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A Historical Analysis Of Medical Spending Growth, 1960-1993
by Edgar A. Peden and Mark S. Freeland

Abstract: About half the growth in real per capita medical spending from 1960 to 1993 and two-thirds of its growth from 1983 to 1993 resulted from either the level or the growth of insurance coverage, chiefly the former. Dividing all factors determining the 1960-1993 growth in real per capita medical spending into two major categories, we find that 70 percent of this growth resulted from cost-increasing advances in medical services induced by insurance coverage levels and spending for noncommercial medical research. Only 30 percent was attributable to standard factors: growth in insurance coverage, changes in age/sex mix, and growth in real per capita disposable income.

Tracking and explaining the growth in medical spending in the United States has been prominent on government researchers’ agendas for several decades. This growth, which averaged 4.8 percent per year from 1960 to 1993, can be explained only partially by standard variables such as short-run insurance coverage elasticities, demographic-mix variables such as age and sex, and income growth. A substantial residual remains that appears to be associated with cost-increasing growth in medical technology and capability. In this DataWatch we examine the extent to which this residual has been “autonomous” and the extent to which it has been induced by the continuous effects of insurance coverage levels and by spending for noncommercial medical research.

We review the literature examining medical spending increases, most importantly the work of Joseph Newhouse and Burton Weisbrod, and then present our analysis of the determinants of real per capita spending growth, using as our primary source of data the U.S. National Health Accounts for 1960-1993. Our analysis includes “standard” factors affecting the growth of consumer medical purchases (holding technology constant) but also adds factors posited to affect the growth of cost-increasing medical technology.

Our results indicate that 70 percent of the 373 percent growth in real per capita medical spending from 1960 to 1993 is attributable to two technology-inducing variables: (1) the insurance coverage level (with the largest effect), and (2) noncommercial medical research spending. Autonomous...
growth in cost-increasing technology was not a significant factor. The standard variables had a positive effect on real per capita spending growth but accounted for only 30 percent of the total. Most recently, in 1983-1993, historically high coverage levels alone accounted for 62 percent of the 57 percent growth in real per capita spending. Real noncommercial research spending accounted for 14 percent, and the standard variables, 24 percent.

Background

Newhouse has developed three models of the medical care marketplace, along with empirical estimates to ascertain the extent to which they were consistent with historical price increases. All three focus on insurance coverage—defined as the percentage of medical payments made by third parties—as the key driver of price increases. His first model, the standard competitive model, posits that growth in insurance coverage causes price increases by rotating or shifting the demand curve. Newhouse did not find much support from this model—in either equilibrium or disequilibrium specifications—for explaining the sustained high medical inflation rates.

Newhouse's second model modifies the first model to account for growth in cost-increasing technology induced by the level of coverage. In this model high coverage levels cause high inflation rates, even if the level stays constant. Patients, or providers acting on their behalf, may be willing to pay more for product enhancements when insurance pays a higher portion of the spending for the patient. This model has special relevance for our subsequent analysis of medical spending growth.

The third model modifies the first to include the effect of coverage on the payoff for finding cost-effective providers. Because greater coverage means a smaller out-of-pocket differential between low- and high-cost providers, providers become freer to raise prices and intensify services without greatly lowering their market share. As coverage approaches 100 percent, the market cannot set a meaningful price. Newhouse found support for this model in 1978, but it weakened a decade later. Models two and three both focus on coverage level as a source of inflation, not just on its growth as in the standard competitive model.

In subsequent work Newhouse accounts for medical spending growth over time, concluding that well over half is a residual associated with growth in technology and capability. This residual is derived using research results, primarily from the RAND Health Insurance Experiment. He points out that economists have been overly focused on a static (or one-period) view of medical markets that holds technology constant, citing as an exception Weisbrod’s 1991 survey of interactions among insurance,
Finally, Newhouse suggests that research should examine the longer-run dynamics of cost increases, which include growth in technology. Our analysis owes much to Newhouse’s medical inflation studies. He used the National Health Accounts data, as we do. He looks at factors behind the growth of technology, as we do. He provides our definition of insurance coverage (the proportion of spending paid by third-party payers) and its complement, the aggregate coinsurance rate (the proportion paid by consumers). His inflation model, however, is modified in our study to reflect our purpose: analyzing real per capita medical spending growth. In addition, we add another variable posited to affect growth in cost-increasing medical advances: real noncommercial medical research spending. Finally, whereas Newhouse analyzes inflation in four separate medical subsectors (hospital, physician, drug, and dental), we examine spending for acute medical care (defined below) as a whole.

Weisbrod has shown how increased insurance finances the development of cost-increasing technology and how expensive new technologies expand the demand for coverage. His thoughtful conceptual analysis thus provides a basis for our posited linkages between coverage levels and growth in technology. Martin Feldstein’s earlier work on the interaction between quality change and demand for hospital care examined the conceptual and econometric relationships among insurance, quality of care, technology, and cost increases. Henry Aaron and William Schwartz also have made important contributions, examining the role of technological advances on rising medical costs. Aaron and Schwartz emphasize the role of new technologies in pushing up real medical spending holding other factors, such as coverage levels, constant. These papers all provide an analytic foundation for our work here. In the next section we define terms and present our theoretical basis for analyzing the growth in medical spending from 1960 to 1993.

**Basis Of The Analysis**

We define *medical spending* as spending for acute medical care, including payments for hospitals, physician services, drugs (and other nondurables), and other professional services. We exclude other types of spending, such as dental care, nursing home care, and so on. We might have analyzed spending for each of the four types of services separately following Newhouse’s 1978 and 1988 inflation studies. But these different types of care are simultaneously substitutes for and complements of each other when combinations of them are chosen as appropriate for a patient’s needs, which might well be influenced by the patient’s coverage as well as by the patient’s medical needs. These interrelationships are complex. We chose to simplify
the problem and do the analysis at the aggregate level.

Medical spending is first adjusted for three factors: economywide inflation, population differences, and age/sex differences.” This results in the variable: adjusted real per capita spending. Having accounted for price and population factors, we focus on the growth of adjusted real per capita spending, positing that it is influenced by three remaining factors: (1) Since the demand for medical care varies directly with insurance coverage—a proposition derived from basic economic theory—adjusted real per capita spending growth will vary directly with growth in coverage.12 (2) Since the growth of medical technology and capability has historically been cost increasing and product enhancing, raising it will raise both growth in real per capita costs of services and growth in demand for services.13 These in turn will act together (assuming a compliant insurance system) to increase the growth of adjusted real per capita spending.14 (3) Since the demand for medical care varies directly with real per capita disposable income, growth in adjusted real per capita spending will vary directly with growth in real income.15 However, because medical care is a necessity rather than a luxury, growth in the former is expected to change proportionally less than the latter.

A problem at this juncture is that the growth of aggregate technology and capability (inherent in medical services) is not directly measurable. But it is a function of three measurable factors that can be used in its stead.

The first factor is the level of insurance coverage. Weisbrod argues that “[i]f insurance coverage is defined, as it has been, to encompass new technologies regardless of the costs involved, and to encompass an ever widening concept of health care . . . the R&D [research and development] sector will continue to face incentives that reward costly new measures relative to cost-reducing innovations.” He argues further that “expanding insurance coverage . . . has provided an increased incentive to the R&D sector to develop new technologies.”16 Indeed, Newhouse has provided empirical evidence linking growth in technology (and prices) to coverage levels.17 Thus, we posit that growth in technology and capability will be greater when the portion of spending covered by insurance is greater. Put another way, greater coverage levels mean continuously easier marketing of costly new services.

The second factor is year-to-year growth in cumulative real spending for noncommercial medical research. Yearly growth in technology and capability is posited to vary directly with growth of cumulative noncommercial resources devoted to this purpose, that is, with yearly growth in cumulative real spending since 1948.

The third factor is autonomous growth. A residual factor, presumed positive, is added to account for autonomous year-to-year growth in medi-
cal technology not accounted for by the other variables. This factor is implicit in what Newhouse calls “the march of science.”

These three plus the two remaining (what we’ll call) standard factors are our posited determinants of adjusted real per capita spending growth. Exhibit 1 shows how these five variables are expected to affect adjusted real per capita medical spending growth.

**Independent variable values.** Insurance coverage is defined as the portion of total spending for our four types of medical care covered by third parties. This is adjusted upward by adding the portion of total spending by which income taxes fell attributable to consumer purchases of acute medical care. The coinsurance rate—the variable used in the analysis—is one minus the coverage rate. Real noncommercial research spending is derived by taking nominal amounts from the National Health Accounts and dividing by the gross domestic product (GDP) deflator; the cumulated sum (from 1948) is then calculated for each year. The percentage change in the latter is the variable used in the analysis. Finally, permanent real per capita disposable income values were used in the analysis. These were estimated using actual values from the Economic Report of the President.

### What Determines Growth Of Real Per Capita Medical Spending?

This section presents empirical results from our regression analysis for the period 1960-1993. As noted above, we used data from the National Health Accounts. Values of our dependent variable—as well as independent variable growth rates—are percentage changes. While our results are from a single regression equation, this was arrived at only after dismissing the possibility that a single equation was not sufficient and after checking its robustness.

Insurance coverage. Growth in coverage—a negative percentage...
change in the coinsurance rate has a positive effect on growth in real per capita medical spending. The estimated coinsurance elasticity of -0.08 is at the upper end of the RAND experiment’s estimate of -1 to -2. For 1960-1993 the coinsurance rate fell an average of 3 percent per year, generating growth in real per capita spending of 0.25 percent per year (-0.079 times -0.32). For 1983-1993 it fell an average of 2 percent per year, resulting in growth of 0.16 percent per year (-0.079 times -0.20).

But the coverage level has a far greater effect on real per capita medical spending growth. The coefficient of the log coinsurance rate, -0.018, is highly significant, and its effect occurs continuously. For each level or its complement, the coinsurance rate, there is a positive, automatic, year-to-year percentage change in real per capita medical spending, which increases when the level rises (the coinsurance rate falls). In the mid-1950s insurance covered slightly more than half of acute care spending; the coinsurance rate was about 48 percent. All else equal, this rate induced real per capita medical spending growth of about 1.3 percent per year in the early 1960s. By the early to mid-1980s coverage had risen to more than 80 percent, the coinsurance rate being about 19 percent. This rate induced real per capita medical spending growth of about 2.9 percent per year in the late 1980s and early 1990s.

Noncommercial medical research spending. Growth in real research spending has had a positive effect on real per capita spending growth, as seen in its highly significant coefficient, 0.13. Around 1960 its 20 percent per year growth rate caused real per capita medical spending to rise an estimated 2.5 percent per year. By the 1980s the growth rate had fallen to and stayed around 5 percent per year, causing real per capita medical spending to grow only about 0.6 percent per year from 1983 through 1993.

Autonomous growth. In our initial regression an intercept was included to account for the unexplained residual growth in real per capita medical spending. But its estimate was negative-counter to what was theorized-when both the coverage level and real noncommercial research spending growth were included as factors underlying the growth in medical technology and capability. Moreover, it was not significantly different from zero. We thus dropped it.

Income growth. Real per capita disposable income growth has had a positive effect on real per capita medical spending growth. Its estimated elasticity of 0.41 is significant and squares fairly well with the 0.2 to 0.4 estimates reported by Newhouse for households, although it is somewhat above the RAND estimate of “at most .2” for individuals. Real per capita disposable income rose an average of 2.1 percent per year over 1960-1993, a little above its 1983-1993 growth rate of 1.5 percent. The former implies an income-induced growth in real per capita medical spending of 0.9
percent per year; the latter, 0.6 percent.\textsuperscript{37}

Assigning cumulative growth in real per capita spending by factor. The top panel of Exhibit 2 shows the simulated relative effect of each causal variable on real per capita medical spending growth for 1960-1993 and 1983-1993 and the relative effects of insurance versus noninsurance variables.\textsuperscript{38}

Real per capita medical spending grew 373 percent from 1960 to 1993, an average of 4.8 percent per year. About half of this growth was induced by the two insurance coverage variables: 44 percent by the level of coverage, and 5 percent by the growth in coverage.\textsuperscript{39} The largest part of noninsurance growth, 26 percent of the total, resulted from noncommercial medical research spending. Real per capita disposable income growth induced 18 percent of the total, and changes in the population’s age/sex mix induced 7 percent.\textsuperscript{40}

Variables affecting real per capita medical spending growth can be regrouped as (1) those inducing growth in cost-increasing medical technology (the coverage level and real noncommercial research spending); and (2) “standard” variables affecting medical purchases holding technology constant (changes in the age/sex mix, coverage growth, and real per capita disposable income growth). The lower panel of Exhibit 2 shows that the first group accounted for about 70 percent of the 1960-1993 growth in real per capita medical spending, while the second accounted for only about 30

\begin{center}
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\hline
\textbf{Exhibit 2} & \multicolumn{2}{c}{Simulated Percentages Of The Cumulative Growth In Real Per Capita Medical Care Spending Attributed By Group And Factor Within Group} \\
\hline
\hline
Insurance total & 49.7\% & 65.7\% \\
Coinsurance rate, percent change & 5.3\% & 3.6\% \\
Log coinsurance rate (level) & 44.4 & 62.1 \\
Noninsurance total & 51.4\% & 34.3\% \\
Age/sex mix, percent change in indices & 7.2 & 6.4 \\
Disposable income, percent change & 17.6 & 13.7 \\
Cumulative research spending, percent change & 25.5 & 14.2 \\
\hline
\textbf{Technology-inducing versus standard variables} & & \\
Technology-inducing total & 69.9\% & 76.3\% \\
Log coinsurance rate (level) & 44.4 & 62.1 \\
Cumulative research spending, percent change & 25.5\% & 14.2\% \\
Standard total & 30.1\% & 23.7\% \\
Age/sex mix, percent change in indices & 7.2 & 6.4 \\
Disposable income, percent change & 17.6 & 13.7 \\
Coinsurance rate, percent change & 5.3 & 3.6 \\
\hline
\end{tabular}
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\textit{Source:} Simulated from regression results.
percent. This split roughly confirms the conjecture by Newhouse that the standard factors “account for well under half—perhaps under a quarter—of the 50-year [1940-1990] increase in medical care expenditure.”

Recent causes of real per capita medical spending growth are seen in simulations for 1983-1993. This growth—57 percent, averaging 4.6 percent per year—is attributable mainly to historically high coverage levels, which alone accounted for 62 percent of total growth (Exhibit 2). The remainder was attributable to research spending growth (14 percent), changes in the age/sex mix (6 percent), income growth (14 percent), and coverage growth (4 percent). The two insurance variables thus accounted for two-thirds of recent growth in real per capita medical spending. Finally, the causal split between technology-inducing and standard variables shifted further toward the former: 75 percent/25 percent for 1983-1993 versus 70 percent/30 percent for 1960-1993.

Discussion

In this study we found that about half of the 373 percent growth in real per capita medical spending from 1960 to 1993 was attributable to either the level or the growth of insurance coverage. The level of insurance coverage was by far the most important. Moreover, spending growth that results from a given coverage level continues as long as that level is maintained. Most recently (1983-1993) historically high levels accounted for more than 60 percent of real per capita medical spending growth (2.9 percentage points of the 4.6 percent average yearly increases).

Real noncommercial medical research spending, mainly by the federal government, also caused real per capita medical spending to grow, generating about one-quarter of its 1960-1993 growth. Most recently, growth in cumulative research spending was smaller than before and accounted for only about one-seventh of the growth during 1983-1993. Finally, growth in real per capita disposable income caused real per capita medical spending to grow, accounting for one-sixth of its 1960-1993 growth and one-seventh of its 1983-1993 growth.

Grouping variables that account for real per capita medical spending growth as variables that induce growth in cost-increasing technology (the coverage level and research spending) or standard variables that affect spending growth, holding technology constant (coverage growth, age/sex changes, and real income growth), we found that the former have dominated, accounting for 70 percent of the 1960-1993 growth in real per capita spending and 75 percent of its 1983-1993 growth. This is consistent with propositions from Newhouse and Weisbrod that the growth of technology has played a major role in increasing real medical spending, although we
differ with Newhouse’s inference that the growth in cost-increasing technology is autonomous. We found that the extraordinary growth of such technology has itself been the result of high coverage levels and, to a somewhat lesser extent, noncommercial medical research spending, agreeing with Ralph Bradley that “[t]echnological change is a symptom of the medical market structure rather than a cause of medical spending growth.”

Caveats. Our study design and conclusions coincide only imperfectly with those of Newhouse. His empirical work examining inflation in four medical subsectors contrasts with our more aggregate analysis of real per capita medical spending growth. His later work draws on findings using a number of approaches, including household data from the RAND experiments over three to five years, and are thus only imprecisely comparable with our aggregate time series analyses. Given the differences in approach, it is somewhat surprising that our estimated elasticities of coverage and income growth were as close as they were to the RAND experiments.

Some observers have suggested that our results do not fit well with the experience of countries such as Canada and Great Britain, which have had high rates of real medical spending growth in spite of relatively stable coverage levels. Given that their levels of coverage are high, this does not differ from what we found for the United States, where the level of coverage, not its growth, has been the main driver of real spending growth.

Other observers have commented that our study may be valid historically, but that its usefulness for prediction is limited by the rise of managed competition and recent government controls on medical spending (for example, Medicare’s prospective payment system for hospitals and the resource-based relative value scale for physicians). Recent evidence does not support this. As noted by Haiden Huskamp and Newhouse, “The purported slowdown in health care spending in the 1990s is modest at best through 1993.” We found no significant or systematic deviations for the late 1980s and early 1990s between actual spending growth rates and those predicted by our results, deviations that might have been expected if there were effects the model did not pick up. These and other changes may restrain future spending and/or its growth, in which case the analysis should be modified to include them. Schwartz notes that such changes could lower the growth path once but not affect long-term growth rates. Our analysis indicates what the primary drivers of medical spending have been for thirty-four years, including 1983-1993. Given their historical importance, we would not rule them out as factors determining future growth.
This paper was presented at the eleventh annual meeting of the Association for Health Services Research and the Foundation for Health Services Research, San Diego, California, 13 June 1994. The authors appreciate the helpful comments of Joseph Antos, Philip Cotterill, Thomas Hoerger, and two anonymous referees. They also thank Guy King, who as chief actuary of the Health Care Financing Administration (until July 1994) motivated the study and provided support for the work. The findings are those of the authors and do not represent the views of the Department of Health and Human Services or those of the persons listed above.

NOTES


7. We modify Newhouse’s insurance coverage definition slightly by including the dollar amount by which income taxes were reduced (as a result of medical spending) in the numerator.

8. Weisbrod, “The Health Care Quadrilemma.” Weisbrod’s analysis is particularly useful for examining the forces acting on the research and development (R&D) sector to develop specific types of technologies (for example, cost increasing versus cost decreasing), the role of insurance in that process, and the long-term effects of new technologies on insurance. With regard to the first, he shows that retrospective reimbursement has created incentives to develop cost-increasing (as opposed to cost-decreasing) technologies.


11. Each year’s medical spending from the National Health Accounts is divided by the gross domestic product (GDP) deflator to get real spending measured by its opportunity cost (the goods and services forgone to buy medical care). The deflator is from the Council of Economic Advisers, Economic Report of the President (Washington: U.S. Government Printing Office, 1994). It is more representative of overall prices than the Consumer Price Index (CPI) for two reasons: (1) In some years the CPI was overly influenced by unusually high interest rates (inflating the mortgage interest part of the
and (2) the GDP deflator reflects government as well as private purchases. See T. Getzen, “Medical Care Price Indexes: Theory, Construction, and Empirical Analysis of the U.S. Series, 1927-1990,” in *Advances in Health Economics and Health Services Research*, ed. R. Scheffler and L. Rossiter (Greenwich: JAI Press, 1992), 83-128. Real spending is divided by the U.S. population to get real per capita spending. *Economic Report of the President*, 1994. Finally, the latter is divided by separate intensity and utilization indices to purge it of medical consumption differences inherent in the changing age/sex mix; this results in adjusted real per capita spending. Indices were from unpublished data provided by the HCFA Office of the Actuary, 1994. From 1960 through 1993 the age/sex intensity-of-use index varied only from .99 to 1.00, and the index of utilization, from .92 to 1.02.

12. Stated differently, adjusted real per capita spending growth varies inversely with percentage change in the coinsurance rate.


14. Theoretically, an increase in unit costs would lead to a shift in the supply curve to the left, which, for a given demand curve, would lead to a decrease in output along with an increase in prices. In fact, the decrease in output has been overwhelmed by the increase in output because of product enhancement and the resulting increased demand. Here the level of technology is defined to be what occurs in the medical sector over and above the economy generally.

15. In the analysis we use permanent real per capita disposable income, defined below.


19. This definition means that coverage is composed of numerous copayment and deductible combinations as well as different maximum coverage amounts and services covered. It also reflects differing movements over time for the four types of medical care covered. In essence, it is a macroindicator, an average.

20. The income tax reduction estimate was calculated as the product of out-of-pocket acute care medical payments, the proportion of all out-of-pocket medical payments deducted from taxable income, and the average marginal rate for federal, state, and local income taxes.

21. From 1948 through 1993 real noncommercial research spending totaled $315 billion in 1993 dollars. In 1993 government accounted for 91 percent; 9 percent was by private nonprofit institutions. This noncommercial spending does not reflect research spending by drug companies and other providers of medical equipment and supplies. Only post-1947 data are used, which should not create a significant distortion since prior to World War II this spending was negligible. See B. Cooper et al., *The Compendium of National Health Expenditure Data*, DHEW Pub. no. (SSA) 76-11927 (Washington: U.S. Department of Health, Education, and Welfare, Social Security Administration, Office of Research and Statistics, January 1976). We repeated our analysis using the Biomedical Research and Development Price Index to deflate research spending. This series had some inconsistencies, and using it made no difference in the results.

22. We allowed for both coverage variables and the research spending variable to have lagged effects by estimating the number of lags minimizing the sum of squared errors along with the other parameters of the regression. Distributed lag estimators for these three variables also were tried but did not improve the results.
23. Permanent values are calculated from current and past values of real per capita disposable income following the permanent income hypothesis. M. Friedman, *A Theory of the Consumption Function* (New York: Princeton University Press, 1957). Weights for current and past values and growth rates are estimated, using Holt’s smoothing technique, as part of the regression; that is, the parameters determining these weights are chosen along with the other parameters to minimize the sum of squared errors. Holt’s technique is found in R. Pindyck and D. Rubinfeld, *Econometric Theory and Economic Forecasts*, 3d ed. (New York: McGraw-Hill, 1991), 428-430.

24. When data prior to 1960 were needed, we used *The Compendium of National Health Expenditure Data*. Katharine Levit of the HCFA Office of the Actuary told the authors that the National Health Accounts data for 1960-1993 are comparable, but that caution must be used for data preceding this period, since they were not benchmarked to the later data. The dependent variable is used only from 1960 on, and independent variables calling for lagged data prior to 1960 are used with caution.

25. For methodological details, write to the authors at the HCFA Office of Research and Demonstrations, 7500 Security Boulevard, C-3-16-15, Baltimore, Maryland 21207.

26. Following Weisbrod, “The Health Care Quadrilemma,” we examined the possibility that greater adjusted real per capita spending may cause greater insurance coverage because cost-increasing advances in technology cause people to purchase greater coverage, as well as vice versa. If so, a single equation would not be appropriate. But based on a Granger test, we did not find any indication that adjusted real per capita spending growth caused growth in coverage as we have defined it. The single equation results thus are appropriate. While this seems to contradict Weisbrod, it may simply reflect a difference in the way insurance coverage is defined. Defining insurance coverage as real per capita insurance spending, instead of as the percentage of medical spending covered (our definition from Newhouse), may obviate the problem. It is very likely that adding cost-increasing technology, which increases adjusted real per capita spending, will create incentives to increase coverage under the first definition, consistent with Weisbrod. But this does not mean that persons purchasing insurance will buy enough to cover an increased percentage of total spending. The latter could remain the same even as real per capita insurance spending rises. We also found our results to be robust when rerunning the single equation excluding two key periods: (1) the pre-Medicare and Medicaid period (remaining data from 1967-1993); and (2) the prospective payment system years for Medicare (remaining data from 1960-1983). Methodological details and calculations are available from the authors at the HCFA Office of Research, Oak Meadows Building (2B14), 6325 Security Boulevard, Baltimore, Maryland 21207.

27. The significance level is only 90 percent. We also note that because our age/sex adjustments to real per capita spending are multiplicative, the percentage change effect of any variable on real per capita spending will be the same as on its adjusted value.

28. Manning et al., “Health Insurance and the Demand for Medical Care.”

29. This is derived by multiplying the estimated coefficient of the natural log of the coinsurance rate, -0.0175, times log (.48). Our results also imply that the effective coinsurance rate is the, actual rate lagged six years. While this is a considerable delay, it is likely that expectations about coverage levels take some time to form and, more importantly, that technological and methodological advances are marketed only after a long period of program planning, development of products and services, testing, learning how to administer new products and services by the medical community, and possible Food and Drug Administration (FDA) or state certificate-of-need approval.

30. -0.0175 times log (.19).

31. There is an estimated two-year lag between growth in real noncommercial research spending and real per capita medical spending growth, which we might have expected.
to be longer, given the highly sophisticated nature of the products or services developed and the need for extensive testing. Our conjecture is that technological advances first encompass seminal research, which does not add significantly to this spending, but that as these advances go through subsequent testing and implementation processes, one to three years prior to the introduction of a product or service, spending rises.

32. Estimated as .126 times .2.
33. Determined as .126 times .05.
34. Indeed, including it led to a multicollinearity problem.
35. This assumes a two-tailed test. In Newhouse’s earlier work, *The Erosion of the Medical Marketplace* and “Has the Erosion of the Medical Marketplace Ended?,” the comparable intercept term was estimated in most cases to be positive and significant.
37. Determined respectively as .407 times .021 and .407 times .015.
38. Here the age/sex factors are switched from being an adjustment to the left-hand-side variable to being a standard right-hand-side determinant of unadjusted real per capita spending growth.
39. The latter is a little below the “perhaps one-tenth” conjectured by Newhouse in “An Iconoclastic View of Health Cost Containment.”
40. The income effect is within the rather wide range conjectured by Newhouse, “somewhere between 5 and 25 percent,” although he goes on to say that he believes the appropriate number is closer to the smaller number. Newhouse, “An Iconoclastic View of Health Cost Containment.”
41. In “Medical Care Costs: How Much Welfare Loss?,” Newhouse adds two other factors, supplier-induced demand and factor productivity in a service industry, but dismisses the first as accounting for only “a trivial fraction of the expenditure increase” and indicates that the impact of the second has been minor as well.
44. Schwartz, “The Inevitable Failure of Cost Containment Strategies.”