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DATE: April 22, 2020

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SUBJECT: The Long-Term Projection Assumptions for Medicare and Aggregate National Health Expenditures

The Office of the Actuary (OACT) annually produces 75-year Medicare expenditure projections for the annual report of the Medicare Board of Trustees to Congress. The assumptions used in the long-term projections have evolved over several decades through internal deliberations, five independent technical advisory panel reports, ongoing discussions with the Medicare Trustees and their staffs, and the input of various external researchers. This memorandum updates the exposition of OACT's long-range health spending projection methods used in the 2020 Medicare Trustees Report.

Because of the significance of the long-range projections for public policy makers, it is important that the projection assumptions be as transparent and understandable as possible. The purpose of this memorandum is to promote a more complete understanding of the long-range cost growth assumptions by: (i) describing the projection challenge, (ii) providing a detailed description of the current-law long-range assumptions, (iii) tracing the evolution of the long-range assumptions used in the Trustees Report, and (iv) evaluating the strengths and limitations of the current cost growth assumptions. Making such projections is not an exact science, and any long-term projection model necessarily makes assumptions about the continuation of trends into an uncertain future. The Office of the Actuary and the Board of Trustees continue to make every effort to ensure that reasonable projections of Medicare's future are included in the Trustees' annual report.

The Long-Range Projection Challenge

Federal law requires the Medicare Trustees to report annually to Congress about the financial and actuarial status of the Medicare program. OACT provides professional technical assistance to the Trustees in their preparation of this report. Financial solvency determinations, defined conceptually as measurement of the adequacy of projected program revenues to pay for projected program obligations under current law, are reported for the Medicare trust funds.

In general, long-term projections, which span 75 years beginning with the current year, are made under an assumption that existing institutional arrangements and program parameters embodied in current law will prevail for the entire projection period. The 75-year "current-law" projections are intended to reflect a policy-neutral baseline that is useful for policy makers, researchers, health-care providers, beneficiaries, and others in considering the need for changes or adjustments in national policy.

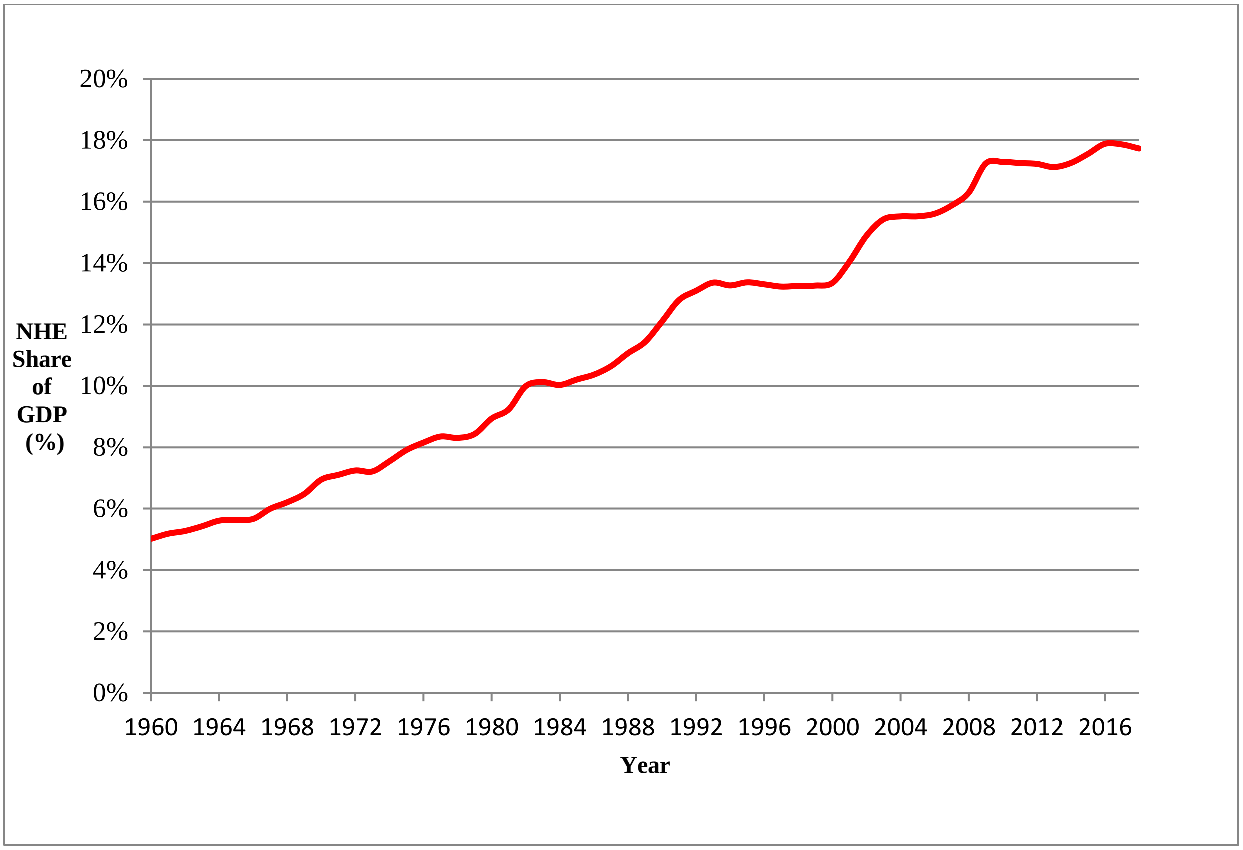
Both the time horizon and the institutional perspectives employed in long-term projections have on occasion been criticized as unrealistic. Some observers have argued that projections extending far into the future are so uncertain as to be of limited value and that a current-law perspective assumes the perpetuation of existing policy arrangements beyond any reasonable point. But such criticisms overlook a fundamental premise of long-term solvency reporting; that is, projecting the long-term consequences of the institutional status quo affords decision makers a reasonable opportunity to investigate trends, to consider alternatives, and to implement well-conceived policy adjustments before financial or programmatic challenges reach crisis proportions. Moreover, in view of the long-range financial commitments made by the Medicare program for the entire U.S. working population,[1] it is critical to take every step to help ensure that these commitments can be fulfilled, starting with a long-range evaluation of the financial status of Medicare.

Long-range projections of Medicare revenues that appear in the Trustees Report are produced using various long-range economic and demographic assumptions such as the size and age distribution of the population, the size of the work force, average earnings levels, and the Gross Domestic Product (GDP). These economic and demographic assumptions are determined annually by the Social Security and Medicare Board of Trustees based on recommendations by the Office of the Chief Actuary at the Social Security Administration. Projection of long-term Medicare and aggregate national health expenditures by the Office of the Actuary at the Centers for Medicare & Medicaid Services follows a similar process, but involves additional assumptions that are especially challenging to formulate and to validate.

The most difficult challenge in making long-range health expenditure projections is in determining if and when a sector of the economy with a long history of rapid cost growth will stabilize relative to the rest of the economy. Since the mid-20th century, the U.S. health sector has grown substantially faster than the economy as a whole. As Chart 1 shows, since 1960 the health sector's share of all of the nation's economic activity has increased by a factor of 3.5 (from 5 percent in 1960 to nearly 18 percent in 2018). Given that the U.S. economy as a whole has experienced more than fivefold real growth since 1960, the health sector has experienced a nearly twenty-fold increase (5.7 times 3.5) in real spending over the past 59 years. The share of national output that the U.S. health sector absorbs has long, and by far, exceeded the health sector share of any other developed nation, as shown in Chart 2, and there is no evidence that the outlier status of the U.S. in this regard relative to other developed nations will end any time soon.

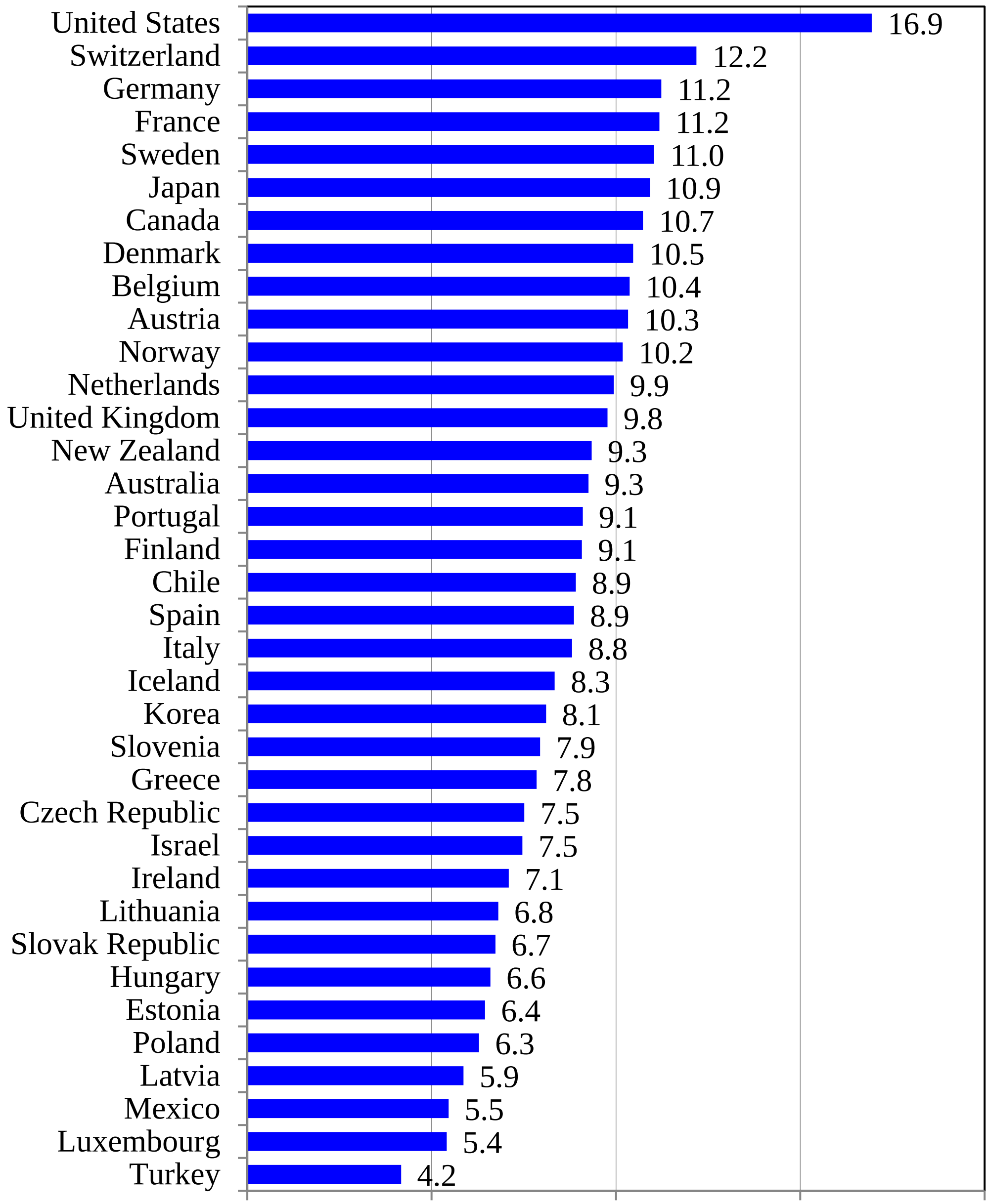
[1] As an example, consider new entrants to the workforce at age 20. If these individuals work and pay Hospital Insurance payroll taxes on their earnings for a sufficient period, then they will qualify for HI benefits at age 65 (or earlier, if they become disabled). Once enrolled at 65, these beneficiaries may live for another 30 years or more. In this way, Medicare makes financial commitments that span at least the next 75 years.

Chart 1—National Health Expenditures (NHE)
as a Percentage of Gross Domestic Product (GDP)
1960-2018



Source: Centers for Medicare & Medicaid Services, Office of the Actuary.

Chart 2—CY 2018 Health Expenditures as a Share of GDP
Selected OECD Countries



Source: OECD Health Data 2018

Note: For the United States the 2018 data reported here do not match the 2018 data point for the United States in Chart 1 since the OECD uses a slightly different definition of "total expenditures on health" than that used in the United States National Health Expenditure Accounts.

One way of analyzing health spending trends is to compare the growth rate of the U.S. health sector with that of the overall economy. Using a definition of "excess cost growth" as the difference between (i) the U.S. per capita growth rate in health-care costs adjusted for demographic factors[2] and (ii) the per capita growth rate in GDP (both in constant dollars), Table 1 shows average excess cost growth rates for selected time periods since 1975.[3] Average excess cost growth rates for national health expenditures (NHE) exhibit some volatility depending on which time periods are used for defining averages, but over the long run this differential has for extended periods been above 2 percent per year or just slightly below this level. There are only two periods in which rates of excess cost growth have clearly deviated from a long-term rate of 2-percent. One of those periods, 1995-2000, coincided with the widespread adoption of managed care approaches to delivery of health care in the 1990s, but that slowdown proved temporary as strong excess cost growth reemerged after the turn of the century. Starting in 2010 in the aftermath of the Great Recession, the United States experienced four consecutive years negative excess cost growth, and as a result the average excess cost growth in the five years after 2010 was minus 0.3 percent. Positive excess cost growth resumed in 2014-2016, which coincided with expansion of insurance coverage associated with the ACA, but in the most recent years for which historical numbers are available (2017-2018) excess cost growth was again negative. Since 2010 average excess cost growth has been minus 0.1 percent, which accounts for the relative stability of the NHE share of GDP in that time period, 17.3 percent of GDP in 2010 versus a 17.7 percent share of GDP in 2018.

Characteristics of the current business cycle could provide new insights about the future course of excess cost growth. Given the sluggish growth of wages and salaries during the current cycle, the implications for the ECG growth rate if wage and salary growth increases will be something that bears watching. Since on a historical basis excess cost growth typically accelerates at the end of business cycles, the effect on the excess cost growth rate when the current business cycle eventually ends could also be informative concerning the robustness of the slowdown in the ECG growth rate observed since 2010.

Even if the long-term excess cost growth rate were to decelerate to a 1 percent or even lower though still positive annual rate, the U.S. health sector would still experience rapid growth relative to the rest of the U.S. economy, and if the historic annual excess cost growth rate of 2 percent were to resume and continue unchecked, the health sector would encompass most, if not all, of the U.S. economy within the 75-year reporting horizon. Since a nation that produces only health care is an impossibility, any method for projecting long-range U.S. national health expenditures should consider and take into account any factors that would contribute to an eventual slowdown in long-term growth rates for the health sector (to the degree deemed likely to occur under existing law). But available research is inconclusive concerning how much of a long-term slowdown in growth

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[2] These demographic factors, which in prior reports reflected the changing distribution of the population by age, now also account for the changing distribution of the population by time-to-death (TTD) for the projections in the 2020 report. More information on the time-to-death adjustment is available at https://www.cms.gov/files/document/incorporation-time-death-medicare-demographic-assumptions.pdf.

[3] The TTD adjustment has not yet been applied to the presentation of historical excess cost growth for the U.S. health sector because these historical health spending estimates were published prior to the incorporation of TTD as a demographic factor. Incorporation of the TTD methods would be expected to slightly increase the calculated residual that is called excess cost growth.

rates might take place, the probable timing of a slowdown, the mechanisms that would cause a slowdown, and whether a slowdown is likely to occur under current law. How these questions are addressed profoundly influences the outcome of the expenditure projection process.

Despite the difficulty and uncertainty involved in projecting long-range NHE and Medicare costs, projections are required for considering whether the promises made to the working population today can reasonably be expected to be fulfilled many years in the future. The balance of this memorandum describes the long-range health care cost growth assumptions, explains the history behind the evolution of those assumptions, and finally considers the reasonableness of the assumptions.

Table 1 - Compound Excess Cost Growth Rates, Selected Time Periods 1975-2018

Time period	Compound Constant-Dollar, Per Capita Growth Rates		Excess Cost (rounded)
	NHE (rounded)	GDP (rounded)	
Periods since 1975:			
through 1980 (5 years)	4.8%	2.7%	2.0%
through 1985 (10 years)	4.8%	2.5%	2.2%
through 1990 (15 years)	5.0%	2.5%	2.6%
through 1995 (20 years)	4.6%	2.2%	2.4%
through 2000 (25 years)	4.2%	2.4%	1.8%
through 2005 (30 years)	4.2%	2.3%	1.9%
through 2010 (35 years)	3.8%	2.0%	1.9%
through 2015 (40 years)	3.5%	1.9%	1.6%
through 2018 (43 years)	3.3%	1.8%	1.5%
Periods since 1980:			
through 1985 (5 years)	4.8%	2.3%	2.4%
through 1990 (10 years)	5.2%	2.3%	2.9%
through 1995 (15 years)	4.5%	2.0%	2.5%
through 2000 (20 years)	4.1%	2.3%	1.8%
through 2005 (25 years)	4.1%	2.2%	1.9%
through 2010 (30 years)	3.7%	1.8%	1.9%
through 2015 (35 years)	3.3%	1.8%	1.5%
through 2018 (38 years)	3.1%	1.7%	1.4%
Periods since 1985:			
through 1990 (5 years)	5.6%	2.3%	3.3%
through 1995 (10 years)	4.4%	1.9%	2.5%
through 2000 (15 years)	3.9%	2.3%	1.5%
through 2005 (20 years)	4.0%	2.2%	1.8%
through 2010 (25 years)	3.5%	1.7%	1.8%
through 2015 (30 years)	3.1%	1.7%	1.4%
through 2018 (33 years)	2.9%	1.6%	1.3%
Periods beginning with 1990:			
through 1995 (5 years)	3.2%	1.4%	1.8%
through 2000 (10 years)	3.0%	2.4%	0.7%
through 2005 (15 years)	3.4%	2.1%	1.3%
through 2010 (20 years)	2.9%	1.6%	1.4%
through 2015 (25 years)	2.6%	1.6%	1.0%
through 2018 (28 years)	2.3%	1.5%	0.7%
Periods since 1995:			
through 2000 (5 years)	2.9%	3.3%	-0.4%
through 2005 (10 years)	3.5%	2.5%	1.1%
through 2010 (15 years)	2.9%	1.6%	1.2%
through 2015 (20 years)	2.4%	1.6%	0.8%
through 2018 (23 years)	2.3%	1.5%	0.8%
Periods since 2000:			
through 2005 (5 years)	4.2%	1.6%	2.6%
through 2010 (10 years)	2.9%	0.8%	2.1%
through 2015 (15 years)	2.3%	1.0%	1.3%
through 2018 (18 years)	2.1%	1.0%	1.1%
Periods since 2005			
through 2010 (5 years)	1.6%	0.0%	1.6%
through 2015 (10 years)	1.3%	0.7%	0.6%
through 2018 (13 years)	1.3%	0.8%	0.5%
Periods since 2010			
through 2015 (5 years)	1.1%	1.5%	-0.3%
through 2018 (8 years)	1.1%	1.3%	-0.1%

Source: Centers for Medicare and Medicaid Services, Office of the Actuary.
Note: NHE rates are adjusted for demographic effects on cost growth.

Long-Range Health Cost Growth Assumptions

This section summarizes the long-range excess cost growth assumptions used in the 2020 Trustees Report. Consideration of the history and reasonableness of the assumptions is deferred until later sections.

The 75-year projections are constructed around the notion of excess cost growth, or the degree to which growth in Medicare or health expenditures generally is expected to exceed the growth rate of GDP. Excess cost growth is an intuitively understandable indicator of when a particular sector is increasing in size relative to the rest of the economy. By definition, as long as a sector's rate of cost growth exceeds that of GDP, that particular sector (such as health care) will be increasing as a share of the nation's total economic output. As noted earlier in the discussion of Table 1, one way of measuring excess health cost growth is as a difference of rates of growth: the rate of demographic-adjusted, per capita health care cost growth minus the rate of per capita GDP growth.[4]

It is important to recognize that 75-year projections are only partially based upon long-run excess cost growth assumptions. In the case of the first 10 years of the 75-year Medicare projections, projections of costs are made separately for each category of health spending (for example, inpatient hospital, physician, home health care, etc.) and are built up from assumptions about payment rate updates for each category of spending, changes in utilization of services, and changes in the "intensity" or average complexity of services. (These methods are described in detail in the Medicare Trustees Report.) An implicit year-10 excess cost growth rate can then be computed from the results of the short-range projections. Years 11 through 24 of the 75-year projection are computed on an excess cost growth basis using rates that blend the excess cost growth rate implicit in the year 10 short-range projection and the long-range excess cost growth rate expected to prevail in year 25. For the last 51 years of the long-range projection (years 25 to 75), excess cost growth assumptions are derived using the output from the factors contributing to growth model described in more detail in the next section.

Each Medicare subpart has a unique implicit excess cost growth rate as of year 10 of the projection. Prior to the Affordable Care Act (ACA), the separate tenth-year growth rates were transitioned to the same long-range excess cost growth rate assumption in year 25, so that the entire Medicare program would then be projected as having a common set of excess cost growth rates for years 25 to 75. The ACA and various subsequently enacted legislation has mandated application of different payment update formulas for each Medicare subpart, and as a consequence projected excess cost growth rates in the current law scenario of the Medicare Trustees as shown in Chart 3 no longer converge.

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[4] Excess cost growth calculations can be performed either on a nominal dollar or a real dollar basis as long as the approach chosen is consistently applied. The long-range Medicare projections have always been computed on a nominal dollar basis. In the actual development of the long-range projections, excess cost growth is computed on a multiplicative basis fully consistent with the additive framework presented here. For a detailed explanation of the implementation of excess cost growth computations see the Notational Appendix of the May 12, 2009 Projections Methodology memorandum "The Long-Term Projection Assumptions and Aggregate National Health Expenditures" at http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/ProjectionMethodology.pdf

For the last 51 years of the 75-year period, growth assumptions are developed for overall national health spending, and these assumptions are used in the development of separate Medicare spending assumptions for Part A, Part B, and Part D. A description of the shared baseline for overall national health spending assumption that applies to all subparts of Medicare is discussed below. This is followed by a detailed description of the methodology used for determining the long-range Medicare spending growth assumptions for Medicare Part A, Part B, and Part D.

Overall National Health Expenditures (NHE)

The long-range projection for Parts A, B and D relies on a shared baseline for growth in *overall* per capita national health spending on a year-by-year basis at rates determined using the Office of the Actuary's "factors contributing to growth" (FCG) model. Statutory adjustments specific to each subpart are subsequently applied to the baseline implied by this shared assumption.

The FCG model is an assumptions-based approach in which the historical impact of key drivers of national health spending growth are used to inform expectations about the long-run future. In building the long-term national health spending projection, the FCG model parameters are adjusted over the 75-year projections horizon to reflect the long-range implications of an increasing share of our economic resources being devoted to health spending. The key factors underlying health care cost growth in the model are: changes in national income, relative medical price inflation, health insurance coverage, and residual effects, which are primarily the impact of innovations in medical technology.[5] (Appendix A describes the FCG model in detail.) Overall health spending is used as a starting point in developing the Medicare assumption since a significant amount of research is available decomposing the drivers of overall health spending trends (both for the U.S. and other countries), and it is assumed that over the long run that those drivers would be generally similar across the health sector.

Medical price growth expectations are another important piece of the long-term national health spending projection built with the FCG model. The growth in health care costs per capita reflects the combined effects of general inflation, medical-specific "excess" price inflation (medical price inflation above general price inflation), and changes in the utilization of services per person and the "intensity" or average complexity per service. General inflation, as measured by the GDP deflator, is assumed to increase 2.05 percent per year over the long-range period (down from 2.25 percent assumed in the 2019 report). Relative medical price growth for the overall health sector is assumed to be 0.75 percent annually. This assumption is roughly equivalent to the difference between the growth in the personal health care deflator over the past three decades and the growth in the GDP deflator over this same period. Combining the projected 2.05 percent general inflation growth with the assumed 0.75 percent relative medical price inflation results in medical sector output price growth of 2.8 percent per year. The medical price change can be decomposed into its two main factors[6]: (i) the prices paid for inputs to the production of medical care (e.g., employee compensation, medical equipment, structures), or medical input price growth and (ii) the efficiency with which those inputs are combined to produce medical care, or resource-based health sector

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[5] Sheila Smith, Joseph Newhouse, and Mark Freeland, "Income, Insurance, and Technology: Why Does Health Spending Outpace Economic Growth?" *Health Affairs*, September/October 2009 28:1276-1284.

[6] A third factor, the level of provider profit margins, is assumed to remain unchanged over the long run.

multifactor productivity growth.[7] Resource-based health sector multifactor productivity is assumed to grow at a pace consistent with published historical rates for hospitals and physicians,[8] and to average roughly zero for all other provider categories, such as skilled nursing facilities, home health agencies, hospices, diagnostic laboratories, dialysis centers, ambulance companies, etc. In aggregate for the overall health sector, resource-based health sector multifactor productivity growth is estimated to be 0.4 percent per year. Thus, the medical input price growth for the overall health sector is assumed to be 3.2 percent per year.

Finally, the growth in the volume and intensity of services is determined as a function of three key elasticity coefficients from the FCG model that influence the demand for health care:

1) *Income-technology elasticity*, which represents the marginal increase in demand for health care including the adoption and diffusion of new medical technologies in response to growth in income. The income-technology elasticity is estimated at 1.6 on average for the historical period from 1980 through 2002. It exhibits a declining trend over time, and is projected to reach 1.4 by 2018. This estimate is based on cross-country comparisons of the relationship of health spending and GDP growth for member countries in the Organization for Economic Co-operation and Development (OECD).[9] A similar elasticity estimate was found using U.S.-specific time-series data.

   In the 2020 Trustees Report it is assumed that the elasticity for the 25th year of the projection period (2044) is 1.25 and declines at a slowing pace to reach 1.08 by the end of the 75-year projection period (2094). This assumption implies that, as health care continues to consume a greater proportion of income, the marginal demand for additional spending on health care and new medical technologies will decrease. As medical care consumption requires a steadily increasing share of total income, growth in non-health consumption will be crowded out, and demand for additional medical care at the margin can be expected to taper off. Over the very long-term, it is assumed that health care spending, including access to new technologies, will tend to become a “normal good,” rather than a “superior good”, and its share of GDP will level out, as the income-technology elasticity converges towards 1.0.

2) *Medical price elasticity*, which reflects the sensitivity of patients and purchasers in consuming health care to rising prices for medical care in relation to all other goods. The assumption for this measure is premised on a decomposition of the price elasticity to capture the increasing sensitivity of demand for health care to price in response to a rising share of

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[7] *Resource-based* productivity is defined as the real value of provider goods and services divided by the real value of the resources (inputs) used to produce the goods and services, where price changes are measured across constant products—that is, defined health services with a constant mix of inputs. Resource-based productivity is used for this decomposition, rather than *outcomes-based* productivity (which incorporates the estimated value of improvements in health resulting from the services) because Medicare and most other payers reimburse providers based on their resource use.

[8] Information on updated estimates of hospital productivity is available at https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/ProductivityMemo2016.pdf. Estimates of physician productivity are available here: Fisher, Charles: “Multifactor Productivity in Physicians’ Offices: An Exploratory Analysis.” *Health Care Financing Review* 29(2): 15-32, Winter 2007-2008.

[9] The elasticity was estimated based on OECD data for 1970-2012 using rolling 21-year sample intervals to evaluate the trend in the parameter over time. For additional detail, please see Appendix A.

income accounted for by health care.[10] For the 2020 report, the price elasticity is estimated at −0.50 in the 25th year of the projection (2044) and follows a non-linear path until it reaches −0.56 by the end of the 75-year projection period (2094).

3) *Insurance elasticity,* which reflects the change in demand for medical care as the level of insurance coverage changes. Based on the RAND Health Insurance Experiment, this elasticity is estimated at −0.2, reflecting the change in demand for health care as the average coinsurance rate changes.[11] For the 2020 Report of the Trustees, the insurance elasticity is assumed to be unchanged over the long-range projection period at −0.2.

Additionally, the breadth of insurance coverage is assumed to be unchanged over the long run in order to maintain consistency with a Medicare benefit package that is unaltered.

Based on the year-by-year growth rates determined from the FCG model, per capita national health spending, adjusted for demographics is projected to grow at a rate of GDP plus 0.7 percent (or 4.4 percent) for 2044, gradually declining to GDP plus 0.5 percent by 2094 (or 4.1 percent). The projected long-term growth rates in national health spending are then adjusted to reflect statutory price update provisions in order to arrive at the subpart-specific, current law Medicare excess cost growth rates.

Current Law Medicare Spending

While excess cost growth rate paths by Medicare subpart in the current law scenario are distinct, the overall health sector long-range cost growth assumptions for volume and intensity are used as the starting point for developing the Medicare-specific assumptions under current law. These assumptions are generated based on the projections for growth in NHE based on the FCG Model discussed above. Three Medicare Technical Panels (2001, 2010-2011, and 2016-2017) have ratified this basic approach (particulars about the history of evolving methods appear in the history section of this memorandum).[12]

For each Medicare subpart, the price update applied to the growth in volume and intensity is based on provisions in current law. Provisions in current law result in deviations from the cost path that would otherwise be expected to prevail generally. A summary of the specific long-range Medicare cost growth assumptions that apply to each of the subparts of Medicare follows:

(i) *All HI, and some SMI Part B, services that are updated annually by provider input price increases less the increase in economy-wide productivity.*

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[10] This decomposition of the price elasticity is based on the Slutsky equation (see Silberberg, Eugene, *The Structure of Economics: A Mathematical Analysis*, McGraw-Hill, 2000.) The relationship between the price elasticity and the health share of GDP is estimated iteratively on a year-by-year basis to maintain internal consistency between the price elasticity and the health share of GDP.

[11] Newhouse J, Health Insurance Experiment Group. Lessons from the RAND Health Insurance Experiment. Cambridge (MA): Harvard University Press; 1993.

[12] Final reports of these panels are available at https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/TechnicalPanelReport2010-2011.pdf and https://aspe.hhs.gov/system/files/pdf/257821/MedicareTechPanelFinalReport2017.pdf

Netting the assumed market basket increase of 3.2 percent against the estimate of economy-wide multifactor productivity, the statutory price update for these services is 2.2 percent per year over the long-range projection period. The initial projected increase in the volume and intensity of these Medicare services is assumed to be equivalent to the average projected growth in the volume and intensity of services for the overall health sector. The Trustees believe that the use of a common baseline rate of volume and intensity growth is reasonable, as there would be only a small likelihood that one part of the health sector could continue to grow indefinitely at significantly faster rates of growth than do other parts.

Additionally, the Trustees assume that the growth in Medicare payment rates under current law will reduce the volume and intensity growth of these services by 0.1 percent per year relative to the assumption from the factors model. The Trustees' assumption is also based on recommendations by both the 2010-2011 and the 2016-2017 Medicare Technical Review Panel, which concluded that there would likely be a small net negative impact on volume and intensity growth due to reduced incentives to develop new technologies, provider exits, and the impact of greater bundling of services for payment purposes.[13] For new technology that leads to new services, the ACA is expected in the long-run to result in lower fees than would otherwise be the case, and providers will be less likely to adopt new services and innovations, thereby lowering the demand for, and intensity of, the medical care provided. Regarding provider exits, as fee-for-service fees decline relative to the pre-ACA levels, facilities of marginal profitability are likely to exit the Medicare market, reducing capacity and volume. This change could also cause a more bifurcated health system to evolve in which only providers who can operate profitably under Medicare offer services to Medicare beneficiaries, with a tendency to provide only the more basic services not associated with new medical technologies. Finally, the innovations being tested under the ACA, such as bundled payments or accountable care organizations, could reduce incentives to adopt new technologies for those participating in these programs and/or could contribute to greater efforts to avoid services of limited or no value within the service bundle.

Reflecting all of these considerations, the year-by-year long-range cost growth assumption for HI services and these SMI Part B services starts at 3.8 percent in 2044, or GDP plus 0.1 percent, and gradually declines to 3.3 percent by 2094, or GDP minus 0.3 percent.

(ii) *Physician services*

Payments are assumed to increase by 0.75 percent per year over the long run for those physicians participating in advanced alternative payment models (advanced APMs) and 0.25 percent per year for those assumed to be participating in the merit-based incentive payment systems (MIPS). The Trustees assume that the rate of per beneficiary physician volume and intensity growth is based on the spending growth from the FCG model and the price of physician services as measured by the Medicare Economic Index (MEI). The year-by-year growth rates for physician

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13 Other factors, such as reduced beneficiary cost-sharing requirements, would tend to increase the volume and intensity of services. The assumption of −0.1 percent reflects the Technical Panel's assessment that the overall impact would be a small net decrease in volume and intensity growth.

payments are assumed to be 3.3 percent in 2044, or GDP minus 0.4 percent, declining to 2.8 percent in 2094, or GDP minus 0.8 percent.

(iii) *Certain SMI Part B services that are updated annually by the CPI increase less the increase in productivity.*

Such services include durable medical equipment not subject to competitive bidding, care at ambulatory surgical centers, ambulance services, and medical supplies, which are updated by the CPI and affected by the ACA productivity adjustment. For these services, the Trustees initially assume that the rate of per beneficiary volume and intensity growth is equivalent to that derived for the overall health sector using the factors model. This volume and intensity growth is assumed to be reduced by 0.1 percent per year, as described above. The volume and intensity assumption is combined with the long-range CPI assumption (2.4 percent, a lower rate than that of 2.6 percent assumed in the 2019 report) minus the productivity factor (1.0 percent) to produce a long-range growth assumption for these SMI Part B services. The corresponding year-by-year growth rates are 3.0 percent in 2044, or GDP minus 0.7 percent, declining to 2.6 percent in 2094, or GDP minus 1.0 percent.

(iv) All other Medicare services, for which payments are established based on market processes, such as prescription drugs provided through Part D and the remaining Part B services.

The Trustees assume that per beneficiary outlays for these other Part B services, which constitute about 33 percent of total Part B expenditures in 2029, and for all Part D services grow at the same rate as the overall health sector as determined from the factors model.[14] These services are assumed to grow similarly because their payment updates are determined by market forces. The year-by-year growth rates are 4.4 percent in 2044, or GDP plus 0.7 percent, declining to 4.1 percent by 2094, or GDP plus 0.5 percent.

In addition to modeling features of the current law Medicare payment system that are unique to each Medicare subpart, demographic effects on cost growth are also specific to each subpart. The current report reflects refinements to the methodology applied to the estimation of the contribution of demographic change to spending growth. In the 2019 report and prior reports, these impacts reflected the changing distribution of Medicare enrollment by age and sex. For the 2020 report, these effects are being modified to estimate not only the changing distribution of Medicare enrollment by age and sex but also the beneficiary's proximity to death (referred to as a time-to-death, or TTD, adjustment).

The TTD adjustment to the contribution to growth from demographic change reflects the fact that health care spending tends to increase as individuals become closer to death. As mortality rates are projected to continue to improve over the projection, a smaller portion of the Medicare population is likely to die at any given age. This shift in the distribution of enrollment away from death also tends to reduce average spending on health care. Thus, the positive effect on spending growth from population aging over the projection (individuals getting older and spending more on health care) is offset somewhat by the shift in the distribution by TTD, which has a small negative effect on

[14] Starting with the 2020 reporting year outpatient drugs are modeled among services for which payments are established based upon market processes.

spending trend. For the 2020 report, inclusion of the TTD adjustment results in demographic impacts that are smaller than those in the 2019 report.[15] This is particularly the case for Part A services—such as inpatient hospital, skilled nursing, and home health services—for which the distribution of spending is more concentrated in the period right before death.[16] For Part B services that are less acute, the incorporation of the TTD adjustment has a smaller effect. Finally, this demographic adjustment has significantly less of an impact on Part D costs because the incidence of prescription drug use is more evenly distributed by age and TTD.

After combining the assumed rates of growth from the four categories of Medicare Part B services described above, the weighted average growth rate for Part B is 3.9 percent in 2044, or GDP plus 0.2 percent, declining to 3.7 percent by 2094, or GDP plus 0.1 percent. When Parts A, B, and D are combined, the weighted average growth rate for Medicare is 4.0 percent, or GDP plus 0.3 in 2044, declining to 3.7 percent, or GDP plus 0.1 percent in 2094. For each of Parts A, B, and D, the assumed growth rates for years 11 through 25 of the projection period are set by interpolating between the rate at the end of the short-range projection period (2029) and the rate at the start of the long-range period described above (2044).

Chart 3 shows year-by-year excess cost growth for Medicare Part A, Part B, and Part D under current law over the last 65 years of the projection period (2030-2094), including the 15-year transition of excess cost growth to their starting long-range values in 2044 together with their gradually declining path thereafter. During the transition, Part A and Part B growth is not perfectly linear because the projected values of economy-wide multifactor productivity vary somewhat from year to year.

After 2044, the excess cost growth rates for each of Part A, Part B and Part D are downward sloping, reflecting the similar income-technology and price elasticities, but increase at different rates due to the uniqueness of the relevant statutory provisions affecting the payment updates. Part D continues at the highest rate because it is based on the full FCG model and is not impacted by the statutory provisions that lower the payment updates for most of Part A and Part B.

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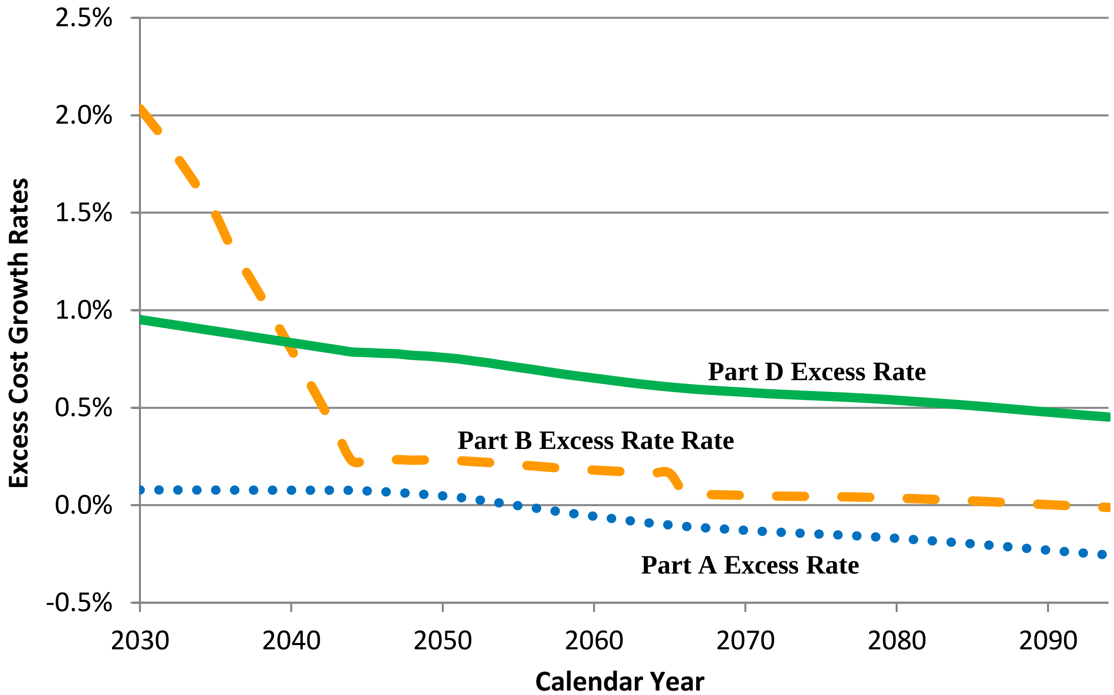
15 More information on the TTD adjustment is available at https://www.cms.gov/files/document/incorporation-time-death-medicare-demographic-assumptions.pdf

16 The one exception is for hospice services, which previously did not reflect changing demographics. The inclusion of an age and sex adjustment in the 2020 report has a larger impact in raising hospice spending—particularly during the period when the baby boom generation reaches older ages—than does the TTD adjustment in lowering such spending.

Chart 3—Medicare Projected Excess Cost Growth
Current Law
2030-2094



Source: Centers for Medicare and Medicaid Services, Office of the Actuary.

NOTE: An excess cost growth is the rate of change in per enrollee costs relative to the growth in per capita GDP. The chart displays projected long-term excess cost growth for Medicare Subparts A, B, and D under the current law. Under this scenario each of the subparts has its own unique series of excess cost growth through the end of the 75-year projection horizon due to the different applicable current law payment provisions. Excess cost growth displayed here do not include additional spending changes attributable to factors such as age and gender composition of the Medicare population.

Illustrative Alternative Scenario

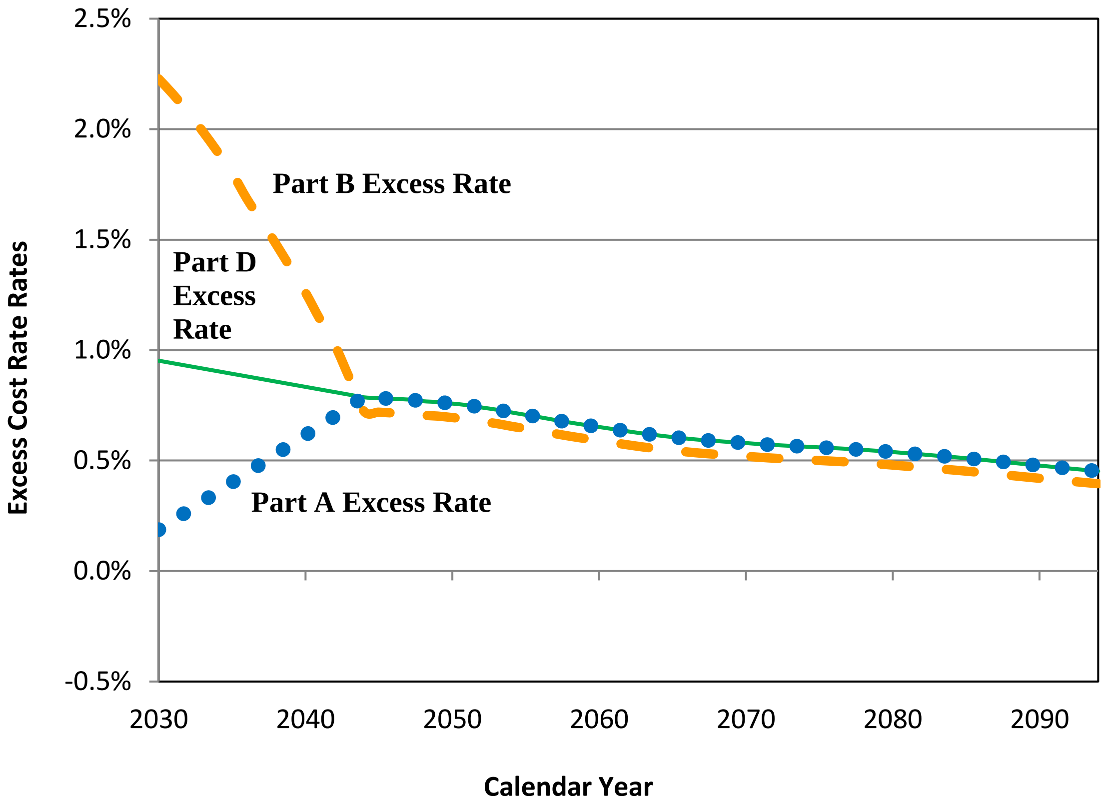
The Trustees Report cautions that "In view of these issues with provider payment rates, the Trustees note that the actual future costs for Medicare could exceed those shown in this report." To help illustrate the level of Medicare costs that could result if these elements of current law are overridden, the Trustees asked the Office of the Actuary to prepare projections based on a hypothetical alternative.[17] These projections are shown in the 2020 Trustees Report and in a supplementary memorandum by the Office of the Actuary. The illustrative alternative projection is based on the assumption that the economy-wide productivity adjustments to Medicare payment rates would transition from current law to the payment updates assumed for private health plans (which reflect an assumption of 0.4 percent annual productivity growth) over the period 2028 to 2042. Additionally, the illustrative alternative assumes that, starting in 2028, physician payments transition from current law to the MEI increase of 2.05 percent beginning in 2042 and that the 5-percent bonuses for qualifying physicians in advanced alternative payment models and the $500 million in additional payments for physicians in the merit-based incentive payment system will continue after 2025. Readers should not infer from this any endorsement of this theoretical alternative to current law by the Trustees, CMS, or the Office of the Actuary, but concern about the long-term feasibility of the adjustments makes it advisable to consider what the state of the world might look like if they should prove infeasible.

Chart 4 shows the assumed year-by-year excess cost growth for Medicare Part A, Part B, and Part D over the last 65 years of the long-range projection period for the illustrative alternative Medicare projection. Under this illustration, per beneficiary cost growth for most of Medicare is assumed to transition from their 2029 values to an approximately common set of growth rates based on the FCG model for overall per capita national health expenditures.[18]

[17] More information on these concerns is available in Appendix C of the 2020 Medicare Trustees Report and in a memorandum by John Shatto and Kent Clemens of the Office of the Actuary, "Projected Medicare Expenditures under Illustrative Scenarios with Alternative Payment Updates to Medicare Providers." These documents can be found at the following links: https://www.cms.gov/files/document/2020-medicare-trustees-report.pdf and https://www.cms.gov/files/document/illustrative-alternative-scenario-2020.pdf.

[18] The one exception is Part B services updated by the CPI, which are assumed to have the same volume and intensity growth as NHE but a lower price update than assumed for NHE since those services are not updated based on the market basket concept.

Chart 4—Medicare Projected Excess Cost Growth
Illustrative Alternative
2030-2094



Source: Centers for Medicare and Medicaid Services, Office of the Actuary.

NOTE: An excess cost growth is the rate of change in per enrollee costs relative to the growth in per capita GDP. The chart displays projected long-term excess cost growth for Medicare Subparts A, B, and D under the illustrative alternative. Under this scenario each of the subparts converges to a similar rate of excess cost growth through the end of the 75-year projection horizon. Excess cost growth displayed here do not include additional spending changes attributable to factors such as age and gender composition of the Medicare population.

The excess cost growth assumptions for Part D as shown in Chart 4 are no different under the illustrative alternative than what is shown for Part D under the current law scenario depicted in Chart 3. For Parts A and B, however, the growth rates are higher than what is shown for current law, and under the illustrative alternative now generally coincide with the Part D path starting in the year 2045.

History of the Medicare Trustees Long-Range Health Cost Growth Assumptions

Officially convened Technical Panels of distinguished economists and actuaries have reviewed the long-range Medicare projection and reporting methods on five different occasions—in 1991, 2000, 2004, 2010-2011, and 2016-2017.[19] Accordingly, the years 1991, 2000, 2004, 2010-2011, and 2016-2017 serve as milestones in the evolution of methods that are employed to project Medicare over a 75-year reporting period. In addition, the projection assumptions and methods have reflected annual reviews and reassessments by the Office of the Actuary and the staffs of the Board of Trustees. From time to time, other events have affected the projections, such as the development of *Actuarial Standard of Practice No. 32, Social Insurance*[20] and the requirements of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (MMA) for the Medicare Trustees Report to compare projected growth rates for Medicare to those for aggregate national health expenditures, private health insurance expenditures, and GDP.[21] This section traces the evolution of projection methods through regular and responsible consultation with recognized subject matter experts and through thoughtful implementation of advice received in light of the reporting responsibilities that exist.

A. Stage I: Basic Structure of Long-Term Projections

The first Trustees Reports for Medicare, issued in 1966, provided 25-year projections for the Hospital Insurance (HI) trust fund and only 3-year projections for the Supplementary Medical Insurance (SMI) trust fund. No longer-range projections of any kind were made by the Medicare Trustees before 1983, although the Office of the Actuary prepared 75-year projections from time to time for special analyses. In 1983, the Board of Trustees decided to report the substantial increase in HI costs that could reasonably be expected for Medicare as a result of demographic changes alone—in particular, the retirement and subsequent aging of the post-World War II “baby boom” generation. Since existing research still had little to say concerning the likely long-term path of health care spending as it might be affected by non-demographic factors, it was determined that initial long-term projections would not explicitly take such factors into account. Accordingly, starting in 1983 long-range HI projections were made under the assumption that long-range costs per unit of service would increase at the rate of average hourly earnings. No long-range projections for SMI were reported by the Medicare Trustees until after the recommendations of the 1991 Medicare Technical Review Panel.

The 1991 Medicare Technical Review Panel was the first formally convened body to consider long-range projection methods to be used in the Medicare Trustees Reports.[22, 23] A fundamental theme

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[19] The Panels’ final report is available at https://aspe.hhs.gov/system/files/pdf/257821/MedicareTechPanelFinalReport2017.pdf.

[20] Available at http://www.actuarialstandardsboard.org/pdf/asops/asop032_149.pdf .

[21] Section 801 of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (Pub.L. 108-173, 117 Stat. 2066), 42 U.S.C. 1395i.

[22] Before 2002 there was an annual Trustees Report for HI and another for SMI; since 2002 there has been a single annual Trustees Report that includes all parts of the Medicare program.

[23] *Report on Medicare Projections* by the Health Technical Panel to the 1991 Advisory Council on Social Security (March, 1991: Washington, D.C.).

of the panel's report is coordination of projection methods for HI and SMI in order to facilitate a combination of the results into a comprehensive understanding of the status of the entire Medicare program. The use of a 75-year projection period was affirmed because, for the average person entering the workforce in any reporting year, this period of time will encompass his/her years as a contributor to the HI fund and as a Medicare beneficiary. The panel thus saw a 75-year reporting horizon as a reasonable period of analysis for evaluating the financial ability of the program to deliver benefits promised to beneficiaries from the inception of their working lives. The panel found the use of short-term projections based on trends that are gradually tapered to meet long-run growth assumptions to be reasonable. The panel cautiously endorsed the long-range assumption that average HI payments per unit of service would grow at the same rate as average hourly earnings and expressed similar approval for a long-range assumption that per enrollee SMI costs would grow at the same rate as per capita GDP. With regard to each long-run assumption, the panel recommended that regular monitoring for continuing plausibility should occur.

The approach to long-range projections described in the report of the 1991 Technical Panel was reflected in succeeding Medicare Trustees Reports up to and including the HI and SMI reports for 2000. Consistent with the recommendation to coordinate the HI and SMI projections, the annual reports starting in 1994 show 75-year projections of HI and SMI as percentages of GDP. The nature of the long-range assumptions meant that HI and SMI would grow more rapidly as a percentage of GDP in the first 25 years of the projection period than in the last 50 years. In the case of HI, the assumption that increases in per unit of service costs would equal the rate of increase of average hourly earnings in the last 50 years of the projection period meant that costs would be relatively stable in the long run. Other long-range assumptions related to demographics still allowed for substantial growth in HI's share of GDP. In the case of SMI, the long-range assumption meant that growth as a share of GDP would largely halt after the first 25 years, except to the degree that changing demographics would continue to boost SMI's share of GDP.[24]

Although the 1991 Technical Panel had not explicitly discussed implementation of an excess cost growth method to model long-range Medicare costs, the elements of the method are discernable in the panel report and in the subsequent reports of the Medicare Trustees. The long-range assumption for SMI was effectually a "GDP+0" assumption that was substantially below historic rates of SMI growth, a fact that had prompted the Technical Panel to recommend regular review of the assumption and that evoked regular cautionary commentary in Trustees Reports during the 1992-2000 period. And even though the long-range assumption for the HI growth rate was not directly related to GDP, the idea of connecting HI's growth to that of a macro-economically important aggregate was present. On these foundations, moving to an explicit excess growth method for long-range projections for all parts of the Medicare program would prove to be a natural next step.

B. Stage II: Addition of the GDP+1 Projection Method

The 2000 Medicare Technical Review Panel deliberated extensively about the long-term rate of health care cost growth and ultimately recommended an assumption of tying Medicare's long-range cost growth to the increase in per capita GDP plus 1 percentage point (GDP+1), exclusive of age-gender effects, for both HI and SMI. The panel viewed its mission as one of delivering credible and

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[24] The resulting projection pattern of HI growth versus SMI growth as a share of GDP is illustrated in Table III.B.1 of the *2000 HI Trustees Report*.

usable assumptions concerning an inherently uncertain issue. The conceptual innovation was in seeing the long-range assumption for both HI and SMI as explicitly a question of the rate of excess cost growth relative to GDP under current law. Within the conceptual framework, the practical task for the panel became a matter of arriving at a consensus for the value to assign to the key projection variable that had been defined.

To achieve a consensus, the experts considered many factors that are thoroughly documented in their written report.[25] Most telling for the panel were long-term time-series expenditure trends when considered in light of causal evidence. Long-term time-series evidence showed that in any multi-year time period examined by the Technical Panel, real per capita health expenditures had never grown at a rate less than 1 percent in excess of real per capita GDP growth. As for determinants of expenditure growth, the panel looked to aggregate and micro-level health economics studies, which pointed to technological change as the primary driver of real growth in health expenditures. The panel report concluded that technological change alone would account for a percentage point of real growth in excess of the rate of real GDP growth.

Also considered by the panel were factors that might in the future slow or accelerate the rate of excess medical expenditure growth through the diffusion of technological change. For example, the spread of managed care in the 1990s was seen as a short-term aberration in a long period of excess cost growth relative to GDP growth rates and, thus, as unlikely to have an enduring effect. The experts did not find evidence for a long-term differential among types of payers that would affect their conclusion about the long-term excess growth rate. The panel also noted that other forecasters showed a range of excess growth in health expenditures of between 0.8 to 1.5 percentage points, with most of the studies congregating around a value of 1 percentage point.

Finally, the panel's report discussed the sustainability of excess cost growth of 1 percent for the duration of a 75-year projection period. Concerning this issue, the report noted that excess growth of 1 percent per year over 75 years would lead to a health sector of unprecedented size as a share of the economy, but since such a growth pattern would still be consistent with increases in the absolute level of real consumption for non-health expenditure, the panel saw little grounds for expecting consumers as a group to reach some point of satiety concerning health expenditures.

Based upon their thorough review of relevant factors, the 2000 Technical Panel unanimously recommended adoption of a long-term excess cost assumption of a full percentage point of excess growth in per enrollee HI and SMI costs above the rate of growth of per capita GDP, exclusive of age-gender effects. Their recommendation was supported by the Office of the Actuary in its assumption recommendations in the Fall of 2000 to the last Medicare Board of Trustees under the Clinton Administration and was adopted formally by that Board. With the changes in Board membership under the incoming Bush Administration, the Office of the Actuary again recommended the GDP + 1 long-range growth assumption, and it was again adopted by the new Board and implemented in the 2001 Medicare Trustees Reports.[26] As was to be expected, the change

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[25] *Review of Assumptions and Methods of the Medicare Trustees' Financial Projections* by Technical Review Panel on the Medicare Trustees Reports (Baltimore: 2000) available at: http://www.cms.gov/ReportsTrustFunds/downloads/TechnicalPanelReport2000.pdf

[26] By law, the members of the Medicare (and Social Security) Board of Trustees are the Secretary of the Treasury, Secretary of Labor, Secretary of Health and Human Services, Commissioner of Social Security, and two members

to a more costly long-term assumption had a substantial effect on the reported financial status of the Medicare program. In 2001, the Medicare share of GDP at the end of 75 years was projected at 8.49 percent, as compared with 5.28 percent projected in the 2000 Report. The GDP+1 assumption as applied in the 2001 HI and SMI Trustees Reports was also used in the annual reports issued from 2002 through 2005.

C. Phase III: Refinement of the GDP+1 Projection Method

A new Medicare Technical Panel was convened in 2004; it reviewed and reaffirmed the long-term GDP+1 assumption as implemented by the Office of the Actuary, but also made suggestions for research into long-term projection methods.[27] In addition, the MMA required that the Medicare Trustees compare past and projected Medicare cost growth rates with annual rates of growth in GDP, private health insurance costs, national health expenditures, and other appropriate measures. Together, the changes in statutory reporting requirements and the suggestions of the 2004 Technical Panel provided impetus for refinement of how the GDP+1 assumption was implemented.

The 2004 Technical Panel considered the analysis of excess cost trends that had appeared in the report of the 2000 Technical Panel and found that analysis to be persuasive. The 2004 panel was comfortable with the existing framework and concluded that the existing GDP+1 long-range assumption was "within the range of the reasonable assumptions, given the limits of current knowledge." However, the panel also found future promise in extramural general equilibrium modeling projects already in progress under the supervision and sponsorship of the Office of the Actuary, and accordingly the experts encouraged the pursuit of additional research to build insight into the behavioral dynamics underlying health expenditure growth.[28]

The Office of the Actuary eventually determined that yearly expected excess cost rates for the overall health sector, exclusive of age-gender effects, as derived from the constrained solution of a stylized macroeconomic model—the OACT computable general equilibrium (CGE) model[29]—could be used as a tool for improving the long-range Medicare cost growth assumptions and for complying with new reporting responsibilities. A review of this approach by independent health economists convened for this purpose confirmed this finding, and the OACT CGE model was adopted as a tool in the production of long-range estimates starting with the 2006 Medicare Trustees Report.

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representing the public. Dr. John L. Palmer and Dr. Thomas R. Saving served as Public Trustees on both the 2000 and 2001 Boards of Trustees (as well as subsequent Boards through 2007).

[27] *Review of Assumptions and Methods of the Medicare Trustees' Financial Projections* by 2004 Technical Review Panel on the Medicare Trustees Reports (Baltimore: December, 2004) available at: https://aspe.hhs.gov/pdf-report/review-assumptions-and-methods-medicare-trustees'-financial-projections-0

[28] The recommendation to explore many possible lines of insight with simple models was reiterated several years later by members of an informal advisory group of distinguished economists and actuaries convened by the Office of the Actuary in 2007.

[29] The detailed structure of the model, but not how it was used in the Trustees Reports, is described in "Projecting long-term medical spending growth," by Christine Borger, Thomas F. Rutherford, and Gregory Y. Won, *Journal of Health Economics*, Volume 27, Issue 1, pages 69-88 (2008).

The CGE model was used solely as a tool for developing a reasonable series of downward-trending, year-by-year health care cost growth rates that were consistent with the constant GDP+1 assumption used previously. A thorough review of the CGE model determined that without exogenous identifying assumptions about the average rate of cost growth the model could not be used as an independent forecasting tool. However, it made sense to use it as a tool to translate the basic GDP+1 cost growth assumption into a financially equivalent series of smoothly decelerating cost growth rates more consistent with a notion of diminishing marginal utility of health care for a representative consumer as the budget share for health care increased.

D. Phase IV: Affordable Care Act

The enactment of the ACA in March 2010 required that several new provisions of the law be taken into account when developing long-range Medicare projections. Most notably, the ACA modifies the annual increases in Medicare payment rates for most categories of health service providers by reducing them for 2011 and later by the 10-year moving average increase in private, non-farm business multifactor productivity.[30]

For the 2010 and 2011 Medicare Trustees Reports, the Trustees first assumed a "baseline" set of pre-ACA, long-range Medicare cost growth rates, using the methods described above regarding the refinement of the GDP+1 method. This approach included continued use of the OACT CGE model to determine the year-by-year growth rates consistent with an underlying average rate of GDP plus 1 percent. These baseline long-range Medicare cost growth assumptions were then altered to incorporate the payment adjustments associated with the ACA. This adjustment affects all HI (Part A) providers; as a result, on average, the resulting long-range growth assumption for HI was the increase in per capita GDP plus 1 percent, minus the productivity factor (estimated at 1.1 percent per year). For SMI Part B, the productivity adjustment affects certain provider categories—for example, outpatient hospitals, ambulatory surgical centers, diagnostic laboratories, and most other non-physician services. These services had the same assumed long-range growth rate as did HI services. The sustainable growth rate formula in current law governed increases in average physician expenditures per beneficiary, so that they would increase at approximately the rate of per capita GDP growth. The remaining Part B services, and all Part D outlays, were not affected by the SGR or the ACA productivity adjustments and had an assumed average growth rate of per capita GDP plus 1 percent.

In December 2011, the panel members unanimously recommended a new approach that built off of the longstanding "GDP plus 1 percent" assumption while incorporating several key refinements. Specifically, the panel recommended use of two separate means of establishing long-range growth rates:

- The first approach is a refinement to the traditional "GDP plus 1 percent" growth assumption that better accounts for the level of payment rate updates for Medicare (prior to the ACA) compared to private health insurance and other payers of health care in the U.S. For applicable provider categories—those with provider payment updates based on input price increases, prior to the ACA—the refinement results in an increase in the long-range pre-ACA "baseline" cost

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[30] "Multifactor productivity" is a measure of real output per combined unit of labor and capital, reflecting the contributions of all factors of production.

growth assumption for Medicare to “GDP plus 1.4 percentage points.” The corresponding assumed average growth rate for aggregate national health expenditures continues to be “GDP plus 1 percentage point.”[31]

- The second approach recommended by the Technical Panel is the “factors contributing to growth” (FCG) model developed by the Office of the Actuary at CMS as a possible replacement for the existing process. This model also builds upon the key considerations used in establishing the earlier “GDP plus 1 percent” assumption, together with subsequent refinements in the analysis of growth factors, additional years of data on national health expenditures available since the 2000 Technical Panel’s deliberations, and use of projected trends in the model’s key factors. The model is based on economic research that decomposes health spending growth into its major drivers—income growth, relative medical price inflation, insurance coverage, and a residual factor that primarily reflects the impact of technological development.[32]

For the 2012 Trustees Report, the long-range Medicare spending assumption was determined as (i) a pre-ACA baseline assumption for the average ultimate Medicare growth rate using the updated “GDP plus 1.4 percent” and (ii) the FCG model to create the specific year-by-year declining growth rates during the last 50 years of the projection. These baseline assumptions were then altered by the payment adjustments in the ACA.

For the 2013 and 2014 Trustees Reports, the long-range Medicare spending assumption was determined based on (i) the volume and intensity assumptions derived from the FCG model, (ii) the impacts on Medicare volume and intensity from the ACA, as recommended by the Technical Panel, and (iii) the Medicare payment updates specified in current law. For the 2014 Report, an SGR override was assumed under the projected baseline scenario. For the 2015-2017 Reports, the passage of MACRA with a new payment system for Medicare physician services prompted a return to a current law perspective and a recalibration of certain FCG parameters was implemented. Finally, in the 2018 Report, the Bipartisan Budget Act was reflected, with the most notable impact on the long-range projections the elimination of the Independent Payment Advisory Board.

E. Phase V: Re-Affirmation of Methods by 2016-2017 Technical Panel

In August, 2016 a Medicare Technical Panel convened, once again charged by the Trustees to perform a fundamental review of long-range expenditure projection methods, including whether uncertainty about sustainability of current law payment provisions continue to warrant presentation of an Illustrative Alternative scenario as part of the annual Report of the Medicare Trustees. The panel executed its assigned role over the next year and submitted a Final Report in September, 2017.[33] The panel largely affirmed long-range projections methods and made a number of

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[31] It is important to recognize that GDP+1.4 is prior to any multifactor productivity adjustment to Medicare administrative payment systems as required by update provisions of ACA; the GDP+1 assumption for NHE is consistent with negotiated provider payment rate updates that are net of provider productivity gains deemed to be attainable across the health sector.

[32] Smith, S., Newhouse, J., and Freeland, M., “Income, Insurance, and Technology: Why Does Health Spending Outpace Economic Growth?” *Health Affairs,* September/October 2009.

[33] The complete report of the technical panel is available at https://aspe.hhs.gov/system/files/pdf/257821/MedicareTechPanelFinalReport2017.pdf.

recommendations for ongoing research concerning issues that, depending on how they develop, could warrant modification of long-range assumptions.

Noteworthy specific findings of the panel included:

- Affirmed the assumptions used in the long-range projections were reasonable and affirmed the current approach and length of the transition from projected short-range cost growth rates to long-range cost growth assumptions were reasonable.

- Affirmed continued presentation of an Illustrative Alternative (IAS) scenario and recommended incorporation of minor adjustments in the manner in which transitions to long-run cost growth rates are implemented in the IAS (discussed earlier in this memorandum) while also recommending ongoing research regarding the sustainability of the ACA-created system of Medicare provider payment updates.

- Recommended research concerning i) spillover effects on Fee-for-Service (FFS) Medicare cost growth from continued growth of Medicare Advantage (MA) enrollments; ii) possible cost-savings from factor substitution such as drug utilization that reduces or even obviates the need for inpatient episodes or outpatient procedures; iii) whether a time-to-death framework could improve modeling of age-effects on aggregate Medicare spending; iv) monitoring whether shifts in settings for end of life care warrant adjustment in assumptions of utilization intensity across alternative settings (for example, inpatient, outpatient, hospice.); and v) evaluation of alternative methods for measuring and tracking volume and intensity of medical services.

As noted elsewhere in this memorandum in response to the recommendations of the panel, the Office of the Actuary has incorporated recommended changes in the production of the IAS and has initiated steps follow-up on elements of the panel's research recommendations.

Evaluation of the Long-Range Cost Growth Assumptions

In this section the reasonableness of the key long-range assumptions and the projections that result are discussed.

A. The NHE Projection Baseline

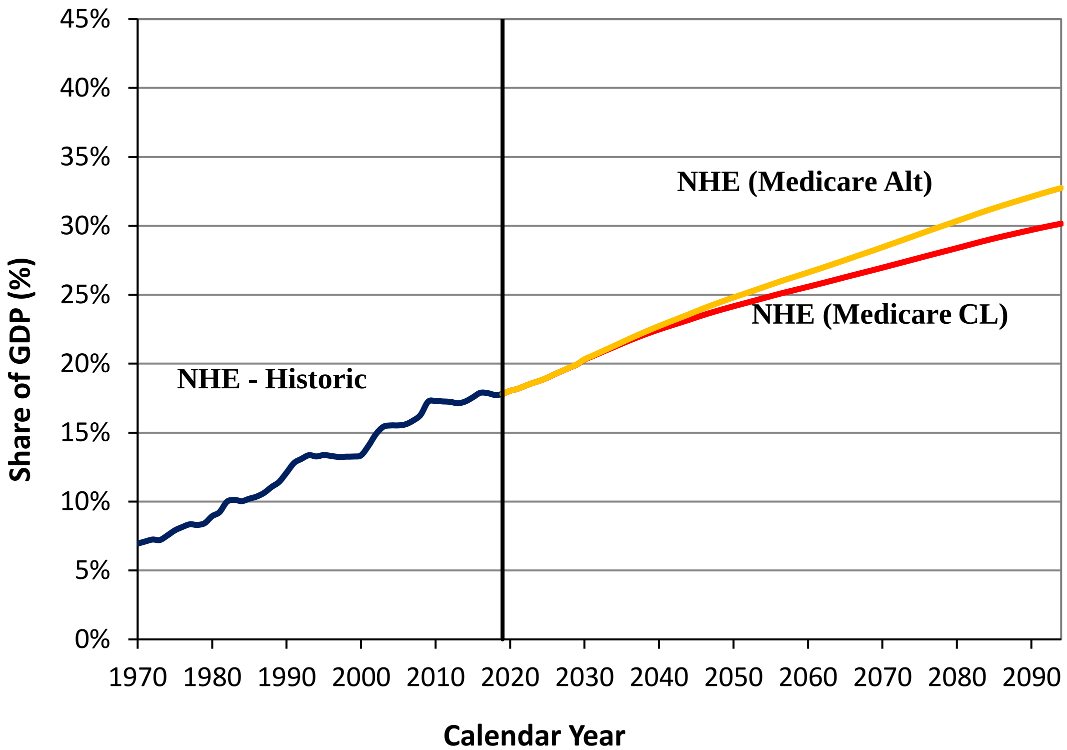
A core assumption underlying the OACT long-range health expenditure projections continues to be that net per capita health expenditure growth for the U.S. health sector as a whole, exclusive of demographic effects, would experience a substantial slowdown from historic rates of excess cost growth. Using the FCG model, the current assumption is that excess cost growth would be GDP plus 0.7 percent for 2044, gradually declining to GDP plus 0.5 percent by 2094. The questions to be considered here concern the reasonableness of the assumptions inherent in the NHE projection that imply a long-term slowdown in excess cost growth.

In approaching these questions, it is worth remembering that the term "excess cost growth" as used by the Office of the Actuary is meant to be a descriptive rather than a normative term. In other words, the term does not mean that there is anything intrinsically bad or inherently unreasonable with faster growth for the health sector than for the rest of the U.S. economy. But, as explained earlier in this memorandum, long-run historic trends in excess cost growth rates for the health sector are ultimately unsustainable. The appropriate question regarding a long-range projection is therefore what state of the world would be expected to prevail under a reasonable set of assumptions about the evolution of the health sector.

The long-range assumptions about excess cost growth, together with demographic projections of population size and age distribution, determine the magnitudes of the long-range projections. Even if the long-range baseline assumptions are believed to be within the range of the reasonable, it is fair to consider the degree to which the outputs are reasonable and credible.

Under the full illustrative alternative scenario, the health sector share of GDP is expected to increase from 17.7 percent in 2018 to as much as 32.7 percent of GDP in 2094 (Chart 5). Such magnitudes have no historical precedent and are even more extraordinary when it is considered that these increased economic shares would be from an economy that, in real per capita terms, is projected to be roughly three times the size that it is today.

Chart 5—National Health Expenditures as a Percent of GDP 1970-2094



Source: Centers for Medicare and Medicaid Services, Office of the Actuary.
NOTE: Historical data is used before 2019 and projections from 2019 forward.

It is fair to question, as some researchers have, whether a future health sector of this size would be macro-economically sustainable to the end of the 75-year projection horizon.[34] When long-range scenarios have been run by the INFORUM group at the University of Maryland, with their detailed, bottom-up macroeconomic model (Long-Run Interindustry Forecasting Tool, or LIFT), maintenance of current-law benefit levels has been found sustainable in the sense that some real growth in the non-health sectors of the economy would still be feasible.[35] But that analysis purposely ignored macroeconomic "feedback effects" on investment, interest rates, and labor supply from the increases in tax rates and/or government debt levels that would be needed to finance Medicare and Medicaid.[36] The more significant those macroeconomic effects are, the more likely a slowdown in Medicare excess cost growth even below the long-range assumption. Distributional issues are also likely to emerge as Medicare Part B premiums and cost sharing start to consume roughly one-third or more of monthly Social Security benefits for some beneficiaries.[37]

A National Academy of Sciences committee has also issued an important report about alternative choices that the nation faces in order to make its system of entitlement programs, including Medicare, fiscally sustainable.[38] Various alternative scenarios, including scenarios involving rates of growth less than GDP+1, are considered to underscore that there are choices to be made to decide the nation's future, but no position is taken concerning which scenario would be optimal.

Abundant reasons thus exist to question whether the long-range NHE projection baseline would itself in fact be sustainable. Yet even though the sources cited here raise pertinent practical questions about the ultimate sustainability of this current law scenario, none of them provides a reliable basis for adopting a lower baseline. What is more, the persistence of high rates of excess cost growth over history, despite previous legislative initiatives aimed at reducing it, is another important inducement to caution in the adoption of a projection baseline.[39] The NHE projections are undoubtedly more realistic than assuming excess cost growth continues unabated at historic trend

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[34] Glenn Follette and Louise Sheiner, "The Sustainability of Health Spending Growth," *National Tax Journal*, Volume 58, pages 391-408 (2005).

[35] Mark Freeland, Greg Won, Stephen Heffler, and Margaret McCarthy, "Issues on the Sustainability of Long-Term Health Spending Projections," Paper delivered at 2002 SGE/ASSA/AEA Conference session on "Long-Term Projections of Health Care and Medicare Costs."

[36] When such factors were reflected in LIFT model runs, the macroeconomic impacts of tax increases and increased federal borrowing resulted in long-range economic growth that was substantially slower than assumed in the Trustees Reports.

[37] See Figure II.F2, *2020 Trustees Report***,** available at: https://www.cms.gov/files/document/2020-medicare-trustees-report.pdf.

[38] Committee on the Fiscal Future of the United States, *Choosing the Nation's Fiscal Future,* The National Academies Press, Washington, D.C., (2010), https://www.nap.edu/

[39] For instance, the Sustainable Growth Rate system that was supposed to control the growth of Medicare physician fees was overridden by Congress nearly every year.

rates, but the results are still large enough to underscore the need for effective policy intervention if the growth of the U.S. health sector relative to the rest of the U.S. economy is ever to be stabilized.[40]

B. The Relationship between NHE and Medicare Projections under Current Law

Recent Medicare Technical Review Panels have in one way or another been comfortable assuming that average growth over the long-range projection period would be consistent with slowing excess cost growth given that historic rates are simply unsustainable. However, the panels have provided little analysis of specific mechanisms that might cause a slowdown of excess cost growth. For example, the 2000 Technical Panel was impressed by evidence that an excess cost growth rate of 1 percent (GDP+1) would still be consistent with maintaining some positive real growth in an absolute sense in other sectors of the economy. Maintenance of positive real growth in per capita non-health expenditures might therefore be interpreted as defining an outer limit on social willingness to pay for additional health care.

How the U.S. economy in the absence of major policy interventions would in fact move from a historic excess cost growth rate of GDP+2 remains a largely unsettled question. The existing Medicare program and private health insurance plans more generally contain numerous features by which consumer preferences for slower expansion in health care could eventually reduce the rate of excess cost growth in line with the expectations of the Technical Review Panels, including the most recent panel.

By way of illustration, consider the potential effects of cost-sharing provisions of current-law Medicare, which are more substantial and more extensive than is often recognized.[41] At present, the great majority of Medicare beneficiaries (roughly 90 percent) have supplemental health insurance coverage that helps insure against Medicare's point-of-service cost-sharing obligations. Such coverage is provided through supplemental private "Medigap" insurance programs paid for by the beneficiaries themselves, participation in private Medicare Advantage coordinated care plans, retiree health plans provided by their former employers, or the Medicaid program. As the costs of comprehensive supplemental coverage rise relative to the growth of personal income and business income, the comprehensiveness and the prevalence of such coverage are likely to diminish, and point-of-service cost sharing faced by Medicare beneficiaries is likely to become more frequent and more burdensome. Accordingly, as time passes, beneficiaries may choose more frequently not to

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[40] Even with zero or slightly negative excess cost growth, as in the current law Medicare projections, the Medicare program will continue to grow as a share of the U.S. economy as long as the share of the population eligible for Medicare benefits is increasing relative to the overall population.

[41] There is no provision in current law that would permit payment of full HI benefits after trust fund exhaustion. Since the purpose of the Medicare and Social Security Trustees Reports is to evaluate the adequacy of program financing, however, the Trustees have always made projections of (i) the benefits specified under current law (and the associated costs of administering the program) and (ii) the revenues specified under current law. The annual report then compares these two projections to evaluate whether financing is sufficient. Thus, the Trustees' application of current law does not follow a strict interpretation of what would actually happen in the event of trust fund depletion; rather, it compares expenditure and income levels under the implicit assumption that full benefits would be paid. In practice, Congress has never allowed the HI trust fund to be exhausted, and it is highly likely that action would be forthcoming to prevent exhaustion at a future date.

seek health care perceived by them to be of limited marginal value or to decline health care offered by providers.

That cost sharing can have substantial effects on demand for health care is an established proposition. The results of the well-known RAND Health Insurance Experiment persuasively confirm that substantial effects on demand for health care arise from point-of-service cost obligations borne by patients.[42] Moreover, an important recent study indicates that the scope of insurance coverage is likely to have had an even greater effect on health sector size than could be identified by the study design used in the original RAND Health Insurance Experiment.[43] Further consumption-side brakes on Medicare as excess costs accumulate might include decisions not to enroll in Medicare Part B or Part D. Such individuals would face even more substantial point-of-service obligations that would have significant effects on their access to health care.

Over the past few decades the apparent role of cost sharing in the finance of health care has diminished, mostly through the spread of public health insurance coverage and private pharmaceutical coverage plans. To some degree the perceived importance of cost-sharing may continue to decline due to further expansion of the share of the population covered by public programs like Medicaid. But OACT is persuaded that the role of cost sharing at the point of service for Medicare beneficiaries as well as the financial burden of Part B and Part D premiums will continue to increase, and absent policy interventions cost sharing effects in Medicare and in the rest of the health sector can be expected to grow.

Theory suggests that, as efficient methods of care become more widely diffused throughout the health sector, such methods would be applied by health care practitioners to patients, regardless of insurance plan. Cost-saving spillovers into Medicare from private sector initiatives that are focused on efficiency of treatment around best practices are another foreseeable brake on excess cost growth. Additionally, research confirms that increases in penetration rates for Medicare Advantage also reduce utilization and spending for traditional Medicare.[44,45] It is also possible that Medicare itself could contribute to this kind of progress, resulting in cost savings that would spill over into private health plans as well. For example, efforts are currently underway at CMS to test the effectiveness of better integration of care through Accountable Care Organizations, patient-centered "medical homes," shared savings programs and capitated plans for dual Medicare-Medicaid beneficiaries, and other approaches. Similarly, CMS is conducting demonstration programs for broader bundling of payments, reductions in unnecessary hospital readmissions and hospital-acquired conditions, etc. Innovations that are successful in reducing Medicare costs are very likely to be adopted in the private

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[42] W.G. Manning, J.P. Newhouse, N. Duan et. al., "Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment," *American Economic Review***,** Volume 77(3), pages 251-277 (1987).

[43] Amy Finkelstein, "The Aggregate Effects of Health Insurance: Evidence from the Introduction of Medicare," *Quarterly Journal of Economics,* Volume 122(1), pages 1-37 (2007).

[44] Baicker, K., M.E.Chernew, and J.A.Robbins. "The spillover effects of Medicare managed care: Medicare Advantage and hospital utilization." Journal of Health Economics, Volume 32(6), pages 1289-300 (2015).

[45] Feyman, Y., Frakt, A.B., "The persistence of Medicare Advantage Spillovers in the post-Affordable Care Act Era", Working Paper, November 2017 (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3072604)

sector as well. Such institutional factors are incorporated into the expectations for growth in national health spending over the long run through the assumptions that underlie the Factors Model.[46]

It is also reasonable to expect that health care providers, under financial pressure from Medicare, Medicaid, and the private sector alike, may adopt new technological innovations more prudently than they have in the past. Drug and medical device manufacturers may focus greater attention on developing cost-reducing technology in the future, more akin to what has traditionally happened in other sectors of the economy.

These examples of "natural brakes" on health care spending are expected to contribute to a slowdown over the long run of excess cost growth even in the face of some foreseeable cost-increasing effects. For example, persons who do not have or who choose to forgo a private supplemental Medicare insurance policy may obtain extra coverage by enrolling in a Medicare Advantage (Medicare Part C) plan, whose government-paid premiums and "rebates" (at least currently) often exceed average per enrollee fee-for-service Medicare costs. To the degree that pharmaceutical coverage sponsored by former employers of Medicare beneficiaries becomes less available or less comprehensive, enrollment in the Medicare Part D plans may also grow, increasing total Medicare outlays. Also, if a disenrollment trend emerged for Part B or Part D, it could be mitigated for some by increased participation in Medicaid, including the "QMB," "SLMB," and "QI" options.

While there are natural brakes in the current health care system that are likely to slow excess NHE and Medicare cost growth, the "out-of-sample" nature of the health expenditure projection problem makes it especially difficult to project the magnitude and speed of a slowdown in the rate of excess cost growth. Given the current state of knowledge and the recommendations of distinguished panels of technical experts, OACT is satisfied that the current long-range assumption, which incorporates a gradual slowing of cost growth from historical trends, is a plausible and reasonable expression of trends likely to prevail under current law. A last attribute of the current methodology is the assumption of the same cost slowdown to all parts of the U.S. health sector.[47] OACT is skeptical that a sustained divergence in cost growth rates between Medicare and the rest of the U.S. health sector could prevail for long without the appearance of access to care issues.

C. Current Law and Illustrative Alternative Medicare Projections

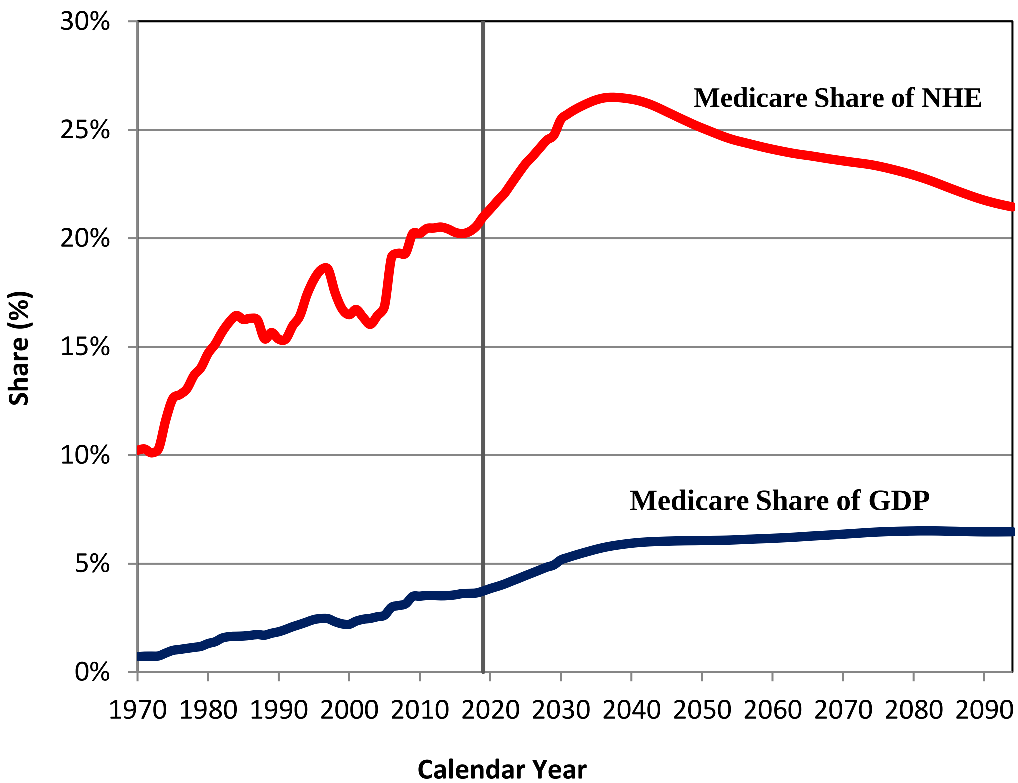
Chart 6 displays the projected long-run expenditures of the Medicare program as a share of GDP and as a share of aggregate national health expenditures, based on the current law projections in the 2020 Medicare Trustees Report. As a share of GDP, Medicare spending is projected to continue increasing until the late 2030s due to the combined effects of excess cost growth and enrollment increases, though mainly due to the impacts of increased enrollment. For the last 50 years of the projection the Medicare share of GDP is relatively stable, reflecting slower enrollment growth and

[46] For further discussion of these spillover effects and their incorporation into the long run expectations through the Factors Model, please see the Appendix A.

[47] How excess cost growth for Medicare under the illustrative alternative scenario and other parts of the health sector would slow is envisioned differently. For the privately insured, prices would be determined through the market process whereas for the Medicare alternative scenario prices would be set through the update process for the administrative payment systems.

assumed per enrollee cost growth rate that is near or below the per capita GDP growth rate. The convergence of per enrollee cost growth to something near or below the rate of per capita GDP growth mainly occurs because the growth in Medicare payment updates over this period are near the increases in the GDP deflator, as required by law. As a share of NHE, however, Medicare spending under current law is projected to fall over the long-range as the assumed rate of per enrollee Medicare cost growth is less than assumed for per capita NHE. Again the main reason for this pattern is the Medicare payment updates, which are projected to increase at a slower rate than non-Medicare health price updates (volume and intensity is assumed to generally grow similarly for Medicare and non-Medicare).

Chart 6—Medicare as a Percentage Share of GDP and as a Percentage Share of NHE under Current Law 1970-2094

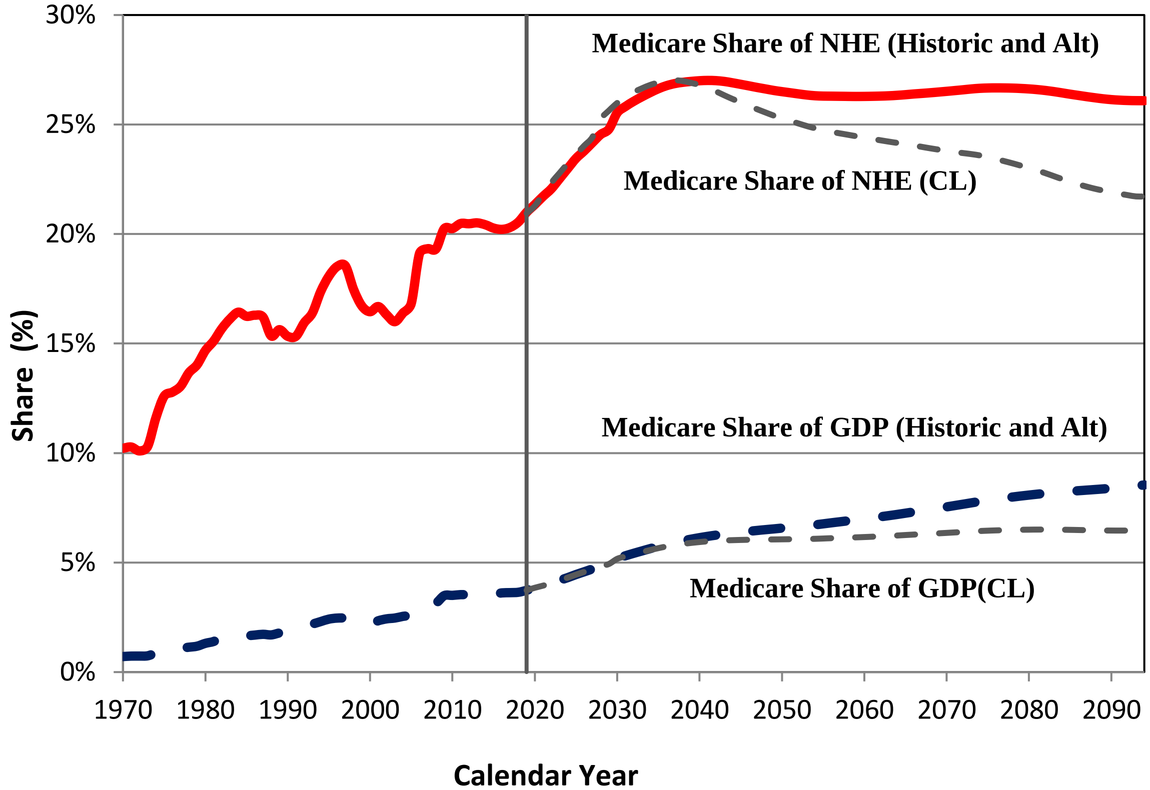


Source: Centers for Medicare and Medicaid Services, Office of the Actuary.

NOTE: For Medicare Share of GDP historical data is used before 2019 and projections from 2019 forward. For Medicare Share of NHE historical data is used before 2019 and projections from 2019 forward.

As noted previously, there is substantial uncertainty concerning whether the provider payment updates could be sustained into the long-run without affecting access to care by Medicare beneficiaries. Therefore, the Trustees also report a long-range projection based upon an illustrative alternative scenario in which adherence to the current law payment updates erode. Chart 7 displays projected long-run Medicare expenditures as a share of GDP and NHE under the illustrative alternative scenario.

Chart 7—Medicare as a Percentage Share of GDP and as a Percentage Share of NHE under the Illustrative Alternative 1970-2094



Source: Centers for Medicare and Medicaid Services, Office of the Actuary.
NOTE: For Medicare Share of GDP historical data is used before 2019 and projections from 2019 forward. For Medicare Share of NHE historical data is used before 2019 and projections from 2019 forward.

As indicated in Chart 7, under the illustrative alternative, Medicare costs would continue to increase as a share of GDP throughout the long-range projection, reaching 8.5 percent by the end of the 75-year period, compared to 6.5 percent under current law. Similarly, as a share of NHE, Medicare costs would level off and stabilize as a share of overall NHE after 2035, rather than declining substantially as it would under the current law scenario also depicted in Chart 7.

D. Other Pertinent Considerations

The model used to develop the long-range projections does not explicitly include many of variables that might affect the trajectory of expenditure growth in the health sector and in Medicare. To the degree that such variables affect expenditure levels (for example, institutional factors like managed care or population factors like the prevalence of obesity), they do so through the judgments of the experts who helped to formulate and validate the current assumption, which is best seen as an informed summary of expectations concerning the net effects of all relevant variables.

Another important source of uncertainty regarding the current long-range assumption is how quickly consumers would respond to the increased costs that they would eventually confront for insurance coverage and for copayments at points of service. If such responses emerged in the near term, then the current baseline assumption might in retrospect be found to have been too high; if they unfolded in the more distant future, then the current baseline assumption might be found to have been too low. The same kind of uncertainty exists regarding the effects of other conceivable natural brakes on health expenditure growth. Such effects would broadly fall into the category of endogenous institutional change that we would expect to be captured in the Factors Model (additional discussion in Appendix A).

Actual long-range Medicare costs are virtually certain to differ from whatever is projected and, as this consideration of sources of variability would suggest, perhaps to a very significant degree. Such variation, however, is unlikely to be sufficient to alter the conclusion that the Medicare program faces serious and enduring financial challenges that will become worse the longer that they continue. OACT continues to engage in internal and external research projects aimed at improving the foundations of the long-range health expenditure cost growth assumptions.

Conclusion

The Medicare Trustees have statutory responsibility to report on the long-term financial and actuarial status of the Medicare program in the context of broader growth trends in the U.S. health sector. To discharge this responsibility, long-range spending projections must be made for both the overall health sector and Medicare, and those sets of projections must be appropriately interrelated. For the 2020 Trustees Report, the FCG model was used to determine the long-term growth trajectory of the U.S. health sector. Under the current law projection, the long-range Medicare cost growth assumptions are implemented as the increases in the volume and intensity of health care services per person from the FCG model of total national health expenditures, adjusted by the expected impact on volume and intensity from the ACA, together with the Medicare-specific provider payment rate updates specified in current law, with further adjustments to incorporate demographic effects. Continuing uncertainty concerning the feasibility of certain elements of current law—the MACRA provision for physician payments and the permanent reductions in most other Medicare payment updates by the increase in economy-wide productivity—has prompted the Trustees to again provide an illustrative alternative projection whose growth trajectory is similar to the health sector as a whole.

The long-range cost growth assumptions have evolved through regular processes of expert review, and improvements, refinements, and alternative approaches to the projection method continue to be considered. In their present form, the long-range assumptions lead to Medicare projections under current law and illustrative alternative scenarios that provide a sound basis for evaluating long-range fiscal challenges to the Medicare program.

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Appendix A: Factors Contributing to Growth (FCG) Model

The Office of the Actuary's Factors Contributing to Growth (FCG) model is an accounting framework that is used to track the historical contribution of factors that drive national health expenditure growth and to develop projections of health care spending that are consistent with the evolution of these factors. The model relies on a wide range of empirical research as the basis for historical parameter estimates that reflect the sensitivity of health care spending growth to changes in each of the factors. Where the projected path for these parameters is expected to differ from historical patterns, the assumptions are adjusted to reflect the expected shift. These parameters are applied to projected growth in macroeconomic and health-care-specific variables to determine growth in national health spending over the long-term projection.

This appendix discusses the underlying structure of the FCG model. Next, it provides a detailed discussion of the historical derivation of the key parameters in the model, and presents the historical fit of the model from 1965-2018. Finally, this appendix discusses how the FCG model is used as the framework for developing long-range projections of national health spending growth that were used in the 2020 Trustees Report.

1. Factors Contributing to Growth (FCG) Model Structure

Basic FCG model equation

There are five key factors that have been identified to influence growth in aggregate per capita growth in national health expenditures:[48]

- demographics (the impact of distributional shifts across age cohorts and proximity to death),[49]
- changes in insurance coverage,
- relative medical price inflation,
- changes in aggregate real per capita income,
- a residual factor attributed primarily to the development and diffusion of new medical technologies.[50]

Below we discuss two versions of the FCG Model equation. In the basic form of the model, the role of each factor contributing to growth is represented separately with all other factors held constant. This version of the model is shown in equation (1) below.

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[48] Sheila Smith, Joseph Newhouse, and Mark Freeland, "Income, Insurance, and Technology: Why Does Health Spending Outpace Economic Growth?" *Health Affairs*, September/October 2009 28:1276-1284.

[49] These demographic factors, which in prior reports reflected the changing distribution of the population by age, now also account for the changing distribution of the population by time-to-death for the projections in the 2020 report. More information on the time-to-death adjustment is available at https://www.cms.gov/files/document/incorporation-time-death-medicare-demographic-assumptions.pdf.

[50] The residual captures the effect of all factors contributing to growth that are not specifically incorporated. The majority of such factors cannot reasonably be assumed to influence growth rates over extended periods of time. A broad consensus holds that technological change is the most critical factor that generates growth in health care spending sustained at rates above what would be predicted based on other key factors contributing to growth.

The current version of the model (shown in equation (2)) is a modified variant of this basic equation. The model equation is adjusted to split the contribution to spending growth from medical technology between an endogenous effect that occurs as a function of income and an exogenous effect within the model residual that captures the pure effect of the expansion of feasible options for medical treatment with all other variables held constant.

The structure of the basic version of the FCG model is shown in equation (1) below:

$$(1) \quad h_t = a_t + \varepsilon_y y_t + \varepsilon_i i_t + (1 + \varepsilon_p) p_t + d_t$$

where each factor is expressed as a log difference (approximate growth rates) and all spending series are in constant dollar terms based on the GDP deflator. Model variables are defined below:

- h_t = constant dollar health spending per capita at time t
- a_t = residual factor (primarily attributed to spending on new medical technology)
- y_t = income at time t (GDP per capita)
- i_t = average coinsurance rates at time t (out-of-pocket share of total health spending)
- p_t = relative medical price at time t (relative to GDP deflator)
- d_t = index of demographic contribution to health care spending at time t

Model parameters are defined as *elasticities*. Each elasticity represents an estimate of the percentage change in real per capita national health spending that results from a one percentage point increase in the model variable in question. These elasticities capture the sensitivity of health care spending growth to changes in each of the causal factors. The elasticity associated with the index of health care spending growth due to changes in the demographic composition of the population is equal to one by construction (and is therefore not shown).

- ε_y = income elasticity
- ε_i = coinsurance elasticity
- ε_p = health care price elasticity

Note that growth in relative medical prices affects health spending in two ways in this model. First, there is the direct impact of higher prices causing higher spending, other things being equal. In addition, however, there is a partial offset to this effect as higher prices for medical services tend to reduce demand somewhat, and this effect is reflected in the $\varepsilon_p \cdot p$ term in equation (1) above (where ε_p is negative).

The contribution of technological change to health care spending, primarily reflected as *a* in equation (1), is defined as the incremental spending on treatment methods within the period associated with new medical technologies. This effect will reflect both the relative utilization of new technology and its relative price in comparison with existing forms of treatment. Effects on spending associated with technological change can be expected to occur with a substantial lag following the development of new treatment options, with the impact on spending extending from the initial availability of the treatment through the process of adoption, followed by a transition to a new equilibrium (in the absence of changes in other variables).

The Basic FCG model, as presented in equation (1), is a simple reduced-form model that assumes that the contribution of each of the factors to health spending growth is independent of all of the others. This use of a reduced-form equation effectively represents a summary of the observed relationships in the aggregate data between health care spending growth and the net effect of growth attributable to a range of factors on both the demand and supply side. Equation (1) assumes that there will be no interaction effects among causal variables – the effect of each factor is assumed to be independent of all others (i.e. ceteris paribus).

This basic version of the FCG model requires that each of parameters in the model be estimated empirically, while holding all other factors constant. This method implicitly assumes that it is possible to accurately control for variation in these factors. In the case of medical technology, however, variation can be expected to occur in relation to the other factors, but it is not feasible to directly measure or control for all these potential interaction effects over time. Attempts to control for interaction effects between technology and other model variables therefore typically utilize a proxy, such as a time trend, to attempt to capture the effects of medical technology.[51]

The most important of these interaction effects is the relationship between changing medical technology and aggregate income, because aggregate income is the key constraint on budgets for health care spending and thus has a strong effect on the adoption of new technology. A complicating factor with this proxy-based method arises with aggregate income, because estimating the relationship between health care spending and income in a model that includes a time trend as a proxy for technology potentially excludes a substantial part of the relationship between health care spending and income. Given the importance of this interaction effect, the FCG model equation was modified to explicitly account for the interaction between aggregate income and medical technology, as described further below.

To the extent that we are unable to control for interaction effects between the individual factors contributing to growth, or where there are additional factors contributing to growth that are not specified, the net impact of interactions and omissions on variation in health expenditure growth will be captured in the contribution to growth from the residual term (a_t).

Modified FCG Model Equation

The Basic FCG model (equation (1)) implicitly captures both endogenous and exogenous contributions from medical technology in the residual, a_t.[52] Under this Basic FCG model, the full contribution of technology to spending growth is projected forward using a time trend as a proxy for technological change. This approach implies that the full contribution from technological change to health care spending growth will remain constant over time with respect to the other factors, and will remain consistent with the historical contribution to growth – even as the resources to pay for this care vary and as future increases in the health share of aggregate income predictably strain budget constraints.

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[51] Parameter estimates that attempt to hold technology constant generally rely on proxies; either a time trend, or some related variable such as patents or research expenditures.

[52] Technical Review Panel on the Medicare Trustees Reports, *Review of Assumptions and Methods of the Medicare Trustees' Financial Projections*, Centers for Medicare and Medicaid Services (formerly Health Care Financing Administration), December 2000.

As discussed above, the actual contribution to growth from medical technology can be expected to be influenced by national income levels. We define changes in spending on new medical technologies that occur in response to changes in income as the income-technology interaction effect and modify the FCG model equation to explicitly project these effects.

The Modified FCG model shown in equation (2) below addresses the issue of the interrelationship between income and medical technology. We separately estimate the elasticity that captures the relationship between health care spending and real per capita GDP (as a proxy for average income) to capture the endogenous contribution from technological change. The estimation of this modified "income-technology" elasticity is discussed in detail in the section below. After incorporating this new income-technology elasticity into equation (2), the resulting residual then encompasses the exogenous contribution to growth from technological change (as well as the effects of all omitted variables and measurement error).

$$(2) \quad h_t = a'_t + \varepsilon'_y y_t + \varepsilon_i i_t + (1 + \varepsilon_p) p_t + d_t$$

where ε'_y is defined as the combined "income-technology elasticity". It is equal to $\varepsilon_y + a(y_t)$ from equation (1), where $a(y_t)$ is variation in the residual that can be explained as a function of real per capita GDP. The estimation of ε'_y is discussed below. The modified residual a'_t is defined to capture both changes in the state of medical knowledge that are independent of variation in income, as well as the net effect of measurement issues and omissions. Ultimately, the Modified FCG Model in equation (2) is the final version of the FCG model and is the basis for the projection of growth rates for the long-range projection for the 2020 Trustees Report.

A substantial part of the explanatory power of the FCG model for growth in national health spending per capita relies on the relationship to aggregate income. This can be understood as the responsiveness of health spending to budget constraints. One part of such responsiveness to budget constraints can be conceptualized as endogenous institutional change. Institutional change is one form of mediating mechanism that allows health care spending to respond to changes in real per capita GDP that define the budget constraint above the out-of-pocket threshold where the effective price to the consumer is at or close to zero. Historically, much of this institutional change involves changes in the nature of insurance coverage and payment methods that alter the incentives facing providers and thus influence both utilization and spending. Thus, to the extent that institutional cost-saving spillovers from care management initiatives in the commercial market (including Medicare Advantage) influence traditional Medicare spending, this effect can be seen as a form of endogenous institutional change. This effect will be implicitly captured in the income-technology parameter of the Modified FCG model.[53] In addition, we would expect part of this institutional effect to also be captured in the residual from the FCG model, to the extent that advancement in medical knowledge is a function of the nature of institutions.

[53] For a discussion of treatment of spillover effects in the context of the Factors Model by the 2016 Medicare Technical Panel, see Frakt, Austin, "Medicare Advantage to Traditional Medicare Spillovers: Draft Recommendations", February 1, 2017 (https://aspe.hhs.gov)

2. Estimation of FCG model parameters

Income-Technology Elasticity

Current OACT research on the income-technology elasticity implies that the combined contribution of income and new medical technology accounts for an estimated 75 percent of constant dollar per capita health spending growth over the period from 1980-2018.[54] Thus, the elasticity of real per capita health care spending with respect to income and technological change is a critical parameter in the FCG Model.

A substantial empirical literature addresses the relationship between health care spending and real per capita GDP.[55] This relationship has long been recognized as a strong and consistent empirical regularity in cross-country time-series data. Variations in real per capita GDP across countries and time can predict a large part of the variation in real per capita health spending. Higher income countries tend to introduce new technologies earlier and to encourage broad diffusion into standards of medical practice.[56] However, this literature does not generally treat technology as an endogenous factor contributing to growth in health care spending. Rather, in a plurality of studies that estimate an income elasticity, medical technology is assumed (implicitly or explicitly) to be an exogenous variable.[57] Many models used to estimate an income elasticity at the aggregate level use pooled data across countries and time and commonly control for variation across both countries and time by including fixed effects (dummy variables) for each country and time period in the sample. Given that technology changes over time, but not across countries within a single time period, its effect is assumed to be subsumed within the estimated fixed effects by time period.

Equation (3) below shows a specification that is similar to those commonly used for the estimation of the aggregate income elasticity. Aggregate national spending on health care is represented as a function of real per capita GDP, and 2-way fixed effects (dummy variables) that capture variation that is constant across all countries in the sample over time (time-period fixed effects) and variation that is constant for each country in the sample across all time period (country fixed effects).

$$(3)\quad \ln\left(\frac{\frac{h_t}{p_t}}{n_t}\right) = \alpha + \beta \ln\left(\frac{\frac{y_t}{p_t}}{n_t}\right) + \sum_{c=0}^{I} c_i + \sum_{t=0}^{T} z_t + \varepsilon_{it}$$

[54] This estimate is based on the mean estimate of the income-technology elasticity over the period 1980-2018, obtained using an extrapolation of the income-technology elasticity.

[55] S.H.Nghiem and L.B.Connelly. "Convergence and determinants of health expenditures in OECD countries", *Health Economics Review*. 2017; 7:29

[56] Moïse, Pierre, "The Heart of the Health Care System: Summary of the Ischaemic Heart Disease Part of the OECD Ageing-Related Diseases Study," in *A Disease-based Comparison of Health Systems: What is Best and at What Cost?,* Organisation for Economic Co-operation and Development, 2003: 27-52.

[57] This choice largely reflects the difficulty of defining a variable that represents the state of medical technology; while there have been attempts to develop a proxy for this concept (e.g. R&D, patents), these proxies cannot address important issues such as the presence of long and variable lags in the relationship between R&D and health care spending, or the fact that many important innovations are not patented (e.g. medical procedures).

α = constant term
h_t = nominal health care spending converted to US dollars based on purchasing power parities
y_t = nominal GDP converted to US dollars based on purchasing power parities
p_t = GDP deflator
n_t = population
β = coefficient on real per capita income (income elasticity)
I = number of countries in pool
T = number of years in sample
z = fixed effect for each year t in the sample
c = fixed effect for each country i in the sample
ε_{it} = error term.

Current estimates of the income-technology elasticity are based on a specification that is similar to equation 3 but with the difference that time period fixed effects are excluded from the model (see equation 4 below). The income-technology elasticity incorporated in the FCG Model is based on the estimation of equation (4) based on pooled cross-country time-series OECD data for 20 countries.[58] Spending and income are defined in constant dollar per capita terms and deflated based on the GDP deflator. Currency conversion to U.S. dollars is based on purchasing power parities.[59]

$$(4) \quad \ln\left(\frac{\frac{h_{it}}{p_t}}{n_{it}}\right) = \alpha + \beta' \ln\left(\frac{\frac{y_{it}}{p_t}}{n_{it}}\right) + \sum_{c=0}^{I} c_i + \varepsilon_{it}$$

h_t = nominal health care spending converted to US dollars based on purchasing power parities
y_t= nominal GDP converted to US dollars based on purchasing power parities
p_t = GDP deflator
n_t = population
α = constant term
β' = coefficient on real per capita income (income-technology elasticity)
I = number of countries in pool (20)
t = year
c = fixed effect for each country i in the sample
ε_{it} = error term.

The exclusion of fixed effects by time period in equation (4) effectively means that we assume that a shared time trend across the countries in our sample is acting as a proxy for technological change. Time-period fixed effects tend to be positively correlated with growth in real per capita GDP. This implies that the coefficient β' on real per capita GDP based on equation (4) is higher than the coefficient β from equation (3). The coefficient β' is conceptually comparable to the elasticity ε'_y

[58] Countries in the sample include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States

[59] Source: Organization for Economic Co-operation and Development (2014), "*OECD Health Data*", OECD Health Statistics (database).

from equation (2). The difference between β' and β is assumed to be attributable to a positive interaction effect between technological change and income growth.

Change in the income-technology elasticity over time

The income-technology elasticity is assumed to change over the projection interval and the historical rate of change over time is estimated empirically. Accounting for potential changes in key model parameters is necessary in the FCG model given the 75-year length of the projections. As the health share of the economy rises over time, sensitivities to changes in price and income are also anticipated to change.

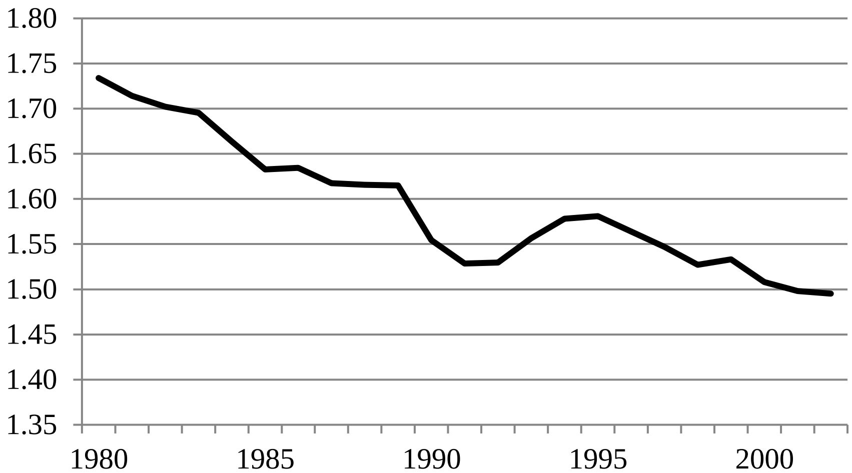
The change in the elasticity in the historical data is determined by estimating the model specification in equation (4) over a series of rolling 21-year sample intervals (within the full data sample).[60] The model in equation (4) was estimated for 21-year sample intervals, starting with 1970-1990, and incrementing the start and end date of the sample by a single year through the final sample interval of 1992-2012.[61] The estimated elasticity based on each of these sample intervals was attributed to the 11th year (the midpoint) of the 21-year sample, resulting in a time series for the income-technology elasticity for the period from 1980 through 2002.

The results of this estimation show a systematic decline in the income-technology over the period from 1970 through 2012. The rate at which the elasticity declines tends to slow down over time. The time-series shown in Figure A.1 provides an estimate of the historical change in the income-technology elasticity over the period 1980-2002. This time series is used as the basis to evaluate the appropriate assumption for the income-technology elasticity over the 75-year projection interval. This greatly strengthens the empirical basis for the long-term assumption for this parameter. However, a substantial degree of uncertainty continues to be associated with the projection, as the historical interval represented by the series (1970-2012) is fairly short in comparison with the projection interval (75 years) and the estimates remain at least somewhat sensitive to issues of data and sample selection. Conceptually, this downward trend captures, in part, the impacts on health spending associated with the influence on technology from endogenous institutional change.

[60] An alternative method of estimating change in the income-technology elasticity (β')would be to include an interaction term between $\beta'$and some function of a time trend. We chose to estimate the change in this parameter based on rolling regression to avoid imposing a functional form on the path of change. This becomes relevant when we consider the projection of the elasticity over the 75-year projection interval, as the difference between (for example) a liner and a log-linear time trend implies a large difference in the long-term assumption.

[61] Historical estimation of model parameters is updated at multiyear intervals to avoid frequent changes in model assumptions that could reflect temporary cyclical fluctuations in economic conditions.

Figure A.1. —Income-technology Elasticity Estimates, 1980-2002



Relative medical price inflation

Data sources for medical prices are consistent with those used in the National Health Expenditure Accounts (NHEA).[62] The price measure for total personal health care spending is a chain-weighted deflator based on relevant Producer Price Indexes (PPI) and Consumer Price Indexes (CPI), with the weight for each index set equal to the share of personal health care expenditures accounted for by that type of service.

The historical estimate of the aggregate price elasticity (−0.4) is based on the estimate in the OACTS's NHE Projections Model.[63] This elasticity exceeds the out-of-pocket price elasticity of −0.2 estimated based on the Rand Health Insurance Experiment (HIE).[64] This higher price elasticity at the aggregate level reflects the broader definition of the elasticity, which includes price sensitivity at the market level in addition to the price effects for households in response to variations in the effective out-of-pocket price that are the basis for the HIE elasticity. Additional price sensitivity occurs at the point of purchase of private health insurance and in the process of selective contracting by insurers acting as agents for consumers.

Insurance coverage

The effects of insurance are defined based on the aggregate average out-of-pocket share of health expenditures. This definition is conceptually consistent with the elasticity based on the Rand HIE

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[62] See documentation of historical National Health Expenditures data, downloadable at https://www.cms.gov/files/document/definitions-sources-and-methods.pdf

[63] Centers for Medicare and Medicaid Services. "Projections of national health expenditures: methodology and model specification." Available from: http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/ProjectionsMethodology.pdf.

[64] Manning WG, Newhouse JP, Duan N, Keeler EB, Liebowitz A**.** Health insurance and the demand for medical care: evidence from a randomized experiment. *Am Econ* Rev. 1987;77(3):251-257.

(−0.2).[65] The estimation of this insurance elasticity was primarily cross-sectional based on variation in health care spending as a function of the generosity of insurance coverage across households at a point in time, so this elasticity effectively holds technology constant. This variable captures static effects of insurance coverage only. This includes the increased utilization of current medical technologies in response to reduced out-of-pocket price. However, this effect would exclude any dynamic effects of insurance coverage on the development of new medical technologies. Dynamic interaction effects between insurance and technology are in theory included in the residual (a'_t). There is also the potential for three-way interaction effects among the contributions of insurance with both income and technology effects that cannot be separated out based on our estimation methods. This suggests that some part of the dynamic effects of insurance coverage may also be captured in the income-technology contribution.

Demographic change

The current FCG model accounts for demographic factors from the change in the composition of the population by age cohort and proximity to death. In prior years, demographic impacts reflected the effects from the changing distribution of the population by age over the long run projection period. However, for the 2020 Trustees Report and in the current FCG model, these effects are inclusive not only of the changing distribution of the population by age but also the population's proximity to death by age cohort, which is referred to as a time-to-death (TTD) adjustment.[66] The TTD adjustment reflects the fact that the closer an individual is to death, the higher his or her health care spending is. Thus, as mortality rates improve and a smaller portion of the population is likely to die at any given age, the effect of individuals getting older and spending more on health care is partially offset, as people farther away from death exhibit per capita spending health spending that is lower.

The adjustment for the effects of shifts by TTD controls for variation in spending between survivors and decedents. The estimated effect for this population rests on a key assumptions that the base year spending in the final year of life for the under-65 population can be reasonably assumed to be equal to that for the youngest age cohort within the Medicare aged population (ages 65 to 69 years). This broad assumption rests on analysis by French et al (2017), and is necessitated by the lack of specific data on the distribution of spending by TTD for the under-65 population in the United States.[67]

The effects of shifts in the population across age and proximity to death cohorts are estimated based on the historical and projected population cohorts over time prepared by the SSA Office of the Chief Actuary on behalf of the Board of Trustees, combined with a base-year distribution of expenditures across age groups and Medicare program data for the population over 65 years of age. The application of base-year weights to projections of population cohorts produces an

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[65] Newhouse J, Health Insurance Experiment Group. *Free for All? Lessons from the RAND Health Insurance Experiment*. Cambridge (MA): Harvard University Press; 1993.

[66] More information on the time-to-death adjustment is available at https://www.cms.gov/files/document/incorporation-time-death-medicare-demographic-assumptions.pdf.

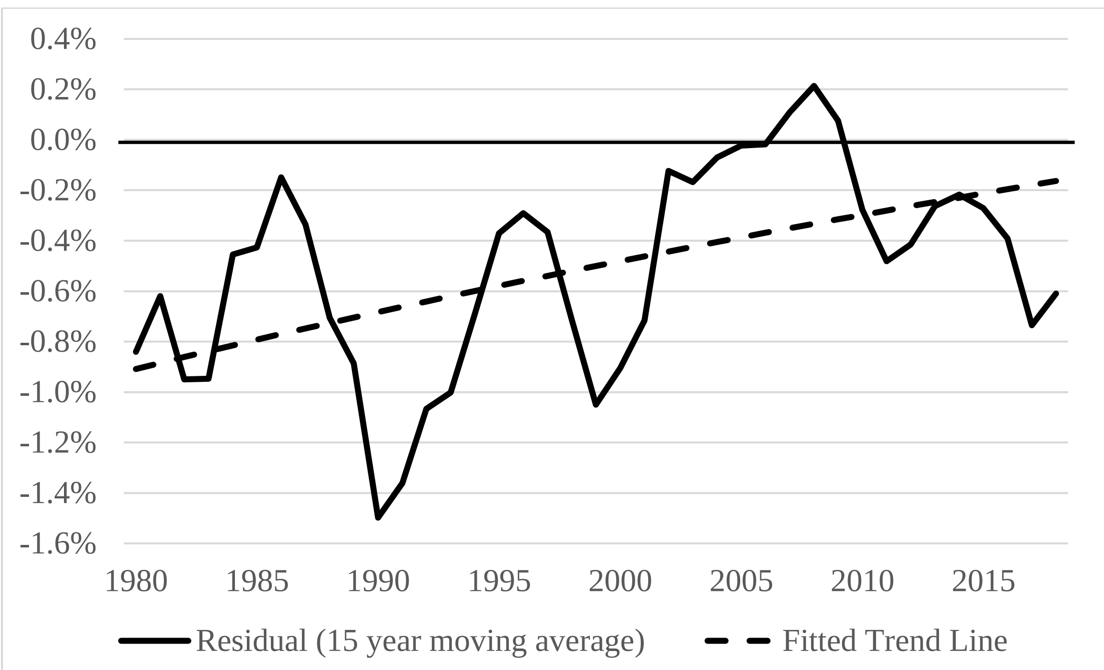
[67] French E, McCauley J, Aragon M, Bakx P, Chalkley M, Chen S, Christensen B, et al. End-of-life medical spending in last twelve months of life is lower than previously reported. Health Aff. (Millwood). 2017; 36(7): 1211–1217

index of growth in health spending that will result from shifts across these cohorts.[68] This methodology assumes that the distribution of expenditures does not change over time in response to changes in the distribution of population across age and TTD cohorts.

Model residual

The model residual captures all variation that is not explicitly explained by other variables in the model. If all factors contributing to growth in health care spending are fully accounted for and accurately measured, then theory implies that the contribution from the residual should be equal to the exogenous effect on health care spending of technological change.[69] Even when every assumption is carefully considered and empirically based, a great deal of uncertainty is reflected in the residual, and the source and relative importance of this uncertainty are impossible to fully determine. Historically, the contribution to growth in real per capita NHE from the Modified FCG Model residual a'_t exhibits extreme volatility. We use a 15-year moving-average to smooth the time series so that we can better evaluate the path of this contribution over time (Figure A.2. below).

Figure A.2. —FCG Model Residual with Fitted Trend Line, 1980-2018



[68] *2020 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds*, https://www.cms.gov/files/document/2020-medicare-trustees-report.pdf

[69] As a practical matter, measurement of the contribution to spending growth from other factors is unavoidably subject to error (both in underlying data and in model parameters), the effect of such errors, and the effects of any omitted variables. Consequently, such factors are thus also included in the residual.

Historical parameter assumptions

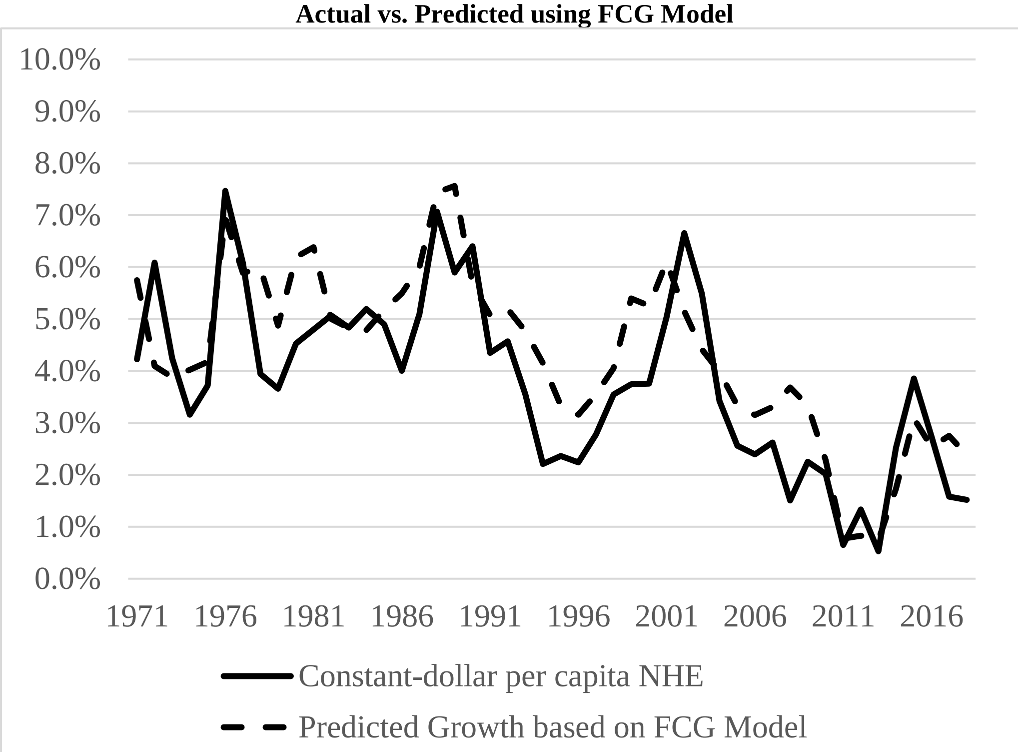
Table A.1.—Historical Elasticities Based on the FCG model

	Equation (2) variable	Historical estimate
Income-technology elasticity	ε'_y	1.5-1.7
Insurance elasticity*	ε_i	−0.2
Relative medical price elasticity	ε_p	−0.4

*Reflects the static impact of insurance coverage

Table A.1. shows the historical elasticity estimates that are used in equation (2) to explain a large part of historical growth in health spending over the period from 1970 through 2018, as shown in Figure A.3. below.[70]

Figure A.3.—Growth in Constant Dollar Per Capita NHE, 1970-2018
Actual vs. Predicted using FCG Model



*The predicted values as shown in Figure A.3. also control for a substantial lag in the relationship between health spending growth and income growth, by incorporating a five-year moving average of growth in real per capita GDP. Figure A.3. is not directly comparable with Figure A.2, because data shown in Figure A.2. are based on a 15-year moving average, while data in Figure A.3. are not.

[70] The predicted increases in real per capita health expenditures (Figure A.3.) include the estimated contribution from a combined income-technology effect, relative medical price inflation, insurance coverage, and demographic change.

3. FCG long-range projections model

Projections of health spending growth using the FCG model should be consistent with historical relationships between growth in health spending and the individual factors contributing to growth. However, a simple extrapolation of the historical relationships over 1960-2018 implies an increase in the health share of spending that would ultimately absorb all available economic resources. In the long run, if the health share of consumption continues to rise along its historical trajectory, economic theory suggests that consumer preferences will adjust to slow the rate of increase in the health share of GDP. This predicted change in consumer preferences implies that the parameters in the FCG model can be expected to change over time. Specifically, as health accounts for a rising share of consumption, we can expect to see rising sensitivity to relative medical prices (as represented by the price elasticity), and a declining tendency to further increase consumption of health care out of income at the margin (as represented by the income-technology elasticity).

In the discussion below we present the FCG parameter assumptions over the projection period, the exogenous parameter assumptions used to develop the FCG projections, and the results from the FCG model that were used in the 2020 Trustees Report.

FCG Parameter Assumptions

The elasticity assumptions in the FCG model determine the sensitivity of national health care expenditures to changes in each factor for the projection in the long-term (defined here as years 25 through 75 of the 75-year projection). As described above, economic theory suggests that as the health share of consumption rises substantially over the long-term, the elasticities that represent consumer preferences can be expected to change (see Table A.2. below). Specifically, we can expect consumers to become increasingly sensitive to the relative price of goods that account for a growing share of total consumption (implying a rising magnitude in the price elasticity). We can also expect to see a decline in the income-technology elasticity over time. An income-technology elasticity greater than one means that health spending will grow faster than GDP, in the absence of a change in other factors (such as price). Though the historical income-technology elasticity is estimated to be well above one, we can expect this parameter to gradually decline to one in a long-term equilibrium state so that non-health consumption is not crowded out by the continued rise in the health share.

Table A.2. below provides a summary of the key elasticity assumptions used for the FCG model in generating the growth in NHE applied in the 2020 Trustees Report.

Table A.2.—Elasticity Assumptions for FCG model: 2044-2094

Income-technology elasticity (ε_y')	Insurance Elasticity (ε_i)	Price elasticity (ε_p)
$1.25 \rightarrow 1.08$	-0.2	$-0.50 \rightarrow -0.56$

Income-technology elasticity assumption

To develop this assumption, we estimated the change in the historical income-technology elasticity over time based on cross-country time-series data from the OECD (as discussed above).[71] The resulting historical time series was then projected forward over the 75-year projection interval. A log-linear trend was fitted to the historical time series of the income-technology elasticity estimates as shown in equation (5) below.[72]

(5) $$\beta_t = \gamma + \delta' \ln(TREND(b)) + \varepsilon_t$$

TREND(b) = time trend such that TREND(b)=1, TREND(b+n) = 1+n, for n=1….30
b = base year for time trend
β_t = Income-technology elasticity estimates based on the rolling regressions with midpoint t
t = year representing the sample midpoint from the rolling regressions (t=1980….2002)
γ = constant term
δ = coefficient on trend variable

As the base year of the trend increases, the log of the trend increases in curvature. The coefficient was estimated based on this specification, which was selected by varying the base year of the time trend so as to maximize the adjusted R-Squared for equation (5).

The resulting actual versus predicted values for the income-technology elasticity, with the projection based on this model are shown below in Figure A.4.

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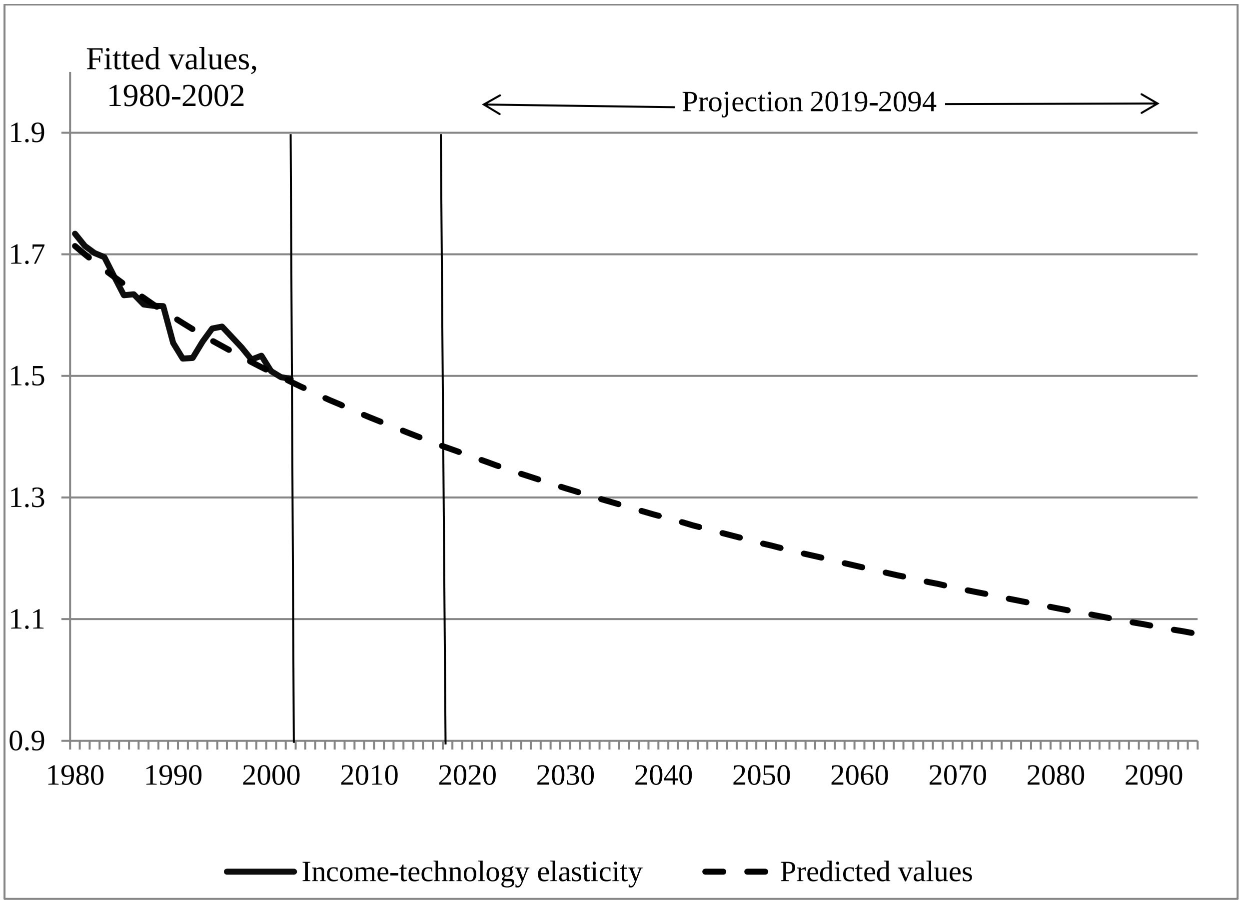
[71] Source: Organization for Economic Co-operation and Development (2014), "*OECD Health Data*", OECD Health Statistics (database).

[72] The use of a log-based time trend was selected following evaluation of alternative functional forms. The choice of a log-form implies that the rate of change in the income-technology elasticity will tend to slow over time. This pattern of change was consistent with the estimated historical time-series for the income-elasticity, and also tended to produce a more reasonable projection that levels out near a value of 1.0 in the long-term. In comparison, a linear time trend implies a constant rate of decline that ultimately reaches zero unreasonably fast (much sooner than the end of the 75-year projection).

Figure A.4.— Income-Technology Elasticity Estimates:
Historical Estimates and Projections for 2020 Trustees Report



Price elasticity assumptions

The price elasticity of demand for health care (ε_p) is inelastic over the history (estimated at -0.4), meaning that a one percentage point increase in medical prices relative to economy-wide prices is associated with a -0.4 percentage point reduction in real health care consumption. This also implies that the net impact of medical prices rising faster than economy-wide inflation on nominal health care spending growth is positive. Over the long-term, medical prices are projected to continue to grow faster than economy-wide prices, although the differential is expected to be smaller than has been the case historically. However, as discussed earlier, the magnitude of the price elasticity is expected to increase (in absolute value) as the share of consumption allocated to health care rises over time.[73]

The rationale for the increase in consumer price sensitivity (or magnitude of the price elasticity) implies that the price elasticity will be a function of the health share of GDP. This relationship is derived from the Slutsky equation (see Box 1). Within the FCG Model, this means that the price elasticity is endogenously determined, since the health share of GDP is a function of all of the

[73] Silberberg, Eugene, *The Structure of Economics: A Mathematical Analysis*, McGraw-Hill, 2000.

parameter assumption in equation (2). The effects of this endogeneity have been explicitly incorporated in the model.[74]

Box 1: Projecting the price elasticity of demand for health care as the health share of consumption rises

The Slutsky equation (in elasticity form) is an identity that decomposes the price elasticity into two components: a pure substitution effect and an income effect. The pure substitution effect is not observed—it is the change in demand in response to a change in the relative price of health care holding utility constant. The income effect occurs because a rise in price implies a lower income. That is, the greater the share of health care out of total consumption, and the higher the income elasticity, the larger will be the income component of the price effect:

$$\varepsilon_p = \varepsilon_p^c - s_h \varepsilon_y'$$

where ε_p is the observed price elasticity, ε_p^c is the compensated price elasticty (or pure substitution effect), s_h is the health spending share of total consumption, and ε_y' is the income-technology elasticity.

Given assumptions of price and income elasticities and historical data on the health share of consumption, we can back out the unobserved pure substitution effect (compensated price elasticity). If in 2013 the observed price elasticity is −0.4, the income-technology elasticity (including interaction effects) is 1.4, and the health share of GDP is 17 percent, then the compensated price elasticity is estimated at −0.2 (calculated as −0.4 + 0.17×1.4).

We assume that the compensated elasticity remains constant at −0.2 over time as the pure substitution effect is not affected as the health share of consumption changes. We can combine this constant with preliminary projections for the health share of consumption and the assumed income-technology elasticity over time to impute the rise in the total price elasticity that is consistent with the rising share of health care spending.

Note that the health share of GDP will be influenced by the projected price elasticity. This means that the system will be simultaneous by nature. However, we can approach an answer that is fairly stable by iterating between the projections based on the FCG model and the relationship between elasticities in the Slutsky equation. The resulting estimate for the price elasticity (ε_p) in year 75 is −0.6 (which is determined by −0.6 = −0.2 − 0.33×1.1), as shown in table A.2.[75]

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[74] The endogeneity of the price elasticity and the health share of GDP effectively require a simultaneous model solution. We approximate this result by solving the model iteratively for the price elasticity and the health share, and then resolving the model until both concepts converge to an internally consistent solution.

[75] Estimate is calculated using the health share of GDP under the Illustrative Alternative Scenario.

FCG Model Residual Assumptions

The residual expenditure growth (a'_t) estimated from the historical predictions of the Modified FCG model in equation (2) is highly volatile. The mean for this residual series has a value less than zero over the 1980-2018 period, but exhibits an upward trend.

Though the historical residual makes a negative contribution to spending growth, empirical case-study evidence implies a probable positive impact on health care spending from new technology (based on the relative cost of new treatment options in comparison with previous best practice).[76] Thus the observed negative impact from the residual is believed to be attributable not to cost-decreasing technological change but to a combination of unavoidable measurement error and possible omitted variables in the model. On balance, the contribution to growth in health care from other factors included in the model may be overestimated (for example, measurement of medical price inflation is a probable issue).

The current assumption for the future contribution to growth from the FCG model residual consists of two parts: an extrapolation of the historical contribution to growth over the short to intermediate term projections horizon (10 to 25 years), and an ultimate steady-state target contribution to growth that applies over the long-term projections horizon (26 to 75 years).

The extrapolation of the time-series reflects a log-linear trend fitted to historical data from 1980-2018. Though the mean contribution to growth in NHE from the residual is a net negative, there is a positive trend in the residual. The projected contribution from the residual based on the fitted log-linear trend reaches zero in approximately 10 years.

After the 25th year of the projection, the contribution of the residual to spending growth is assumed to be zero due to several factors. First, we cannot reasonably predict on an a priori basis whether new medical treatments developed in the future will tend to increase or decrease costs relative to existing treatment options. It is plausible that the nature of technological change (cost-increasing or cost-decreasing) could be a function of systemic factors, as innovators respond to incentives inherent in public and private insurance that influence expected returns on investment.[77] Collectively, empirical evidence suggests the exogenous component of technological change may be small, while theory suggests the future effects are unknown with incentives pushing in both the cost-increasing and cost-decreasing directions. Second, an extrapolation of the historical trend based on the observed residual throughout the 75-year projection would imply a positive contribution to growth over the longterm. Given that the historical contribution to growth is almost uniformly negative, such an extrapolation would suggest a higher level of confidence in the estimated trend than could reasonably by justified given the degree of uncertainty. Consequently, it seems reasonable to assume from both perspectives that the contribution to spending growth from the exogenous component of technological change may not be substantively different than zero.

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[76] K. J. Hult, S. Jaffe, T. J. Philipson. "How Does Technological Change Affect Quality-Adjusted Prices in Health Care? Systematic Evidence from Thousands of Innovations", Working Paper Series: Health Economics Series. No. 2016-29.

[77] Weisbrod, B.A. "The Health Care Quadrilemma: An Essay on Technological Change, Insurance, Quality of Care, and Cost Containment," *Journal of Economic Literature*, June 1991, Vol. XXIX(2): 523-552.

Exogenous Assumptions

The key economic assumptions for per capita GDP and the GDP deflator are from the intermediate set of assumptions underlying the 2020 Social Security and Medicare Trustees Reports. The relative medical price inflation is determined based on long-range assumptions regarding growth in medical input prices and available evidence on achievable resource-based health sector productivity growth. As described in the main text of this memorandum, medical input prices are assumed to grow at roughly 3.2 percent per year. The GDP deflator is assumed to grow at 2.05 percent per year over the long run. Overall resource-based health sector productivity is assumed to grow at 0.4 percent per year by assuming hospital and physician productivity will grow at published historical rates (0.4 percent and 1.0 percent, respectively),[78] while all other provider categories, such as skilled nursing facilities, home health agencies, hospices, diagnostic laboratories, dialysis centers, ambulance companies, etc., will grow at zero, on average. Combining these assumptions produces a medical output price increase of 2.8 percent per year, which is 0.75 percentage point faster than the GDP deflator. Thus, the FCG model uses a relative medical price inflation assumption of 0.75 percent per year, which is consistent with research on productivity growth in medical care and long-term historical trends in the deflators for personal health care and GDP.[79]

Finally, it is assumed in the FCG model that the out-of-pocket share of national health expenditures remains unchanged over the projection period. This assumption reflects, in part, that the average cost sharing associated with the Medicare benefit is likely to remain stable over the long-range projection period under current law, including consideration of the effects of supplemental coverage through private Medigap policies, Medicare Advantage plans, employer-sponsored retiree health plans, and Medicaid.

Results

The FCG model output was used to determine the year-by-year growth rates for overall national health spending and volume and intensity in the 2020 Trustees Report. Figure A.5. below shows the excess cost growth rates from the FCG model based on the methods and assumptions described above. As noted in the main body of this memorandum, the volume and intensity growth rates from the FCG model were used with the Medicare-specific payment rate updates under current law and anticipated impacts on volume and intensity from the ACA to obtain the projected increases in Medicare expenditures per beneficiary by type of service.

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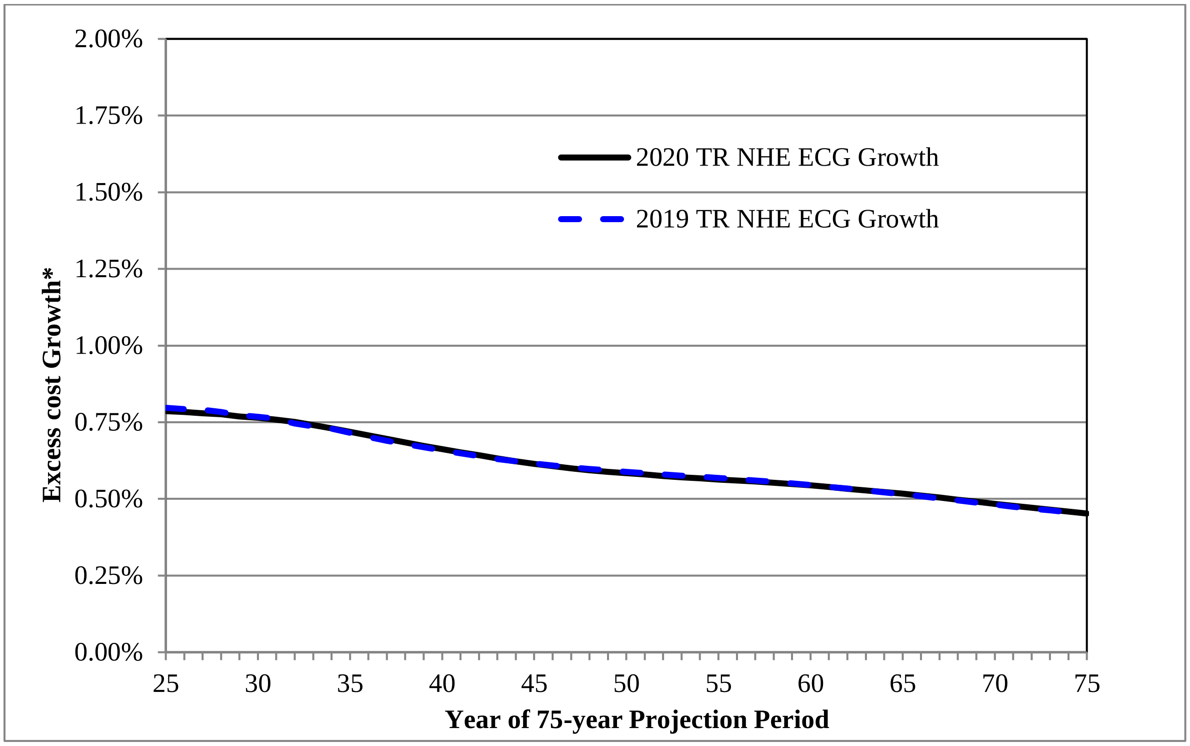
[78] Information on updated estimates of hospital productivity is available at https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/ProductivityMemo2016.pdf. Estimates of physician productivity are available here: Charles Fisher, "Multifactor productivity in physicians' offices: An exploratory analysis," *Health Care Financing Review*, Volume: 29, Issue: 2, 2008. p. 15-32.

[79] CMS, Office of the Actuary, *National Health Expenditure Accounts:* http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html.

Figure A.5.—Long-Range NHE Excess Cost Growth* based on the FCG Model



Source: Centers for Medicare & Medicaid Services, Office of the Actuary.
*Excess Cost Growth is defined as growth in per capita, health spending adjusted for demographics less growth per capita GDP.