DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institutes of Health
Bethesda, Maryland 20892

DATE: February 2, 2018
SUBJECT: Biomedical Research and Development Price Index (BRDPI): Fiscal Year 2017 Update and Projections for FY 2018-FY 2023

Summary

- The estimated growth in the BRDPI for FY 2017 is 2.5 percent, which is slightly less than the 2.6 percent rate previously projected for that year.
- The revised estimate for FY 2016 is 2.2 percent, which exactly matches the 2.2 percent growth rate estimated last year.
- The BRDPI is projected to grow at 2.6 percent for FY 2018, 2.7 percent for FY 2019, 2.8 percent for each of the years FY 2020 through FY 2022, and 2.9 percent for FY 2023.
- The projected 2.6 percent growth for FY 2018 reflects an increase in the general rate of inflation as indicated by the U.S. Office of Management & Budget (OMB) annual projection of the Gross Domestic Product (GDP) Price Index. The FY 2018 projected rate assumes that Federal employee salaries and the cap on compensation of extramural investigators will grow during FY 2018 at about the same rate as during FY 2017. Academic salaries and prices for equipment, services and supplies are also assumed to accelerate in accordance with the increase in general inflation.
- Partly because of the past freeze on Federal civilian employee salaries and the cap on compensation of extramural investigators, the rate of growth of the BRDPI during the years FY 2012 through FY 2017 continued to be relatively low compared to its historical relationship with general inflation as represented by the growth of the GDP Price Index. The projections for each of the following years, FY 2018 through FY 2023, assume that the growth of the BRDPI will gradually revert to the historical pattern observed before 2012 of faster growth relative to the growth of the GDP Price Index.

Definition of the BRDPI

The BRDPI measures changes in the weighted-average of the prices of all the inputs (e.g., personnel services, various supplies, and equipment) purchased with the NIH budget to support research. The weights used to construct the index reflect the actual pattern (or the proportion) of total NIH expenditures on each of the types of inputs purchased. Theoretically, the annual change in the BRDPI indicates how much NIH expenditures would need to increase, without regard to efficiency gains or changes in government priorities to maintain NIH-funded research activity at the previous year's level.

Background and Modification of the Methodology Used to Estimate the BRDPI

Section 3 of the attachments includes a series of appendices that provide a brief history of the BRDPI including reasons for changes in the methodology used to estimate and project future values of this price index. Appendix A briefly summarizes the role of the Bureau of Economic Analysis, Department of Commerce and the NIH in the estimation process. Appendix B describes the benefits of the move to a Fischer chain-weighted methodology to estimate the BRDPI.

Beginning with the BRDPI estimate for FY 2011, developed in December 2011, NIH has explicitly adjusted the estimates of annual growth for changes in Federal policy regarding the cap on salaries of investigators on extramural awards. See Appendix C below for the history and details of this adjustment.

Since FY 2012 the salary cap has been linked to Federal Executive Level II salaries and that cap value has increased slightly each year. As a result, the cap on extramural salaries still constrains the growth of the BRDPI. The impact of the cap is markedly less than when it was frozen for FY 2011 or when it was reduced for FY 2012. However, the effect of the salary cap on the estimated growth of the BRDPI could increase over time. Consequently, we expect to continue indefinitely to adjust the BRDPI for the effects of the salary cap. The reasons for and implications of the ongoing adjustment for the salary cap for the projection of future values of the BRDPI are summarized in Appendix D.

Revision of FY 2016 BRDPI Growth and the FY 2017 Update

This year, the revised estimate for growth of the BRDPI adjusted for the cap on extramural salaries is 2.2 percent for FY 2016, and the preliminary estimate is 2.5 percent for FY 2017.[1] The revised FY 2016 estimate matches the preliminary value of 2.2 percent projected last year.

The preliminary estimate of 2.5 percent growth in the BRDPI for FY 2017 is just slightly below the 2.6 percent projected for FY 2017 during December of 2016. The slight difference is attributed to the underlying prices that drive the estimate of the BRDPI, which did not grow quite as fast as originally expected. Also, the GDP Price Index increased at a slower rate than OMB projected, and some of the slower growth in the price level in the overall economy filtered through to the estimate for the BRDPI for FY 2017.

Projections for FY 2018-2023

The BRDPI provides the best historical estimate of inflation for the NIH budget for any completed fiscal year. However, development of future NIH budgets benefit from consideration of how prices of the goods and services NIH expects to purchase in future years might change. We could simply project that the rate of change for FY 2017 will hold for the next few years. However, it would be unrealistic to assume the BRDPI will grow at a fixed rate when the general rate of economic activity and the average growth of prices is expected to change from year to year. Adjustment of future year projections to account for any anticipated changes in Federal policy is also desirable. Changes in Federal policy as well as annual budget resources appropriated can potentially influence the prices NIH pays for goods and services used to support research and development (R&D).

A more sophisticated, but still simple, projection methodology for future annual changes in the BRDPI embodies two considerations. The first is the expected general rate of inflation of prices for the U.S. economy. The second is the expected relationship between the general rate of inflation and changes in the BRDPI.

NIH defers judgment on the change in the general rate of inflation to the OMB. We use the most recently issued OMB economic assumptions dataset available as the source of future year percentage change rates for the GDP Price Index. The GDP Price Index increased by 1.71 percent for FY 2017. OMB forecasts an increase of 1.9 percent for FY 2018, and 2.0 percent for each year from FY 2019, through FY 2023.[2]

The historical relationship between the BRDPI and the GDP Price Index is summarized by a statistically estimated linear equation (by ordinary least squares regression) that relates the annual percent change in

[1] As a reminder, the estimate for the most recent fiscal year (e.g., FY 2017 in December 2017) is referred to as "preliminary" because the initial data on prices available to the BEA each December are often revised during the following months. Consequently, each December the BEA also provides a revised estimate for the prior fiscal year (e.g., the estimate for FY 2016 was revised in December 2017).

[2] Updated GDP Price Index projections were not available at the time of the BRDPI estimation in December 2017. The analysis uses GDP Price Index data from November 2016.

the BRDPI to the annual percent change in the GDP Price Index. Using the data for the most recent ten years (FY 2008 through FY 2017) the estimated equation is:

(Projected annual percent change in the BRDPI)
= 1.77 + 0.65 x (annual percent change in GDP Price Index).

If we assume the historical relationship will persist into the future, we simply plug the OMB projected values of the GDP Price Index into the equation and use the predicted growth of the BRDPI as the corresponding out-year projections of the BRDPI.

For FY 2017, after adjusting for the salary cap, the estimated growth of 2.5 percent for the BRDPI is 0.4 percentage points lower than the 2.9 percent growth predicted with the equation above based on the 1.7 percent growth in the GDP Price Index for FY 2017 (and then adjusting for the salary cap). The difference between the estimated 2.5 percent increase for FY 2017 and the 2.9 percent value predicted by the historical trend also reflects the slower growth in the BRDPI than what is considered historically normal in comparison with the GDP Price Index for the past few years.

The 1.3 percent rate of growth for FY 2012 was the lowest annual growth in the history of the BRDPI and the first time that the BRDPI increased less than the GDP Price Index (1.9 percent).

For more recent years the growth of the BRDPI, relative to the growth of the GDP Price Index, remains low by historical standards. However, it seems to be moving towards recovering its historical relationship with the GDP Price Index. The BRDPI growth has exceeded the growth of the GDP Price Index every year since FY 2012. Additionally, the difference between the BRDPI and the GDP Price index rates has been increasing each year

Consequently, because of the slower than normal growth of the BRDPI in recent years NIH projects a 2.6 percent growth in the BRDPI for FY 2018. This is lower than the 2.9 percent growth implied by the historical equation above.

To summarize the projected 2.6 percent growth for FY 2018 reflects an increase in growth of the general rate of inflation as indicated by the OMB annual projection of the GDP Price Index. A concurrent assumption is that the BRDPI will grow somewhat below its historical rate.

Absent a significant change in the mix or relationship of factors that drive the BRDPI rate profile, NIH expects that after FY 2018 the growth of the BRDPI will gradually revert to the historical pattern observed before FY 2011 marked by faster growth relative to the growth of the GDP Price Index. This assumption underpins the following pattern of the BRDPI projections: 2.6 percent for FY 2018, 2.7 percent for FY 2019, 2.8 percent for each year between FY 2020 through FY 2022, and 2.9 percent in FY 2023.

Forecasting the future path of price changes is an inherently imprecise exercise. We cannot expect OMB projections of future year GDP Price Index rates to be realized precisely each year. Likewise, the complex relationship between the general rate of inflation and the BRDPI can change from year to year. However, NIH rigorously strives for an unbiased process—i.e., the projections miss high roughly as frequently as they miss low.

Summary Tables

Table A depicts values of the annual percent change in the GDP Price Index and the BRDPI for the past ten years. Table B includes projected values of the BRDPI and the GDP Price Index for FY 2017 through FY 2022.

For the convenience of the reader, Table C illustrates how to translate annual changes into annual levels of the BRDPI. After designating a reference year, for which the value of the BRDPI is specified as 100, projections of the annual levels of the BRDPI can be constructed using the following recursive relationship:

BRDPI (for year t) = BRDPI (for year t-1) x [1 + {Annual Percent Change (for year t)}]

In Table C, the calculations are presented for FY 1989 through FY 1992 using FY 1989 as the reference year (1989 = 100). To calculate the value for FY 1991, for example, the formula would be: 110.5 = 105.4 x 1.048. In other words, to derive the BRDPI value for FY 1991 (110.5), start with the FY 1990 BRDPI value (105.4) and multiply by one plus the annual change for FY 1991 (1+ [4.8/100] =1.048).

Attachments

ATTACHMENTS

1. **Supplementary Tables**

2. **References to BEA Price Index Methodology**

3. **Background and Modification of the Methodology Used to Estimate the BRDPI**

TABLE A
HISTORICAL ANNUAL PERCENT CHANGES

Fiscal Year	GDP Price Index	BRDPI
Col. (1)	Col. (2)	Col. (3)
2008	2.1%	4.7%
2009	1.2%	2.9%
2010	0.9%	3.0%
2011	2.0%	2.9%
2012	1.8%	1.3%
2013	1.7%	1.9%
2014	1.8%	2.1%
2015	1.2%	2.0%
2016	1.2%	2.2%
2017	1.7%	2.5%

TABLE B
PROJECTED ANNUAL PERCENT CHANGES

Fiscal Year	GDP Price Index	BRDPI
Col. (1)	Col. (2)	Col. (3)
2018	1.8%	2.6%
2019	1.9%	2.7%
2020	2.0%	2.8%
2021	2.0%	2.8%
2022	2.0%	2.8%
2023	2.0%	2.9%

TABLE C

Conversion of Annual Changes into Annual Levels

Fiscal Year	Annual Percent Change	[1+(Percent Change/100)]	Previous Year Value			Annual Level BRDPI
Col. (1)	Col. (2)	Col. (2)	Col. (3)			Col. (4)
1989						100.0
1990	5.4%	1.054	*	100.0	=	105.4
1991	4.8%	1.048	*	105.4	=	110.5
1992	4.4%	1.044	*	110.5	=	115.4

Section 2: References to BEA Price Index Methodology

Robert P. Parker and Eugene P. Seskin, "Annual Revision of the National Income and Product Accounts: Annual Estimates 1993-96, Quarterly Estimates 1993:1-1997:1," Survey of Current Business, 77, No. 8 (August 1997), pp 6-35.

J. Steven Landefeld and Robert P. Parker, "Preview of the Comprehensive Revision of the National Income and Product Accounts: BEA's New Featured Measures of Output and Prices," Survey of Current Business, 75, No. 7 (July 1995), pp 31-38.

Allan H. Young, "Alternative Measures of Change in Real Output and Prices, Quarterly Estimates for 1959-1992," Survey of Current Business, 73, No.11 (March 1993), pp 31-41.

Allan H. Young, "Alternative Measures of Change in Real Output and Prices," Survey of Current Business, 72, No. 4 (April 1992), pp 32-48.

Jack E. Triplett, "Economic Theory and BEA's Alternative Quantity and Price Indexes," Survey of Current Business, 73, No. 4 (April 1992), pp 49-52.

Section 3: Background and Modification of the Methodology Used to Estimate the BRDPI

Appendix A. Background on the BRDPI Estimation Process

In the early 1980s, the Bureau of Economic Analysis (BEA) in the U.S. Department of Commerce developed the Biomedical Research and Development Price Index (BRDPI). Under an interagency agreement with the NIH, each December the BEA provides an estimate of the BRDPI for the most recently completed fiscal year. In December 2016, for example, BEA transmitted information for FY 2016. This estimate is referred to as "preliminary" because the initial data on prices available to the BEA in December are typically revised during the following year. Consequently, each December the BEA also provides a revised estimate for the prior fiscal year, i.e., the estimate for FY 2016 was revised in December 2017.

The Office of the Director at NIH projects future year values based on a methodology described below. An updated table of BRDPI annual estimates and future-year projections is posted on the NIH website each year shortly after the release of the President's Budget (PB), typically in early February. Refer to the following link http://officeofbudget.od.nih.gov/gbiPriceIndexes.html, or use the search engine at http://www.nih.gov/ to find "BRDPI."

Appendix B. Adoption of the Fisher Chain-Weighted Index Methodology to Estimate the BRDPI (2006)

This section is included for users interested in more of the technical details regarding methods used to estimate annual values of the BRDPI.

As stated in the memo above, the weights used to construct the BRDPI reflect the actual pattern (or the proportion) of total NIH expenditures spent on each of the types of inputs purchased with the NIH budget (e.g., personnel services, various supplies, and equipment). In fact, the use of weights specific to the NIH budget is what distinguishes the BRDPI from other price indexes designed to reflect different patterns of expenditures.

Until FY 2006, the BEA estimated the BRDPI using a fixed weight (or Laspeyres) index. This type of index compares prices over several years using a fixed set of weights based on the composition of expenditures in a single, specified base year (say 1993 or 2003).

Beginning with the revised estimate for FY 2005 (published in December 2006) the BEA now estimates the BRDPI using a Fisher chain-weighted index methodology. The chain-weighted methodology improves the accuracy of the BRDPI and is consistent with the methodology BEA adopted in 1996 to estimate the Gross Domestic Product and its component series. For the interested reader, five articles in BEA's publication, *Survey of Current Business*, discuss the reasons BEA now uses the chain-weighted methodology. (See the references to BEA Price Index Methodology above.)

In less technical terms, the move to chain weighting means primarily that the expenditure weights used to estimate the BRDPI will be updated each year. Also, when estimating the growth of the BRDPI between two consecutive years (say 2005 and 2006) the Fisher Price Index reflects the average experience of two

slightly different indexes: the first index uses first year weights (e.g., 2005) to estimate average growth in prices; the second index uses second year weights (e.g., 2006) to develop the estimate. To estimate growth over several years, the consecutive year indexes are multiplied, or chained. (As an analogy, think of calculating compound growth on your retirement portfolio over ten years as the mix of stocks and bonds changes from year to year.)

By contrast, to the chain weighting methodology, the previously used fixed-weight (or Laspeyres) index approach can result in a "substitution bias" that tends to overstate price increases for periods after the base year and understate price increases for periods before the base year. This bias occurs because use of the fixed-weight index implicitly assumes the composition of the items being priced does not change over time. In fact, the mix of items purchased and included in a price index tends to shift over the years. The shift in purchases may be a response to changes in relative prices or to advances in technology which provide new opportunities and new tools for investigation (e.g., more computers and automated test equipment and fewer laboratory assistants). Or the mix may reflect changes in policy with a larger share of the NIH budget allocated to support of extramural research and less to inside NIH activities, including intramural research and administration of extramural research.

During periods close to the base year, differences in the composition are usually small, and a fixed-weight index provides a good approximation. Farther away from the base period, however, larger differences in expenditure composition are likely. Consequently, weighting formulas that allow for changes in composition over time provide a better measure of both year-to-year price changes and long-term trends.

In response to BEA recommendations, in past years the expenditure weights used to estimate the BRDPI were updated, or rebased, occasionally to overcome the problem of substitution bias. In the BRDPI Table of Annual Values listed on the NIH website and in the attached Table A, the values of the BRDPI for FY 1999-2004 are constructed using the FY 2003 expenditure weights; the FY 1991-1998 values are based on FY 1993 weights; the FY 1986-1990 values are based on FY 1988 weights; and the FY 1979-1985 values are based on FY 1984 weights. The pre-1979 values of the BRDPI were estimated using a preliminary methodology with a less-detailed set of expenditure weights. Pre-1979 values are not likely to be as accurate as the later year values because of the less precise methodology.

Appendix C. Adjusting the BRDPI for the Cap on Extramural Compensation

Every year since 1990, Congress has legislatively mandated a provision limiting the direct salary that an individual may receive under an NIH grant.[3] The cap has been increased most years at a moderate rate. Although the increase is generally somewhat below the average growth in academic salaries, in years before FY 2011 the impact of the salary cap on the estimated growth of the BRDPI was negligible. However, for FY 2011 the NIH salary cap was frozen at the previous year's level. The cap "freeze" had a noticeable effect on the estimated change of the BRDPI for FY 2011.

The limitation on the direct salary that an investigator may receive under an NIH award might not reduce the investigator's effective income. The host institution or another funding source may make up the difference. However, changes in the cap affect what NIH pays for an

[3] http://grants.nih.gov/grants/policy/salcap_summary.htm and http://grants.nih.gov/grants/guide/notice-files/NOT-OD-11-073.html

investigator's research effort if the investigator's annual compensation rate exceeds that cap. Given the definition of the BRDPI as an input price index for the NIH budget, the effect of the cap on the price NIH pays for an investigator's effort must be considered.

For FY 2012, the level of the cap dropped from $199,700 to $179,700. The reduction in the cap on investigator salaries, flat civilian Federal salary levels, and limits on the growth of fellowship and training stipends and related expenses on training awards combined to reduce the estimated BRDPI growth for FY 2012 and the projected growth for subsequent years.

For FY 2012 NIH estimated the share of academic salaries subject to each of the two salary caps. Using a sample of successful applications for competing new and renewal NIH awards the NIH extracted data on salaries from the detailed budget requests submitted as part of each application. Our best estimate is that for NIH awards to academic institutions:

- 12.9% of requested salaries are subject to the original cap of $199,700;
- 14.4% of requested salaries are subject to the lower cap of $179,700;
- -10.7% is the average reduction due to lowering the cap (from $199,700 to $179,700) for the 14.4% of salaries subject to the lower cap.[4]

Appendix D. Unadjusted and Adjusted Values of the BRDPI

Since FY 2012 the salary cap has been linked to Federal Executive Level II salaries and that cap value has increased slightly each year. As a result, the cap on extramural salaries still constrains the growth of the BRDPI. The impact of the cap is markedly less than when it was frozen for FY 2011 or when it was reduced for FY 2012.

[4] Information on base salaries and requested salaries for each member of the proposed research staff can be found in the detailed budget tables included as part of the project proposal. The salary information must be extracted from a sample of PDF file copies of applications and placed in Excel files for analysis.

The sample of project budgets was stratified by types of award (e.g., "R01, R21, P01), whether the award was made to a medical school or to a non-medical component of a university, and whether the degree of the corresponding principal investigator (PI) was an MD (including dual MD and PhD degrees) or something else (primarily a PhD).

The results for each cell in the three-dimensional sampling strata were then aggregated to estimate the overall share or requested salaries subject to each cap. The relative weight for each combination of type of award, medical/nonmedical component, type of degree was based on the distribution of all award amounts to academic institutions for FY 2011.

BEA estimated the growth in academic salaries for the BRDPI at 2.82 percent for FY 2011 and 3.24 percent for FY 2012. These estimates were based on the AAMC survey of salaries of medical school faculty and the AAUP survey of university salaries, adjusting for the freeze on the salary cap for FY 2011 and the reduction of the salary cap for FY 2012, the estimated growth in academic salaries was reduced to 2.46 percent and 1.23 percent respectively.

At the request of the NIH, the BEA re-estimated the BRDPI using the rates of growth of academic salary rates adjusted for the cap freeze and the cap reduction. The revised estimates of BRDPI growth captured the direct effects of reduced growth in academic salaries on the growth of the overall BRDPI. It also captured the indirect effects of academic salary growth through its effects on growth of fringe benefit rates, academic indirect costs and estimates of growth of compensation for consultants and for personnel on awards to non-academic institutions.

At one point we thought the need to adjust the BRDPI estimates for the effect of the salary cap would be temporary. We now believe it is important to adjust for the effects of the salary cap as long as it is in existence, no matter the magnitude of the effect. The salary cap is likely to remain in place indefinitely. It tends to be tied to the growth of compensation for Federal civilian salaries. Historically, those civilian salaries increase less each year than the growth in academic salaries. If average academic salaries continue to grow faster than the cap limit on salaries of extramural investigators, the impact of the cap on the estimated BRDPI will increase over time as a higher percentage of extramural salaries are subject to the cap.

With apologies for introducing any confusion we explicitly acknowledge that the NIH now maintains two BRDPI series. Since FY 2011 the NIH has posted estimates of the BRDPI adjusted for the effects of the salary cap. However, to calculate the adjusted series, NIH must maintain a preliminary series of BRDPI estimates unadjusted for the salary cap. To avoid confusion, this preliminary series is not routinely published or posted.

BEA prepares estimates of the unadjusted BRDPI growth series using traditional methodology. NIH then calculates the effective growth of academic salaries as the result of the salary cap[5] and asks BEA to re-estimate BRDPI growth subject to the slower growth in extramural compensation. The effect of this adjustment for the FY 2017 value was to reduce the estimated growth of the BRDPI by 0.4 percentage points, from 2.9 percent, unadjusted, to 2.5 percent growth after adjusting for effect of the salary cap.

NIH uses the unadjusted BRDPI series to estimate the statistical equation described in the cover memo and to project future year values of the BRDPI. We use the unadjusted BRDPI series for this projection methodology because it seems more natural to correlate a BRDPI series free of policy constraints (such as the salary cap) with the GDP Price Index, our measure of general inflation for the economy.

After the unadjusted values of the BRDPI are projected using the estimated equation and integrating any other considerations (see section on Projections in the cover memo) the projected values can be adjusted downward for the effects of the salary cap. These cap-adjusted values are reported in the summary tables below and in the larger table of BRDPI values posted with this memo each year.

[5] Effectively, this is a weighted average. The percentage of extramural salaries subject to the cap grows at the same rate as the salary cap. The salaries not subject to the cap grow at the constrained rate.