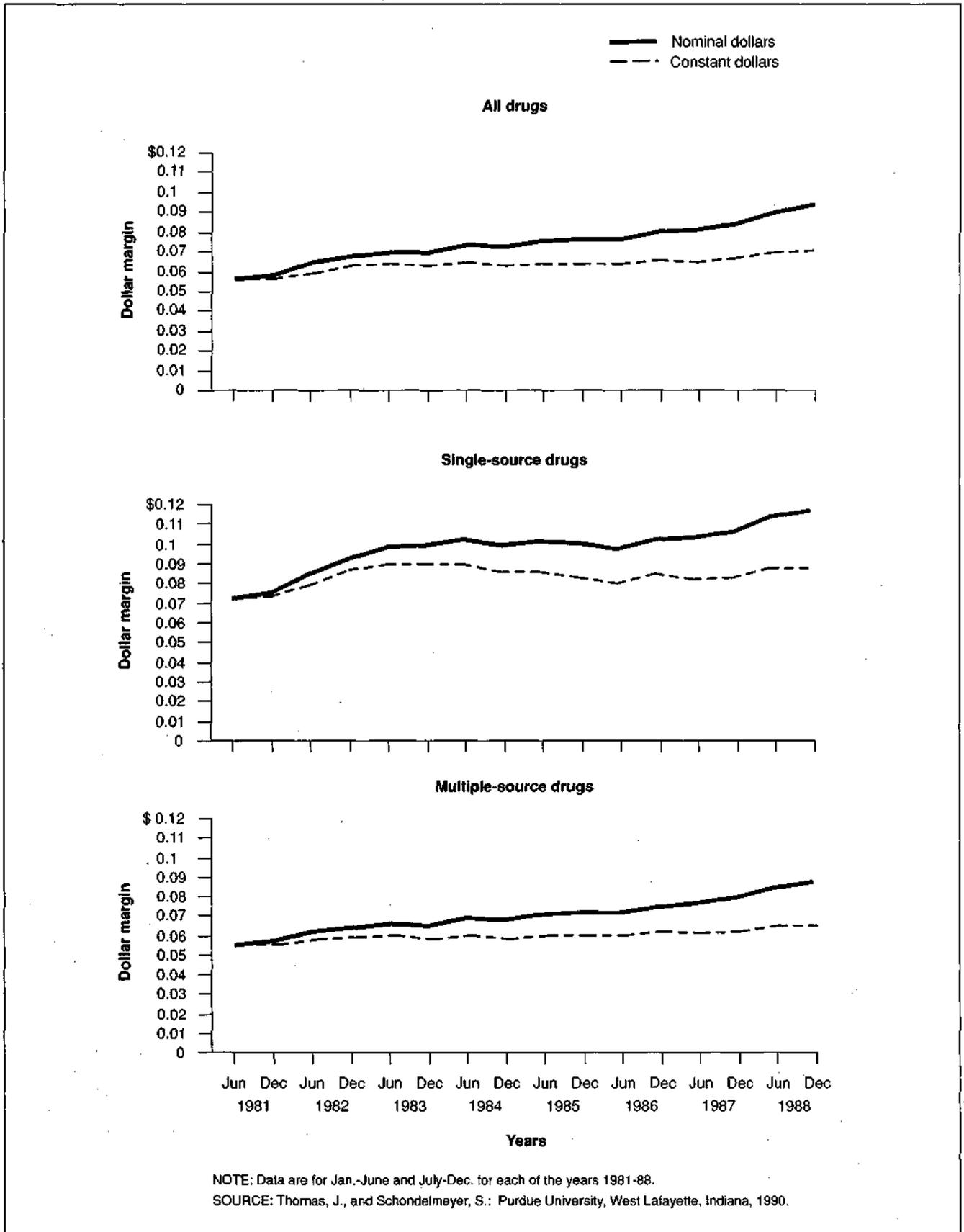**Average dollar margin per unit in retail pharmacies: All drugs, multiple-source drugs, and single-source drugs, 1981-88**

—— Nominal dollars
— — · Constant dollars

All drugs

Single-source drugs

Multiple-source drugs

Jun Dec Jun Dec Jun Dec Jun Dec Jun Dec Jun Dec Jun Dec Jun Dec
1981   1982   1983   1984   1985   1986   1987   1988

Years

NOTE: Data are for Jan.-June and July-Dec. for each of the years 1981-88.
SOURCE: Thomas, J., and Schondelmeyer, S.: Purdue University, West Lafayette, Indiana, 1990.

Average percent margin on prescriptions in retail pharmacies: 1981-88

NOTE: Data are for Jan.-June and July-Dec. for each of the years 1981-88.

SOURCE: Thomas, J., and Schondelmeyer, S.: Purdue University, West Lafayette, Indiana, 1990.
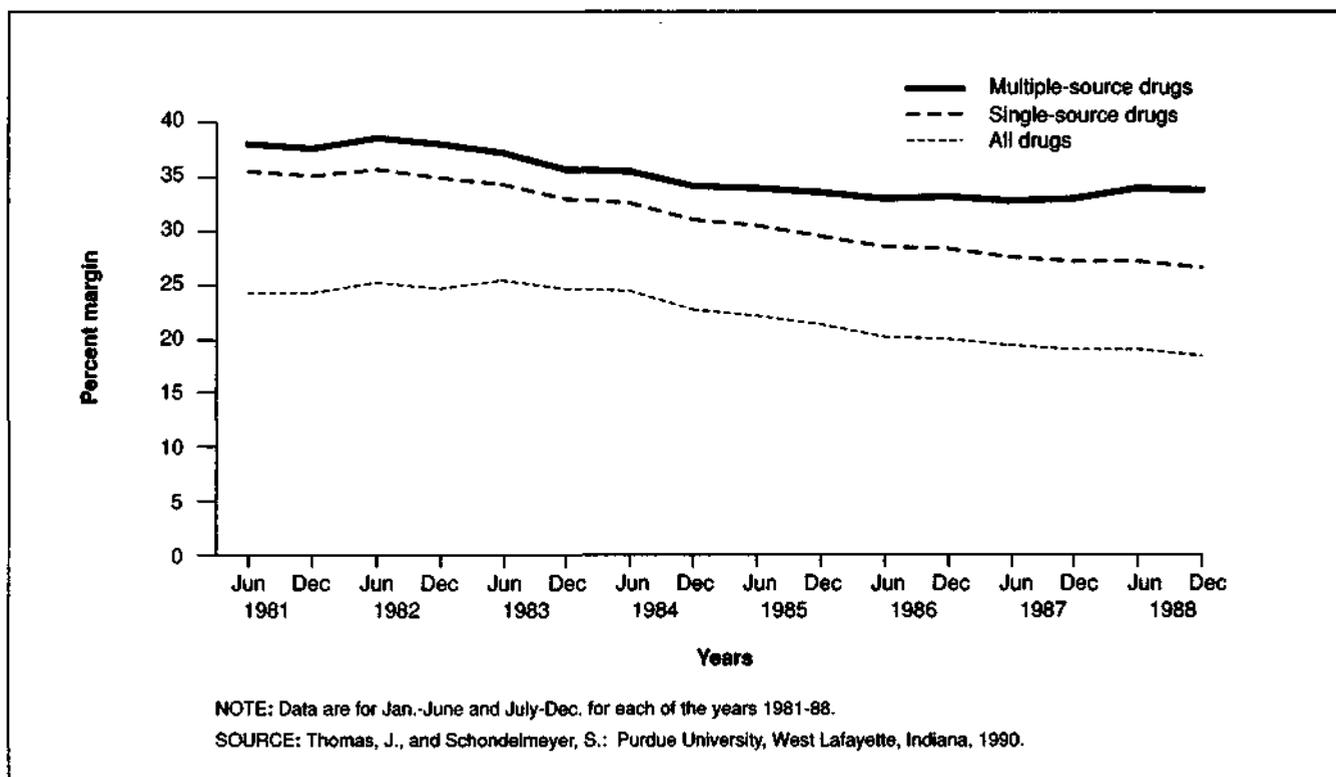
Laspeyres price indexes were developed for selected categories of pharmaceuticals. Changes in those indexes at the manufacturer and retail level were analyzed. At the manufacturer and retail levels, drugs that were available from multiple sources before 1981 were found to have lower average change in prices than drugs that became available from multiple sources after 1981. There was a substantially greater average annual change in prices of originator multiple-source drugs than in non-originator multiple-source drugs.

In comparing the changes in prices at the manufacturer and retail levels, the average annual change in manufacturers' prices for all drugs combined and for single-source drugs alone were greater than the changes in the corresponding retail price indexes. The average annual change in the manufacturer price index for multiple-source drugs also was greater than the average annual change in the retail price index for multiple-source drugs.

The average annual changes in prices at the retail level tended to be lower than those at the manufacturer level. The one exception was that the average annual change in manufacturer and retail prices for non-originator multiple-source drugs was virtually the same (20.0 versus 20.3 percent). In all other instances, the average annual change in manufacturer prices was greater than the change in retail prices.

Analysis of pharmacies' margins was undertaken to determine whether increased pharmacy markups were responsible for the increases in retail drug prices. The average prescription price for all the drugs examined

increased from $10.73 in 1981 to $20.78 in 1988. During the same period, the average cost to pharmacies for the drug product dispensed in a prescription increased from $6.94 to $15.29. As a result of these changes, pharmacies' margins increased from $3.79 in 1981 to $5.48 in 1988. However, the dollar margin in 1988 was equivalent to only $4.12 in 1981 constant dollars, an increase of only $0.33 (8.7 percent) in real terms over a 7-year period. This compares with an increase of $4.56 (65.7 percent) in product costs from the manufacturer in 1981 constant dollar terms.

There was a small increase in pharmacies' dollar margin per prescription, the difference between what pharmacies paid for drugs and what they charged retail customers. However, other data suggest that pharmacies' profits, the amount remaining after covering all operating expenses, such as rent, wages, and utilities, have decreased (National Association of Chain Drug Stores, 1989). This indicates that pharmacies have not been able to increase their margins at a rate equivalent to the increase in their product and operating costs. As a result pharmacies' profits have been forced down. Pharmacies' dollar margins as a percent of prescription price on all the drugs examined decreased from 35.3 percent in 1981 to 26.4 percent in 1988. The average dollar margin per prescription for multiple-source drugs was less than that for single-source drugs. Yet, because the average price of prescriptions for multiple-source drugs was much less than that of single-source prescriptions, the average percent margin on prescriptions for multiple-source

drugs was higher than that of single-source drugs. Pharmacies' average percent margins on prescriptions for both single-source drugs and multiple-source drugs declined from 1981 through 1988. During this period, the percent margin received by pharmacies on prescriptions for multiple-source drugs decreased from 37.8 percent to 33.7 percent and from 24.2 percent to 18.4 percent for single-source drugs.

The data and methods used for analysis of drug price changes described in this article represent new approaches to analysis of drug price changes. The methodology has an advantage over CPI and PPI in that it allows analysis of price trends at levels that cannot be achieved with CPI and PPI through the creation of indexes for specific drug groupings based on defined beneficiary populations or other criteria. Further exploration of drug price trends based on the methods presented in this article and on analysis of the current methodology's strengths and weaknesses in comparison to CPI and PPI is warranted. Such exploration could provide powerful tools that would produce the detailed pharmaceutical price trend data necessary for program expenditure forecasting and managing drug benefit program expenditures.

Technical note

This note provides some of the key formulas used to calculate values for many of the key indicators used in the analysis.

Formulas used for calculation of analysis variables

Manufacturer unit price
$$= \frac{\text{USD-Tot-Dol-Vol}}{\text{USD-Tot-Ext-Unit-Vol}}$$

Retail unit price
$$= \frac{\text{NPA-Tot-Retail-Dol}}{\text{NPA-Tot-Ext-Unit-Disp}}$$

Pharmacy margin per unit
$$= \frac{\sum_{\text{all products}} (\text{NPA-Tot-Retail-Dol} - (\text{NPA-Tot-Ext-Unit-Disp} \times \text{manufacturers' unit price})}{\sum_{\text{all products}} \text{NPA-Tot-Ext-Unit-Disp}}$$

Average retail prescription price
$$= \frac{\sum_{\text{all products}} \text{NPA-Tot-Retail-Dol}}{\sum_{\text{all products}} \text{NPA-Tot-Pres-Disp}}$$

Average retail prescription ingredient cost
$$= \frac{\sum_{\text{all products}} (\text{NPA-Tot-Ext-Unit-Disp} \times \text{manufacturers' unit price})}{\sum_{\text{all products}} \text{NPA-Tot-Pres-Disp}}$$

Pharmacy margin per prescription
$$= \frac{\sum_{\text{all products}} (\text{NPA-Tot-Retail-Dol} - (\text{NPA-Tot-Ext-Disp} \times \text{manufacturers' unit price})}{\sum_{\text{all products}} \text{NPA-Tot-Pres-Disp}}$$

All drugs manufacturer price index

$$= \dfrac{\displaystyle\sum_{\text{all products}} \text{manufacturer unit price}_{it} \times \text{NPA-Tot-Ext-Unit-Disp}_{i1984}}{\displaystyle\sum_{\text{all products}} \text{manufacturer unit price}_{i1984} \times \text{NPA-Tot-Ext-Unit-Disp}_{i1984}}$$

Where:

Manufacturer unit price^{it} is the manufacturer unit price for the ith product in period t.

Manufacturer unit price$_{i1984}$ is the manufacturer unit price for the ith product in the 1984 base period.

NPA-Tot-Ext-Unit-Disp$_{i1984}$ is the quantity, i.e., number of extended units of the ith product dispensed in the 1984 base period.

As is general practice, every formula was multiplied by 100 so that the value of each index in the 1984 base year would be 100.

After calculation of index values, the values for each index were multiplied by a constant to convert the 1981 index to a value of 100 for ease in showing graphical trends from 1981 through 1988.

Formula component definitions

Manufacturer unit price—U.S. drugstore estimate of the average cost paid by pharmacies per IMS extended unit of a drug.
NPA-Tot-Ext-Unit-Disp—National Prescription Audit based estimate of total quantity of product dispensed in terms of extended units by retail pharmacies.
NPA-Tot-Pres-Disp—National Prescription Audit based estimate of total prescriptions dispensed by retail pharmacies.
NPA-Tot-Retail-Dol—National Prescription Audit based estimate of product dispensed in terms of retail or patient dollars by independent retail pharmacies.
Retail Unit Price—National Prescription Audit based estimate of the average charge by pharmacies to patients per IMS extended unit of a drug.
USD-Tot-Dol-Vol—U.S. Drugstore estimates of purchases expressed in thousands of dollars.
USD-Tot-Ext-Unit-Vol—U.S. Drugstore estimates of purchases expressed in thousands of equivalent units (e.g., number of tablets, number of milliliters).

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