DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institutes of Health
Bethesda, Maryland 20892

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SUBJECT: Biomedical Research and Development Price Index: Fiscal Year 2021 Update and Projections for FY 2022–FY 2027

Summary

- The revised growth rate estimated for the Biomedical Research Development Price Index (BRDPI) in fiscal year (FY) 2021 is 2.1 percent, which is the same as the rate previously projected for that year.
- The actual growth rate for FY 2020 BRDPI is 1.7 percent, which is only 0.1 percentage points higher than the 1.6 percent growth projected last year.
- The BRDPI is projected to grow 3.1 percent in FY 2022, 2.6 percent in FY 2023, and 2.3 percent between FY 2024 and FY 2027.
- For FY 2022, the projected 5.3 percent Gross Domestic Product (GDP) price index growth rate is 1.4 percentage points higher than the general rate of inflation as indicated by the U.S. Office of Management & Budget (OMB) annual projection of the GDP price index. It should be noted that the OMB's annual projection is from early December 2021, which did not account for revised data to be released in early 2022.
- Partly because of the freeze on Federal civilian employee salaries and the cap on the compensation of extramural investigators in the past, the rate of growth of the BRDPI between FY 2012 and recent has remained relatively low compared to its historical relationship. However, the growth rate of the BRDPI has remained above that of the GDP price index except for a few brief periods such as during the Oil Shocks of the 1970s or in 2012 when the federal salary cap dropped by10 percent. In FY 2021, due to the continued impacts of the pandemic and the recent spike in the general inflation rate, we again observe the GDP price index growth rate exceeding the BRDPI rate. Estimated annual BRDPI rates are also projected to remain lower than corresponding GDP factors in FY 2022 and FY 2023. In the computation of the BRDPI, more than 80 percent of the National Institutes of Health (NIH) annual budget expenditure typically goes towards funding extramural institutions, of which approximately 70 percent is received by academic institutions and 30 percent is distributed to non-academic institutions. There are numerous NIH expenditure categories, but the BRDPI is largely determined by the salaries of employees and consultants, and by factors that are primarily mark-ups of these salaries, i.e., fringe benefits and academic indirect costs. In FY 2021, the academic salaries and wages increased by 1.5 percent which was less than the 2.1 percent increase reported in FY 2020. The academic indirect costs increased by 2.2 percent in FY 2021, a moderate drop from a 2.6 percent rise experienced in FY 2020. Similar trends were observed for non-academic salaries and wages. The price indexes of the BRDPI components unrelated to personnel costs increased at a higher rate in FY 2021 than in FY 2020, for example, industrial chemicals, inside-NIH utilities expenditure on fuel, water, gas, as well as facility maintenance and repair. Overall, prices measured within the BRDPI increased in FY 2021 due to which the BRDPI increased and at a faster rate than in FY 2020 (2.1 percent versus 1.7 percent), but not as aggressively as the rise in the GDP price index (3.1 percent versus 1.3 percent). Notwithstanding the projected significant increase in the GDP price index rates, the BRDPI growth rate is 0.4 percentage points higher than the previous year, the largest year-over-year increase in the BRDPI since FY 2017. Assuming the rise in the general inflation rate will stabilize in near future, we project that the growth of the BRDPI will continue to track the general rate of inflation measured by the GDP price index as we have seen historically.

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 proportions, 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 Updates to the Methodology Used to Estimate the BRDPI

Appendix 3 below consists of four sections 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 3A briefly summarizes the role of the Bureau of Economic Analysis (BEA), the Department of Commerce and the NIH in the estimation process. Appendix 3B describes the benefits of the Fisher chain-weighted methodology that has been used to estimate the BRDPI since FY 2005.

Beginning with the BRDPI estimate for FY 2011, developed in December 2011, NIH has explicitly adjusted the estimates for changes in federal policy regarding the cap on salaries of investigators on extramural awards. See Appendix 3C 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. Since FY 2012 the impact of the cap on BRDPI 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 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 3D.

The FY 2021 Preliminary Estimate of BRDPI Growth and Data Revisions

For FY 2021, the preliminary estimate of growth of the BRDPI is 2.1 percent.[1] This estimate is essentially same as the 2.1 percent BRDPI growth that was projected for FY 2021 in February 2021.

The actual estimated growth of the BRDPI for FY 2020 is 1.7 percent, which is 0.1 percentage point higher than last year's preliminary value of 1.6 percent.

Projections for FY 2022–2027

The BRDPI provides the best indicator of inflation (or deflation) conditions that NIH budgeted activities will experience in the future based on historical experiences for any completed fiscal year. The development of future NIH budgets benefits from consideration of how prices of the goods and services NIH expects to purchase in future years might change. We project the rate of change of the BRDPI for future years, but it would be unrealistic to assume that BRDPI will grow at the FY2021 rate or any fixed rate when general economic activity and the average growth of prices are expected to change from year to year. Additionally, the continued impacts of the COVID-19 pandemic, and the recent rise in the general inflation rate due to fuel price changes, supply chain constraints etc. make such projections volatile. Adjustment of future year projections to account for any anticipated changes in Federal policy is always desirable. Changes in Federal policy, as well as annual budget resources appropriated, can potentially

[1] The estimate for the most recent fiscal year (e.g., FY 2021) was provided by BEA in January 2022 in which BEA also provided a revised estimate for the prior fiscal years 2018, 2019, 2020 and 2021.

influence the prices the NIH pays for goods and services used to support research and development (R&D).

The current projection methodology used for estimation of future annual changes in the BRDPI involves some sophisticated concepts but still reflects a straightforward approach that embodies three considerations. The first is the expected general rate of inflation of prices for the U.S. economy. The second is planned or expected changes in the cap on salaries of investigators on extramural awards. The third is the expected relationship between changes in the BRDPI and the general rate of inflation and changes in the salary cap.

For projections of the general rate of inflation the NIH relies on the projections prepared by the OMB and the quarterly GDP price indexes released by the BEA. We used the most recently issued OMB economic assumptions dataset (released in early December 2021) and BEA's quarterly GDP price indexes from Table 1.1.4 released on January 27, 2022, as the source of future year percentage change rates for the GDP price index. We projected a 5.3 percent growth rate of the GDP price index in FY 2022, 3.3 percent in FY 2023, 2.1 percent in FY 2024, and 2.0 percent between FY 2025 and 2027. The OMB's forecast of the same is 3.9 percent during FY 2022, 2.2 percent during FY 2023 and 2.0 percent during the FYs 2024 to 2027[2].

The salary cap increased 1.0 percent in 2021 and is scheduled to increase 2.2 percent in 2022 according to the executive order that was signed by the President on December 22, 2021. For FY 2023 to FY 2027, We assume that the salary cap will grow 1.5 percent per year between FY 2023 and FY 2027, which is its average rate of growth from FY 2016 to FY 2022.

The historical relationship between the BRDPI, the GDP price index, and the salary cap is summarized by a statistically estimated linear equation (by ordinary least squares regression) that relates the annual percent change in the BRDPI to the annual percent changes in the GDP price index and the salary cap. Using the data for the most recent ten years[3] (FY 2012 through FY 2021) the estimated equation is:

(Projected percent change in the BRDPI)
= 1.7 + 0.23 × (percent change in GDP price index) + 0.08 × (percent change in salary cap).

Assuming the historical relationship will persist into the future, we plug the projected values of the GDP price index and the salary cap into the equation and derive the projected growth of the BRDPI for FY 2022 through FY 2027.

For FY 2021, after adjusting for the salary cap, the preliminary estimated growth of the BRDPI of 2.1 percent which is the same as the 2.1 percent growth predicted last year with the equation based on the 3.1 percent growth of the GDP price index and the 1.0 percent growth of the salary cap for FY 2021.

The projected 3.1 percent BRDPI growth for FY 2022 reflects the 5.3 percent growth in the GDP price index and the 2.2 percent increase in the salary cap. Based on the information that is currently available,

[2] GDP factors incorporated in calculations of rates for FY 2022 and later reflect economic assumptions issued by OMB in early December 2021 for budget formulation purposes during the time the BRDPI update was prepared (December 2021-January 2022). GDP price index values would not account for any revised economic assumptions that will be released later in 2022 by the OMB.

[3] We included data from the most recent nine FYs as was done previously where FY 2009 and FY 2010 were excluded because the GDP price index grew 1.1% and 0.9% during those years. These low values, reflecting the depths of the economic recession, distorted the historic linear relationship between BRDPI and GDP price index and were therefore excluded.

NIH expects that after FY 2021 the BRDPI will increase approximately at the rate of 2.6 percent in FY 2023 and 2.3 percent per year from FY 2024 to FY 2027.

Forecasting the future path of price changes is an inherently imprecise exercise. We cannot expect OMB projections of future year GDP price index rates or NIH projections of future changes in the salary cap to be realized precisely each year. Likewise, the complex relationship between the general rate of inflation, the salary cap, 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

In Appendix 1, Table A depicts values of the 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 2022 through FY 2027.

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 are constructed using the following recursive relationship:

$$\text{BRDPI (for year } t) = \text{BRDPI (for year } t-1) \times [1 + \{\text{Percent Change (for year } t)\}]$$

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).

APPENDICES

1. **Supplementary Tables**

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

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

Appendix 1: Supplementary Tables

TABLE A
HISTORICAL ANNUAL PERCENT CHANGES

Fiscal Year	GDP Price Index	BRDPI
Col. (1)	Col. (2)	Col. (3)
2011	2.0%	2.9%
2012	1.8%	1.3%
2013	1.8%	1.9%
2014	1.9%	2.1%
2015	1.1%	2.0%
2016	0.8%	2.2%
2017	1.8%	2.6%
2018	2.3%	2.5%
2019	2.0%	2.1%
2020	1.3%	1.7%
2021	3.1%	2.1%

TABLE B
PROJECTED ANNUAL PERCENT CHANGES

Fiscal Year	GDP Price Index	BRDPI
Col. (1)	Col. (2)	Col. (3)
2022	5.3%	3.1%
2023	3.3%	2.6%
2024	2.1%	2.3%
2025	2.0%	2.3%
2026	2.0%	2.3%
2027	2.0%	2.3%

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

Appendix 2: References to BEA Price Index Methodology

Bureau of Economic Analysis, U.S. Department of Commerce, "Chapter 4. Estimating Methods," In *Concepts and Methods of the U.S. National Income and Product Accounts,* November 2019, https://www.bea.gov/resources/methodologies/nipa-handbook.

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.

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.

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.

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.

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

Appendix 3A. 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 2020, for example, BEA transmitted an estimate for FY 2020. 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 2019 was revised in December 2020.

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, 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 3B. Use of the Fisher Chain-Weighted Index Methodology to Estimate the BRDPI

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 proportions) 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.

Prior to 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, the BEA's *Concepts and Methods of the U.S. National Income and Product Accounts* as well as five articles in BEA's publication, *Survey of Current Business*, discuss the reasons BEA now uses the chain-weighted methodology (see Appendix 2 above).

In less technical terms, chain weighting means that the expenditure weights used to estimate the BRDPI are 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 estimate growth over several years, the consecutive year indexes are multiplied together, 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 each year 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 occasionally updated, or rebased, to reduce 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 3C. 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.[4] 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 investigator's research effort if the investigator's annual compensation rate exceeds that cap. Given the definition of the BRDPI as an input

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

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. [5]

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.

[5] 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 awards (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 if it is in existence, even if the effect is small in some years. The salary cap is likely to remain in place indefinitely. It tends to be tied to the growth of compensation for federal civilian salaries. In recent years, civilian salaries have on average grown less each year than the growth in academic salaries. If average academic salaries continue to grow faster than the cap on salaries of extramural investigators, the impact of the cap on the estimated BRDPI will increase over time.

Since FY 2011 the estimates of the BRDPI that NIH has posted have included adjustments for the effects of the salary cap. To calculate the adjusted series, NIH begins with 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 the traditional methodology using extramural employee compensation data that are not limited by the salary cap. NIH then calculates the effective growth of academic salaries as the result of the salary cap[6] and asks BEA to re-estimate BRDPI growth subject to the slower growth in extramural compensation. The effect of this adjustment for the FY 2021 value was to reduce the estimated growth of the BRDPI by 0.1 percentage points, from 2.2 percent, unadjusted, to 2.1 percent growth after adjusting for the effect of the salary cap.

In 2021, the GDP price index percentage changes were from OMB economic assumptions released in December 2021, included in the 'ALT_PRICE' tab of the excel file provided by the OMB. The 'ALT_PRICE' tab is the primary reference for GDP inflation rates that identified 3.1% of GDP price index percentage changes for FY 2021, 3.9% for FY 2022, 2.2% for FY 2023 and 2.0 for later years.

For 2021 BRDPI estimation, NIH used the unadjusted BRDPI series to estimate the statistical equation to project future year values of the BRDPI. Like the previous year, we use the adjusted BRDPI series for the projection methodology described in the cover memo above because it produces a more adequate statistical fit than the unadjusted BRDPI series. The new projection methodology used this year accounts for changes in both the GDP price index and the salary cap in their impact on the BRDPI, whereas the previous methodology focused just on the GDP price index (though the resulting projections could be adjusted for projected changes in the salary cap). By accounting for both variables, the new equation better captures the effects of the major factors contributing to the cost of NIH research.

[6] 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.