Research Spotlight

Recent Research on Disease-Based Price Indexes: Where Do We Stand?

By Ana M. Aizcorbe

AS HEALTH CARE continues to account for a larger share of the gross domestic product (GDP)—17.9 percent in 2011, compared with 5.1 percent in 1960—economists agree that improved statistics are sorely needed. Toward that goal, several avenues of new research have emerged recently, aiming to develop statistics that can shed more light on the sources of medical spending growth and whether such spending leads to better health outcomes. Ultimately, economists, policymakers, and the public would like a deeper understanding of whether society is better off—and by how much—given the fast growth in costs.

For the Bureau of Economic Analysis (BEA), the challenge is to develop better measures of medical care prices in order to decompose how much of the growth in medical care costs is inflation and how much is growth in real, or inflation-adjusted medical output.

To produce more meaningful health care statistics, academics and policymakers have advocated a new approach based on disease treatments. Recasting traditional spending measures of health care goods and services in terms of episodes of care would provide valuable new metrics that would potentially answer questions such as, "What medical conditions are driving costs?" and that would logically complement conventional statistics. Disease-based health care statistics would also provide an essential step toward better connecting medical spending with key outcomes measures, an important ingredient in assessing whether such spending is worth it.

BEA continues to conduct research that explores how a transition to a disease-based economic accounting framework from a service-based framework might be achieved and how this transition would affect the widely used national income and product accounts (NIPAs) and the industry economic accounts.[1]

This article discusses one of the most important issues in the development of disease-based output measures: price indexes. Currently, there are well-known problems with the official producer price indexes (PPIs) used by the BEA to deflate medical care spending. One problem has to do with the difficulty in accounting for improvements in outcomes that are associated with new treatments and drugs or changes in medical practice.[2] The fact that the price indexes only incompletely account for these improvements in the quality of care is one reason why the PPIs are widely thought to overstate inflation for this sector. Another reason is that the official PPIs do not account for any cost savings that accrue when high-cost treatments in one industry (for example, surgery as an inpatient at hospitals) are replaced with lower cost treatments in another industry (surgery at ambulatory surgical centers). Recent empirical work, discussed below, has documented the importance of these substitutions across industry lines as a potential source of upward bias in the PPIs.

In addition, there is another source of the difference—one that has not been widely explored—between the official PPIs and the "ideal" price indexes advocated by health economists. Abe Dunn, Eli Liebman and Adam Shapiro (2012) have shown that shifts in the number or intensity of procedures used to treat a condition—something they call "utilization"—will cause movements in the ideal price index but not in the PPI. Importantly, they have shown that the bias created by these shifts could go either way: it could cause the PPIs to overstate or understate true inflation for this sector. Thus, it is not necessarily the case that the PPIs have an upward bias. If this utilization effect is sufficiently negative, it could conceivably swamp the two other sources of bias.

Ralph Bradley, John Greenless, Abe Dunn, Anne Hall, Steve Heffler, Tina Highfill, James Kim, and Jonathan Samuels provided useful comments.

1. See www.bea.gov/national/health_care_satellite_account.htm.
2. See Schultz and Mackie (2002) and National Research Council (2010) for discussions of the enormous difficulties in introducing new goods and accounting for the attendant quality increases.

This article summarizes what is currently known about the substitution and utilization issues and their implications for price index measurement. Research staff at the BEA will continue to study these topics as part of the development of a detailed economic account for the medical care sector.

The need for new price indexes

As currently envisioned at BEA, the development of disease-based components for medical care spending in the NIPAs would involve redefining nominal output components from the current service-centered presentation to a new disease-centered presentation.[3] This restatement would leave the level of total nominal spending the same. But estimating real (inflation-adjusted) measures of health care spending in this new framework would require new appropriate disease-based price indexes to deflate the disease-based nominal output measures.

Conceptually, these new price indexes should measure the cost of an episode of care, that is, all medical procedures, drugs, office visits, and other treatments prescribed in the episode, no matter who provided the service.[4] For acute conditions like an ear infection, an episode of care might last a week or so, and the treatments might involve a visit to the doctor and a prescription for antibiotics. In this case, the "good," or output, is the episode, or the complete treatment of the ear infection. The price is the cost of all procedures (all goods and services) utilized to treat the ear infection throughout the episode—including both the doctor's visit and the antibiotics. For chronic conditions like diabetes that require year-round treatment, an episode of care could be defined as a year of treatment and the price is the annual cost of treatment.

We would report spending and prices for each disease category. An overall price index would aggregate over the price indexes for the individual diseases. This type of index was called a Medical Care Expenditure (MCE) index by a National Academies Panel (Schultz and Mackie 2002). The price indexes for individual conditions track the change in average expenditures per patient to treat that specific condition and would answer questions like, "What is happening to the cost of treating cancer?" The overall index is essentially a weighted average of the underlying disease-level price indexes and would answer the more generic question, "What is happening to per patient expenditures on medical care?"

Such indexes, which remain experimental, mark a departure from the approach now used by the Bureau of Labor Statistics (BLS) to produce the PPIs.[5] In this approach, indexes essentially price a fixed basket of procedures provided by a particular type of provider. For physician services, for example, BLS chooses a representative office visit in which a patient was treated for some condition using particular procedures. It then obtains prices for identical office visits to see how the price of office visits changes over time. This strategy essentially prices a bundle of procedures (a fixed basket) provided by a particular type of provider (office visits). In general, this will not provide much information on what is happening to the costs of treating the underlying medical conditions, the preferred definition of the services provided by the health sector. Indeed, research staff at BLS are pursuing a research agenda to develop experimental indexes that improve upon the official statistics. See, for example, Bradley and others (2010) and Bradley (2013).

Substitution across industry lines

One critical issue when comparing disease-based price indexes with conventional price indexes has to do with possible shifts in where and how the treatment is provided—that is, substitution of health care across industry lines.

Economists have documented quite a few examples of substitution in health care services. Consider the treatment of depression. Over time, there has been a shift away from talk-intensive therapy to lower cost drug therapy. Conventional price indexes that track these two types of therapy separately cannot account for the substitution that has occurred. As another example, knee surgery used to involve a costly overnight stay in a hospital but now is often performed on an outpatient basis, resulting in a lower cost for the complete treatment of the bad knee. By tracking the cost of hospital stays separately from the cost of outpatient visits, standard medical care price indexes cannot capture the cost savings that arise from this change.

Empirical work has documented that this type of substitution occurs and that it tends to lower costs or restrain increases in the price of treating certain conditions. Early empirical work demonstrated the importance of this effect for some important medical conditions: heart attacks (Cutler and others 1998), depression (Frank, Berndt, and Busch 1999), cataracts (Shapiro, Shapiro, and Wilcox 2001), and schizophrenia (Frank and others 2004).

3. See Aizcorbe et al. (2012) for an illustration.

4. See Chapter 3 in National Research Council (2010) for a discussion of the different methods that one might use to allocate spending by disease and the difficulties in implementing those methods.

5. See Berndt and others (2000) for a detailed description of the problems in existing PPIs.

Later studies explored this issue over a more comprehensive list of conditions (table 1). All of the studies confirmed earlier results for mental conditions and cataracts. In addition, they also found the shift of surgeries from inpatient hospitals to ambulatory surgical centers to be significant.

Aizcorbe and Nestoriak (2011) in particular documented shifts in treatments across a broad range of medical conditions. The study measured several important shifts in treatment at the disease episode level, such as shifts away from inpatient services for many conditions. They also found a clear divide between an episode-based MCE index that properly accounts for cross-industry shifts in where procedures are performed and an index that prices a fixed distribution of procedures across industries. They found that the MCE index shows slower growth, implying that cross-industry shifts held down the growth in prices.

This result appears to be quite robust and has been replicated in other studies, including Dunn and others (2013) and Aizcorbe and others (2011). The estimated upward bias of official measures due to these types of substitutions has ranged as high as 1.5 percentage points (Aizcorbe and Nestoriak 2011).

Utilization of procedures per encounter

While the available data show that cross-industry shifts caused an upward bias in the BLS PPIs, there is another source of bias related to shifts in utilization that is potentially important. In this setting, we use the term utilization to refer to the intensity of treatments during a medical encounter, measured as the number and mix of procedures. As discussed above, the MCE index tracks changes in the cost of episodes of care. So, for example, a decrease in the number of procedures required to treat an ear infection would be reflected in the MCE index as a drop in the cost of those episodes. However, because the PPI tracks a fixed basket of procedures, it will not reflect the decline in episode costs. Thus, changes in the number and mix of specific procedures per disease treatment encounter will cause the PPIs to diverge from the MCE indexes.

In contrast to recent empirical work related to price indexes and cross-industry substitution effects, only one study to date has specifically explored the effect of utilization on health care prices, showing that utilization effects in some cases can counter substitution effects. Using a database of commercially insured patients, Dunn, Liebman, and Shapiro confirmed previous research, showing that indexes that account for substitution across industries show slower price growth, compared with indexes that do not allow for substitution. The more intriguing finding, however, was that the number or intensity of procedures performed to treat episodes of illness increased over time and that those increases translated into increases in the cost of treating individual diseases. In fact, Dunn, Liebman, and Shapiro found that overall these increases in procedures per visit almost completely offset the cross-industry substitution effect.

How do the substitution and utilization effects combine to affect health care prices?

Dunn, Liebman, and Shapiro provide a decomposition of the growth in an MCE index into four terms: (1) the growth in a PPI-type price index, (2) the bias in that

Table 1. Estimates of Bias in the Medical Care PPIs From Cross-Industry Substitution

Study	Data			Estimate of bias[1] (percentage points)
	Period	Source	Coverage	
Song, Marder, Houchens, Conklin, and Bradley (2009)	1999–2002	MarketScan	Commercially insured patients living in three metropolitan areas; random sample of 40 conditions.	Statistically insignificant
Bradley, Cardenas, Ginsburg, Rozental, and Velez (2010)	1999–2004	MEPS/BLS data	Nationally representative sample of noninstitutionalized population; prices adjusted using BLS aggregates.	1.2 to 1.4
Aizcorbe and Nestoriak (2011)	2003–2005	Pharmetrics	Commercially insured patients; unadjusted convenience sample.	1.5
Aizcorbe, Bradley, Greenaway-McGrevy, Herauf, Kane, Liebman, Pack, Rozental (2011)	2001–2005	MEPS	Nationally representative sample of noninstitutionalized population.	1.0
Dunn, Liebman, Pack, and Shapiro (2013)	2003–2005	MarketScan	Commercially insured patients; convenience sample adjusted to represent the NHIS population.	0.9
Bradley (2013)	2005–2010	MEPS/BLS data	Nationally representative sample of noninstitutionalized population; prices adjusted using BLS aggregates.	1.0

BLS Bureau of Labor Statistics
MEPS Medical Expenditures Panel Survey
NHIS National Health Interview Survey
1. At compound annual growth rates.

index from cross-industry substitutions, (3) the bias from shifts in utilizations, and (4) an algebraic cross term that is near zero. While they did find evidence of cross-industry substitutions that held down cost growth by an average of about 2 percent per year (at a compound annual growth rate) over this period, they also found that the bias from shifts in utilizations pushed up costs by about the same amount (1.8 percent per year). All told, the growth in the (preferred) MCE index (3.2 percent) is not much slower than the growth in the PPI-type measure (3.6 percent). Their analysis underscores the importance of considering both potential biases—correcting only one might give measured price growth that is even further from that of the ideal index (table 2).

Table 2. Substitution and Utilization Biases in PPI-Type Price Indexes, 2003–2007

Index	Compound annual growth rate
PPI-type procedure price index	3.6
Bias from cross-industry substitutions	–2.1
Bias from shifts in utilization	1.8
Cross term	–0.4
Medical care expenditures index	3.2

PPI Producer price index
Source: Dunn, Liebman, and Shapiro (2012)

Conclusion and future research

Dunn, Liebman, and Shapiro's work opens a new line of thinking as national economic accounting agencies continue to research relevant issues related to improving health care statistics. By accounting for shifts in treatment utilization at a granular level, the study adds a new wrinkle in the health care price puzzle. While previous studies have established that cross-industry substitution effects cannot be ignored when it comes to developing price indexes for the treatment of diseases, Dunn, Liebman, and Shapiro's study suggests that utilization effects in some cases might offset any upward bias from cross-industry shifts, a conclusion that is worthy of additional study.

One implication of the potentially powerful utilization effects is that conventionally produced price measures may not be understating economic growth and productivity growth by as much as the previous research suggested.

As for now, many issues regarding price indexes suitable for deflating nominal health care spending measures remain unanswered, thus the potential effects on GDP and aggregate value added remain uncertain.

The existing empirical literature focuses on a relatively recent period with either partial coverage of patients (as in claims data for commercially insured patients) or the broader coverage of surveys that likely have relatively large standard errors owing to the relatively small number of observations. An important item on BEA's research agenda is to study the possibility of combining the benefits of large sample sizes in claims data with the statistical properties of government surveys. BEA will also expand its coverage of price indexes to include more historical data.

Moreover, it bears repeating that a major caveat of this work is that we do not yet have a way to account for the changes in outcomes associated with the treatment of disease (that is, quality change), an issue that is likely numerically important.[6] Lacking methods by which to adjust for quality and attribute these changes in quality to specific medical interventions, we cannot address the important question about whether spending on medical care is effective in terms of saving lives. One of BEA's main efforts going forward will be to explore the usefulness of existing measures to quantity quality change. Here, we will adopt National Academies Panel suggestion that measures such as QALYs (quality-adjusted life years) and QALEs (quality-adjusted life expectancy) might be good places to start.

References

Aizcorbe, Ana M., and Nicole Nestoriak. 2011. "Changing Mix of Medical Care Services: Stylized Facts and Implications for Price Indexes." *Journal of Health Economics* 30, no. 3 (May); 568–574.

Aizcorbe, Ana M., Eli B. Liebman, David M. Cutler, and Allison B. Rosen. 2012. "Household Consumption Expenditures for Medical Care: An Alternate Presentation." Survey of Current Business 92 (June 2012):34–47.

Aizcorbe, Ana M., Ralph Bradley, Ryan Greenaway-McGrevy, Brad Herauf, Richard Kane, Eli Liebman, Sarah Pack, and Lyubov Rozental. 2011. "Alternative Price Indexes for Medical Care: Evidence from the MEPS Survey." Bureau of Economic Analysis (BEA) Working Paper WP2011–01. Washington, DC: BEA.

Berndt, Ernst R., David M. Cutler, Richard G. Frank, Zvi Griliches, Joseph P. Newhouse, and Jack E. Triplett. 2000. "Medical Care Prices and Output." In

6. See for example, Cutler and Richardson (1997), Cutler, McClellan, Newhouse, and Remler (1998), Nordhaus (2003), Murphy and Topel (2006), and Hall and Jones (2007).

Handbook of Health Economics, ed. Anthony J. Culyer and Joseph P Newhouse, 119–180. Amsterdam, The Netherlands: North Holland.

Bradley, Ralph. 2013. "Feasible Methods To Estimate Disease-Based Price Indexes," *Journal of Health Economics* 32, no. 3 (May): 504–514.

Bradley, Ralph, Elaine Cardenas, Daniel H. Ginsburg, Lyubov Rozental, and Frankie Velez. 2010. "Producing Disease-Based Price Indexes." *Monthly Labor Review* (February): 20–28.

Cutler, David M., and Elizabeth Richardson. 1997. "Measuring the Health of the U.S. Population." In *Brookings Papers on Economic Activity: Microeconomics* 28. Washington, DC: The Brookings Institution, 217–271.

Cutler, David M., Mark McClellan, Joseph E. Newhouse, and Dahlia Remler. 1998. "Are Medical Prices Declining? Evidence from Heart Attack Treatments." *The Quarterly Journal of Economics* 113, no. 4 (November): 991–1,024.

Dunn, Abe, Eli B. Liebman, and Adam Shapiro. 2012. "Implications of Utilization Shifts on Medical Care Price Measurement." Bureau of Economic Analysis (BEA) Working Paper WP2012–9. Washington, DC: BEA.

Dunn, Abe, Eli B. Liebman, Sarah Pack, and Adam Shapiro. 2013. "Medical Care Price Indexes for Patients with Employer-Provided Insurance: Nationally Representative Estimates from MarketScan Data" *Health Services Research* 48, no.3 (June): 1,173–1,190.

Frank, Richard G., Ernst R. Berndt, and Susan M. Busch. 1999. "Price Indexes for the Treatment of Depression." In *Measuring the Prices of Medical Treatments*, ed. Jack E. Triplett, 72–102. Washington, DC: The Brookings Institution.

Frank, Richard G., Ernst R. Berndt, Susan M. Busch, and Anthony F. Lehman. 2004. "Quality-Constant Prices for the Ongoing Treatment of Schizophrenia: An Exploratory Study." *Quarterly Review of Economics and Finance* 44 (July): 390–409.

Hall, Robert E., and Charles I Jones. 2007. "The Value of Life and the Rise in Health Spending." *The Quarterly Journal of Economics* 122, no.1 (February): 39–72.

Murphy, Kevin M., and Robert H. Topel. 2006. "The Value of Health and Longevity." *Journal of Political Economy* 114, no. 5 (October): 871–903.

National Research Council. 2010. *Accounting for Health and Health Care: Approaches to Measuring the Sources and Costs of Their Improvement.* Washington, DC: The National Academies Press.

Nordhaus, William D. 2003. "The Health of Nations: The Contribution of Improved Health to Living Standards." In *Measuring the Gains from Medical Research: An Economic Approach,* ed. Kevin M. Murphy and Robert H.Topel. 9–40. Chicago: University of Chicago Press.

Schultze, Charles L., and Christopher Mackie, ed. 2002. *At What Price? Conceptualizing and Measuring Cost-of-Living and Price Indexes. National Academies Panel on Conceptual, Measurement and Other Statistical Issues in Developing Cost-of-Living Indexes.* Washington, DC: National Academy Press, for the National Research Council.

Shapiro, Irving, Matthew D. Shapiro, and David W. Wilcox. 2001. "Measuring the Value of Cataract Surgery." In *Medical Care Output and Productivity*, ed. David M. Cutler and Ernst R. Berndt, 411–437. Studies in Income and Wealth, vol. 62. Chicago: University of Chicago Press.

Song, Xue, William D. Marder, Robert Houchens, Jonathan E. Conklin, and Ralph Bradley. 2009. "Can A Disease-Based Price Index Improve the Estimation of the Medical Consumer Price Index?" In *Price Index Concepts and Measurements,* ed. W. Erwin Diewert, John S. Greenlees, and Charles R. Hulten, 369–372. Chicago: University of Chicago Press, for the National Bureau of Economic Research.