Getzen Model of Long-Run Medical Cost Trends

Technical Manual

October 2018

Getzen Model of Long-Run Medical Cost Trends

Technical Manual

AUTHOR Thomas A. Getzen

SPONSOR Society of Actuaries

Caveat and Disclaimer

The opinions expressed and conclusions reached by the authors are their own and do not represent any official position or opinion of the Society of Actuaries or its members. The Society of Actuaries makes no representation or warranty to the accuracy of the information

Technical Manual for
Getzen Model of Long-run Medical Cost Trends
revised 10 October 2018

I. INTRODUCTION:

USER INPUTS

The Getzen model is available on the SOA research website as an excel spreadsheet with four tabs (pages).

1) **Intro Page:** *Read only*. Basic brief information guide for users.
2) **Input Page:** Any changes to defaults made by user are done in the light blue cells on this page. Baseline values (in grey) are fixed and will not change. Use the discussion in the annual update document to inform user modifications of expected values for these inputs.
3) **Output Page:** *Users make no changes on this page, automatically recalculates if new user inputs are made*. Shows baseline and revised values for total medical cost increase percentage projected for next 80 years, as well as decomposition in per capita income growth, and excess medical cost (share) growth.
4) **Projection Matrix Page:** This is the page where all the formulas reside and calculations are made. There are links to the input page values [light blue cells]. *Users should make no changes on the projection matrix*.

BACKGROUND

Originally developed in 2007 to estimate long-run liabilities for retiree health plans, the Getzen model has been used since then in a variety of other settings. Designed to make long-run forecasts of medical cost trends, the model is constructed in four parts:

Short-Run	:	**Blended**	:	**Long-run**	:	**Steady State** *(GDP+0%)*
(years 1 to 5)		*(years 6-9)*		*(years 10+)*		*(begins in 50 to 100 years)*

Many actuaries will want to rely on the baseline model to establish long-run trends, but customize short-run forecasts for the first 1 to 5 years to reflect the particulars of specific groups, benefit packages, regional markets, or provider networks, and use their information and actuarial skills to improve accuracy, coherence, and client acceptability.

This model, like the forecasts prepared by CMS for the Medicare Trustees and the CBO for Federal Budgeting purposes, makes a standard accounting decomposition that distinguishes the expansion in the health sector from general economic growth. Income, inflation, and technology (excess) growth are the main input parameters extrapolated from past trends and expected future developments.

% Trend in Medical Costs
===================
% real income growth
% inflation
% "excess" medical cost growth

Two other parameters, "**share resistance**" and "**year limit**", represent restrictions expected to bend the cost curve downward so that the trend eventually reaches a stable steady-state relationship with wage and income growth. The user wishing to make alternative projections can change these parameter values on the "input" page of the spreadsheet model.

The Getzen model is a tool to simplify the estimation process and provide a baseline for actuaries to work from, not a substitute for independent judgment. Hence, it is important for actuaries to understand not only how and why national trends develop, but also why they may differ substantially from premium and cost increases for specific groups or plans affected by local prices, regulations, contractual changes, and employee demographics.

This TECHNICAL MANUAL provides discussions of the model structure and each of the input variables in sections II and III; forecast accuracy in IV; historical context and long-run excess medical cost trends in V; business cycles and short-term fluctuations in VI; uncertainty and likelihood of a major trend break in VII; spreadsheet modifications in VIII, and ends with a brief summary listing major points. Notes, references, and appendices on the POG's opinion regarding the consistency of baseline model assumptions with Actuarial Standards of Practice and other topics are also provided at the end.

II. INPUT PARAMETERS

A starting point for discussions by the SOA project oversight group (POG) to arrive at consensus baseline estimates for each of the three main input parameters are 30-year averages and standard deviations in annual rates of increases for income, inflation, and excess cost growth due to technology. Two other parameters, "share resistance" and "year limit", represent restrictions expected to bend the cost curve downward so that the trend eventually reaches a stable steady-state relationship with wage and income growth. Users wishing to make alternative projections can change these parameter values on the "input" page of the spreadsheet model.

INCOME

Growth in medical spending is dependent upon growth in income and wages. It is usually not possible for health expenditures to double, or even to rise by 25%, without underlying growth in the economy. Furthermore, economic growth tends to push up wages of nurses, technicians, biomedical scientists, pharmaceutical representatives, and doctors, so that dollar expenditures rise even without any increase in service intensity or utilization.

Income data for prior years are obtained from the U.S. Bureau of Economic Analysis National Income and Product Accounts.[1] Annual growth of real per capita income (rpci) averaged 1.4% with a standard deviation of ±1.5% from 1988 to 2018. In making long-term forecasts, year-to-year fluctuations do not matter very much. The ten-year moving average of rpci has ranged from 0.5% to 3.5% since 1960. Future projections are obtained each year when the model is updated from the most current *Medicare Trustees Report* and the Congressional Budget Office *Economic Outlook* or *Long-term Budget Outlook* as well as the CMS Office of the Actuary *National Health Expenditure Projections* and other sources such as Blue-Chip economic forecasts and the Federal Reserve Bank of Philadelphia *Survey of Professional Forecasters*.

INFLATION

The average rate of inflation from 1988 to 2018 was 2.1% with a standard deviation of 0.8%. The ten-year moving average has varied from 1.6% to 7.5% since 1960. The BEA deflator series is used to measure inflation in prior years. For future years, the CBO, CMS, and other sources used to project real income are also relied upon for inflation, along with the differential in rates between 30-year Treasury Bonds and 30-year TIPS. However, inflation is much more volatile, uncertain, and generally more difficult to estimate beyond a two- or three-year horizon. In practice, this difficulty is not very problematic since inflation changes the reported nominal rate of increase in health spending but does not materially change the health share of GDP or health benefits as a percentage of employee compensation. Inflation is best considered as a scaling factor that affects reported dollar amounts but not real resource use. There are many different measures of monthly and annual inflation, although, they must all converge over the long-run. The GDP deflator is chosen here because it is the most inclusive and maintains consistency between nominal and real measures of reported income growth. There is no generally accepted meaningful measure of "medical inflation" as distinct from the regular inflation measures such as the CPI (the existing "medical price indexes" are all known to have serious flaws that render them almost useless in forecasting real trends over the long-run).[2]

TECHNOLOGY AND "EXCESS" MEDICAL COST GROWTH

Advances in medical technology are the primary reason for growth in the health sector above and beyond the rate of general economic growth. The average annual rate of excess medical cost increase from

1988 to 2018 was 1.7% with a standard deviation of 2.2%. The ten-year moving average has varied from 0.9% to 3.7% since 1960, based on data from the CMS Office of the Actuary National Health Expenditure Accounts.[3] Projections in the *Medicare Trustees Report* and the CBO Budget Outlook provide estimates of future annualized rates of excess medical cost increases either directly or indirectly by subtracting income and inflation from projections of nominal medical costs.

For a health actuary, the technology factor should be considered the most important element of a medical cost trend projection. Forecasting income and inflation should be left primarily to experts practicing in that arena, limiting the role of the health actuary to reviewing the available forecasts and then presenting a consensus value and range as a supporting part of the medical cost forecast. However, the rate of increase in the technology factor must be measured indirectly, as the difference between rates of growth in total health spending and total income (including inflation), or as the percentage increase in the health share of total income (which is mathematically identical).

% “excess” = % health spending growth - % income growth (including inflation)

= % growth in Health Share of GDP (Health$/Total GDP)

It is excess medical cost increases that expand the health share and create financial pressure. If costs went up by 35% and wages also went up by 35% there would be only minor adjustment problems. Liabilities rise faster than the ability to pay due to excess cost increases. Prior to 1960 the share increase appears to have been very slow—certainly less than +1% a year and usually closer to + ½%. Excess cost growth peaked in the 1970s and early 1980s and has drifted erratically downward since then (see Section V below). Many health futurists expect this downward trend to continue, bringing the long-run average below +1% in the coming decades.

SHARE RESISTANCE LEVEL and EXPECTED SHARE IN 10 YEARS

Share resistance implements the reasonable concern that there is, or may be, a level of spending that is high enough relative to income that it creates resistance to further increases, reducing the rate of excess medical cost growth. If the projected share exceeds the input for “share resistance level of GDP” (set at .250 in the baseline 2019 model), then the excess growth rate is reduced by a fraction equal to the square root of the difference ratio as seen in the equation below.

1 - [[(*Share* in year *xxxx*) – (Share Resistance Level)]^(1/2)]

The excess growth rate is reduced more and more each year after the actual share exceeds the specified resistance level, asymptotically approaching a 100% reduction (i.e., reducing the excess to 0 thus limiting projected future growth in medical costs to GDP+0%) as the share approaches twice the specified resistance level. This means that the projected share in the model can never exceed twice the specified resistance level. The input for “**expected share in ten years**” is based primarily on the projection made by the CMS Office of the Actuary, as modified by the POG, and forms the starting point for share values in all future years (set at .205 in the baseline 2019 update model). That is to say, it is fixed by the value in this input cell and projected shares for years 10+ are therefore independent of any input changes in short-run growth rates. The share resistance level may be modified by the user, but caution should be exercised in doing so. Furthermore, there is a “power factor” of 2.0 that is preset on the projection matrix of the spreadsheet so that resistance increases by the square root of the differential. While it is possible for an advanced user to put in a different power factor making the curve bend slower or faster, any such modification of the model should only be done with a thorough understanding of all the parameters and interactions within the model structure, as well as a thorough familiarity with the usual variance and fluctuations in health spending measures. It is more meaningful to change the resistance by adjusting the specified resistance level without modifying the power factor as the square root factor has been found to perform well at most levels.

Advanced users should consider doing a sensitivity analysis by varying the level of share resistance—exploring varying ideas of how much concern higher spending is apt to generate among employers and policy makers. For example, using the baseline 2019 version of the model, which has a technology factor excess growth rate of +1.2% per year, the baseline share resistance level of .250 would not begin to reduce excess growth until 2046 and would cut it by half (to 0.6%) in 2075. Specifying a resistance level of .300 means that resistance would not begin until 2061 and would cut excess growth by only about one-third in 2075 (to 0.8%). Conversely, specifying a resistance level of .200 would imply that resistance is already occurring in 2028, the first year of the long-run projection, and would cut excess growth rates in half before 2056. A very strong assumption of setting the resistance level at .150 implies resistance has already begun and that excess growth rates in the first year of the long-run projection (2028) would be reduced to less than half (0.5%) from the outset. More extreme assumptions can force the model to corner solutions and, hence, are not available from the spreadsheet drop-down menu. Setting the resistance level at .100 or less forces zero excess growth (constant share) after the first year of the long-run projection (2028), while specifying a level of .500 or above makes the resistance constraint have no effect on projections.

YEAR LIMIT

"Year Limit" imposes a restriction of zero excess growth after the specified limit, making the health share remain constant so that the growth in medical costs thereafter exactly matches the growth in incomes (including inflation). The year limit is phased in linearly over a ten-year period, hence, with a year limit of 2075 the projected excess growth rate is reduced by 1/10th in 2066, 2/10^{ths} in 2067, and so on, reducing the excess growth rate to zero in 2075 and thereafter.

III. Temporal Components of the Model

The model is constructed in four parts. The linkage, estimation, or extrapolation process for each part is distinct. The main focus of the Getzen model is the long-run trend for years 10+, which effectively becomes the fulcrum or gravitational center to which all of the other components link to and revolve around.

Short-Run :	Blended :	Long-run :	Steady State *(GDP+0%)*
(years 1 to 5)	*(years 6-9)*	*(years 10+)*	*(begins in 50 to 100 years)*

Currently there are three sources of forecasts of medical spending trends provided regularly and consistently each year, the CMS Office of the Actuary, the CBO, and the SOA.[4] While CMS, CBO, and SOA projections may differ in the specifics of estimating short-run growth rates for the next five or ten years, the length of the transition period, or the share of GDP ultimately consumed, they all have a similar four-part temporal structure and eventually end with a stable medical cost trend that exactly matches the rate of growth in GDP.

SHORT-RUN ESTIMATES FOR YEARS 1 TO 5

The forecasts for rates for years 1 to 5 are input directly by the user and may come from any suitable source. However, it is important that a long-run model have a neutral set of short and mid-term forecasts that can be used as a baseline. Determination of the baseline short-run forecasts begins with a purely technical extrapolation projecting growth rates equal to smoothed income (6-year MA for real per capita income, 3-year MA for inflation) + "excess" due to technology and other factors that accounts for expected business cycle fluctuations (discussed at more length in Section VI below), then adjusted to reach a consensus of the POG members regarding current conditions.

By construction, short-run increases for years 1 to 5 have no effect on the projected trend for years 10 and after. Local conditions and contract characteristics are apt to make cost estimates for specific groups over the next few years quite diverse, even though eventually all must converge toward the national trend in aggregate. Since short-term rates for specific groups may deviate substantially from the average national medical cost increases projected in this model, actuaries should consider additional information such as regional market competition, benefit design, demographics, incidence of high-cost diseases, known rate increases at the time the valuation is performed, legislative and regulatory changes, and/or other factors and provide documentation to justify expected short-term rates, and may even wish to consider values outside of the suggested ranges in some cases.

STEP-DOWN TRANSITION FOR YEARS 6 TO 9

Estimates for years 6 to 9 are a linear interpolation between the rates in year 5 and year 10. Each year one-fifth of the difference is added or subtracted to link the two rates.

LONG-RUN PROJECTIONS FOR YEARS 10+

Making the long-run projection for year 10 can be described very simply as *GDP+X%*, but also as a complex historical and path-dependent process deserving of the more lengthy discussion provided in Section V below. Income and inflation estimates for the coming decades are taken from the sources described above. Defining and describing excess cost growth is not so straightforward, even though the average values are likely to cluster in a fairly narrow range between 0.5% and 2.0%. Isolating the trend in excess cost growth from confounding factors requires analysis of total health expenditure accounting procedures and decomposition into component parts as well as a thorough understanding of financial and organizational developments over time.

VERY-LONG-RUN TRENDS: STABILITY, LIMITS AND DISRUPTION

The share restriction and year limit parameters give the model stability, implying an asymptotic steady-state growth rate that matches the rest of the economy (GDP+0%). Any continual increase or decrease would otherwise drive the model to project an ultimate health share of 0% or 100%. Users interested in results for twenty years or more should consider doing sensitivity analyses varying the share restriction and year limit parameters. Even more importantly, they should consider the possibility of "black swan" disruptions that significantly disrupt the financing of health care. Major shifts in medical organization and financing are rare, but are also inevitable if the time horizon is long enough. This issue is explored in more depth with some quantified speculation in Section VII.

IV. Accuracy and Uncertainty

Although there is not yet sufficient data to empirically determine the expected errors for this model ten or twenty years into the future, assessment of similar models over prior periods suggests that a cumulative range of uncertainty on the order of 1% per year (i.e., ±5.1% over five years or ±28.2% over 25 years) would be reasonable so long as there is no drastic change in underlying conditions or systems. Accuracy of the CMS OACT projections has been the subject of an internal CMS study of single-year projection errors that concluded that such errors were about ±1% on average. Subsequently, an external study of multi-year accuracy up to 10 years was conducted by Getzen and published in the *North American Actuarial Journal* concluding that the regular post-1990 CMS forecasts were more accurate than the sporadic earlier attempts in the 1980s, and that errors were minimized by projecting "shares" rather than nominal dollar amounts or absolute growth rates, with errors that compounded at about ±0.9%% per year.[5] Short-run accuracy depends upon many factors, and a local forecaster familiar with the details of particular benefit plan and local medical providers can fine-tune accordingly. Long-run accuracy, however, is almost entirely dependent upon the twin questions "by how much, and for how long, does the medical cost trend exceed the growth trend of income?" The baseline assumption in model v2019_a is "by +1.2% and gradually vanishing for about 40 years." Since there are no long-run forecast data from long ago that can be evaluated with actual results 50 years later under varying conditions, any confidence interval is necessarily speculative. That said, a range of +0.6% to +1.8% on average for the next 30 or 90 years probably provides an interval that should include actual future outcomes with a likelihood of at least 50%, if not 90%.

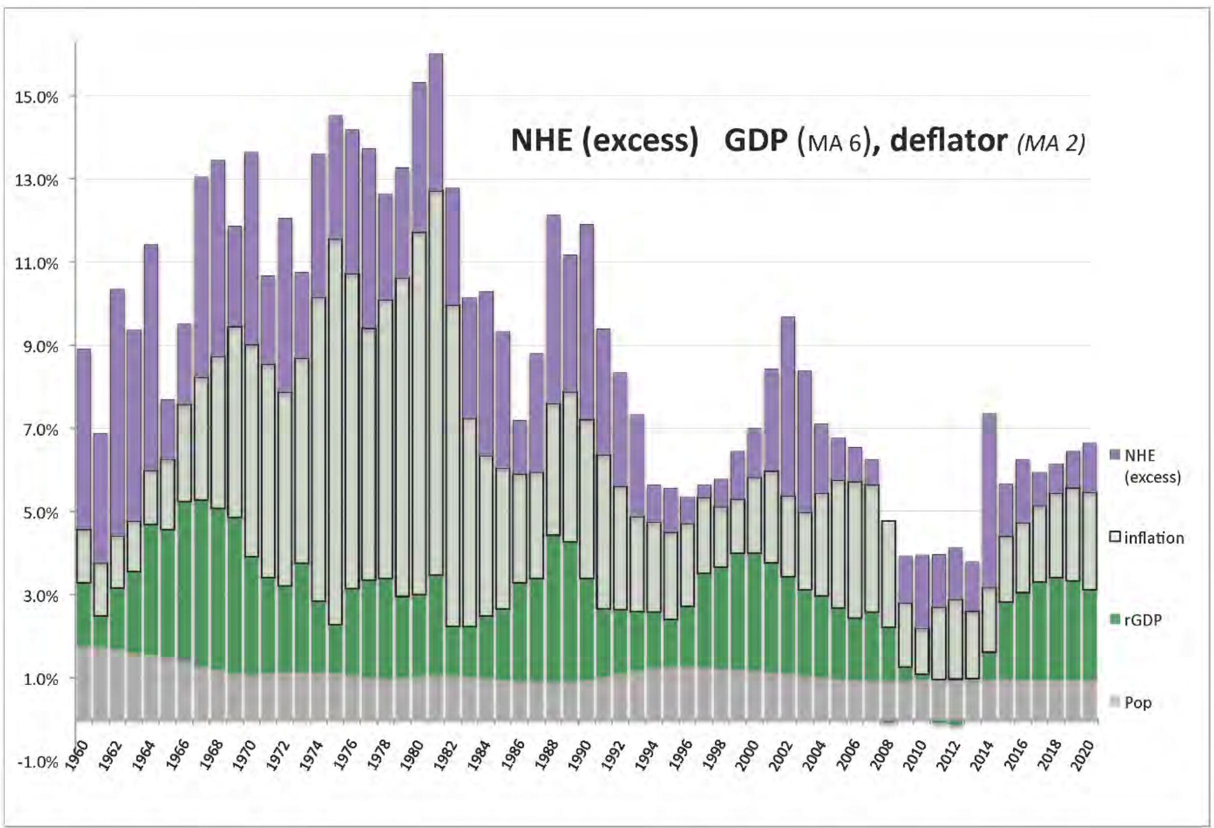
Uncertainty cannot be eliminated, but it is possible to narrow the range of plausible estimates, even when projecting decades into the future. To do so, it is necessary to recognize that the biggest sources of uncertainty regarding medical spending are future economic growth and the rate of technologically induced cost increases (or decreases); the first can be avoided by leaving the task of predicting economic growth to the Fed, or some macroeconomic forecaster, leaving the focus on "excess growth" as measured by the percentage increase in share (e.g., benefits relative to total compensation or wages, medical consumption relative to median household income, health share of GDP, etc.)[6] Excess cost growth has clearly moderated over the last 50 years, going from +3.5% in the 1960s and 1970s to averaging less than 1½% since 2005. However, there is little reason to expect that excess cost growth will disappear in the near future, just as it is unlikely that it will again soar to prior rates and double the size of the health sector of the economy in a decade.

V. Context and History

TREND COMPONENTS

The starting point for modeling the growth in medical costs is to decompose the historical trend into its components, as shown in Figure 1 and Table 1.[7] During the 90 years for which data are available (1929-2018) total medical costs for residents of the U.S. have increased from $3.7 billion to $3,675 billion, an average increase of 8.1% per year. Regular population increases have been responsible for over 1% of that growth, and inflation accounts for almost 3%. Real inflation-adjusted per capita incomes grew 2.1% a year, leaving 1.9% as the "excess" trend relative to regular economic growth (GDP). It was this excess growth that drove medical care to double, and double again, as a share of total consumption (4% of GDP before WWII to more than 16% after 2010).

Figure 1



The development of national health expenditure accounting, which now makes it possible to examine the growth of spending over almost 100 years, is reviewed in several of the sources listed among the references.[8] Having such a long time-series helps an actuary to grasp how often the medical system experiences major disruptions that reorganize and redirect financing. The frequency and magnitude of such tail risks for medical care spending is considered in Section VII. The fact that such an exercise inherently has speculative elements does not keep it from being worthwhile.

Table 1: Medical Cost Trends 1929-2018 - Total and by component, in decades

	1929-1940	1940-1950	1950-1960	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	2010-2018
Total National Health $	0.90%	12.20%	8.00%	10.60%	13.10%	11.00%	6.60%	6.60%	4.43%
"excess"/ Share of GDP	**1.20%**	**0.70%**	**1.80%**	**3.30%**	**2.50%**	**3.10%**	**1.00%**	**2.60%**	**0.46%**
real Income per capita	2.60%	2.50%	1.80%	3.00%	2.10%	2.40%	2.20%	0.70%	1.50%
inflation	-4%	7%	2%	2.70%	6.90%	4.20%	2.10%	2.10%	1.66%
population	0.80%	1.40%	1.70%	1.30%	1.10%	0.90%	1.20%	0.90%	0.74%

Sources: U.S. Census, Bureau of Economic Analysis, and CMS Office of the Actuary.

Mathematical equivalence of percentage growth in the health share of GDP with the percentage excess growth rate of per capita or total national health spending facilitates the making of measurements over the long-run.[9] Comparing health shares at any two points in time immediately reveals the rate of excess growth. If the shares are the same, there has been zero excess growth (i.e., the increase in medical costs was equaled by economic growth in GDP). This avoids the complexities, errors, and analytical inconvenience of making adjustments for exchange rates, inflation, population increase, and so on.

$$X_{\text{("excess" \% increase in Health \$)}} = S_{\text{(\% increase in Health Share of Total)}}$$

Regular economic growth, GDP, is the primary driver of all expenditures, including medical care. It determines the **budget**, how much is available to spend. Disproportionate increases in health insurance premiums, federal Medicare reimbursements, and state Medicaid payments can only occur if growth in medical expenses exceeds the growth in resources available to pay (wages, incomes, GDP). Excess growth demonstrates by exactly how much medical care is valued more than other items in the budget. It is the visible evidence of the *de facto* policies of the government, employers, and the public. It is this willingness to pay that matters more than the voluminous rhetoric about costs, bureaucratic waste, malpractice insurance, obesity, or new diseases.

The most common explanation for the expanding cost of medical care is the value of advances in medical technology. Unfortunately, the only available method to measure such "extra" value is to subtract regular growth from the medical cost trend; that is, to define technological growth as a residual, or "excess medical cost growth".

"Excess Medical Cost growth" = % (Medical Costs) - % (Income)

It may be intellectually unsatisfying or even seem misleading to take "the remainder" and label it as "technology," yet the same procedure is used to measure "productivity" and "technological growth" for GDP and other elements of the official NIPA accounts by the Federal Reserve Bank, CBO, and other government agencies or macroeconomists.

Medical costs cannot continue to grow faster than per capita incomes indefinitely, or else medical care would ultimately consume 100% of the budget. It is readily demonstrated mathematically that a weighted average of the percentage growth of spending across all items and categories (including savings) for the U.S. as a whole must sum to exactly 100%, so that growth of the total is constrained identically to *GDP+0%.* This logical necessity, that medical cost growth must in the long-run be brought back down to match the growth rate of wages and incomes, is incorporated into the Getzen model in the form of the **Share Resistance** and **Year Limit** parameters.

Many long-run forecasting models, including those used by the CBO, Social Security, and the CMS Office of the Actuary, incorporate some form of this constraint forcing future spending to eventually converge to *GDP+0%*. In the Getzen SOA model, the user can stipulate when this convergence is expected to occur (2075 in the baseline model). The model also allows a user to incorporate a common intuition that health spending at 10% or 15% or 20% of earnings may be fine, but that above some point (25% in the baseline model) additional excess growth will become increasingly problematic and subject to resistance from the tax-paying public, policy-makers, or employers. Both the year and resistance limits are plausible and conceptually sound, yet any specific value chosen for such limits is somewhat arbitrary and speculative, resting more on the validity of the theoretical constructs that bind spending rather than actual empirical evidence of the ability to control spending.

A BUDGETARY MODEL

The structure of the Getzen Model is budgetary: how much of the increase in income during the next period will be spent on health care rather than other goods and services? The base economic growth is subtracted to reveal the excess growth in health care. This expansionary trend is tracked over time and extrapolated into future decades. Treating the residual as single variable time series has performed well in practice with good forecast accuracy but does raise several issues. The first is one of timing: are expenditures in the observed period related to current income, or are some predetermined by financial obligations made in earlier periods? This issue of temporal dynamics is taken up in Section VI below. A second issue is categorical boundaries. The extent to which "health spending" includes expenditures on long-term care, nursing homes, home health, assisted living, or family support has, and probably always will be, somewhat ambiguous. Shifting the boundaries would create a discontinuous shift in trend. In forecasting percentage increases, "what" is included may be less important than assuring that the category boundary is stable over time. Boundary issues will always arise at the borderlines, especially with regard to mental health, rehabilitation, and nutrition. A third and potentially more intriguing issue is whether "excess cost" should be treated as a unitary variable measured by the residual and extrapolated as a single-variable time series, or are there other variables such as disease prevalence, demographics, drug patents, and so on that can meaningfully incorporated to improve trend forecasts?

The price of surgery, population aging, positron scans, patent expirations, influenza epidemics, coinsurance rates, regulation, hospital competition, taxes, legislation, and many other factors may also affect medical costs, yet the practical reality is that forecasters cannot reliably predict long-run changes in such variables a decade or more into the future, nor can they demonstrate empirically that such variables, no matter how important they may be for predicting individual expenditures, reliably affect average *national* medical costs per person over the long-run. Fifty years of research and hundreds of studies have confirmed just one consistent predictor of national health expenditures: per capita income. Everything else, even life expectancy and population aging, has become doubtful or faded into insignificance when studies are repeated in different conditions or time periods or are re-examined with careful accounting for the timing and variable lags of income effects (see "Business Cycles" in Section VI below). With no other predictor variables, it becomes an accounting identity that any difference between the rate of growth in income and the long-run medical cost trend must be attributed to this "excess medical cost" growth factor. The Getzen model, as well as the models used for official projections by the CBO, CMS Office of the Actuary, and SSI Trustees Report, all rely on the same basic formula for long-run cost projection, although, they differ substantially in detail and in short-run forecasts.

In the 1970s most analysts were still "certain" that national health expenditures could never sustainably exceed 10% of GDP, yet they were also afraid that the system would be stressed to a breaking point as inflation rapidly pushed hospital prices higher and older patients consumed ever larger quantities of care. The twin fears of inflation and aging seemed reasonable at that time. Annual increases in the consumer price index had exceeded 15% in the aftermath of the 1973 OPEC oil crises, Medicare had become the largest payer of hospital care, and nursing homes filled up faster than they could be built. Identifying inflation and aging as the main policy concerns along with usually unstated assumptions that quantity of services used by each narrowly defined age/sex group stayed constant or moved in some predictable way with health status as led to models of this form:

$$NHE = \sum (price) \times (quantity) \times (illness\ prevalence) \times (age/sex\ group)$$

Similar categorical multiplicative summation models were commonly used in demography, made sense, and could be estimated with available data, albeit not without a considerable amount of effort. Sadly, such categorical models for medical cost trends did not perform very well in practice. Making them more elaborate and detailed, with ever-finer categorizations of illness, age, or medical procedures, did not seem to help. The reasons that future spending trends were not being predicted very well by such categorical models based on prices and aging became evident in subsequent research.[10] It was determined that budgets and funding, rather than aging or illness or pricing power, determined the growth of health spending. Funding is ultimately dependent on tax revenues and consumer willingness to pay, both of which are driven by GDP. Hence, macro models focusing on GDP and budget constraints, even very simple ones, are able to improve accuracy and significantly outperform complex categorical ∑(price *x* age *x* illness) models that must rely on constancy within each cell.[11] After a period of testing in the 1980s, which led to models with large and growing errors, the CMS Office of the Actuary began in 1996 to incorporate distributed lag GDP macro budget constraints as a guide to total spending trends, with categorical breakdowns used more to allocate projected costs across multiple payers and providers than to determine aggregate totals. [12]

VI. Business Cycle Fluctuations, Inertia, and Lags

As the 2009 recession made clear, economic ups and downs create major short-run deviations from trend. The rate of increase in health spending fell precipitously—yet the share of GDP spent on health actually rose, from .164 to .174. This apparent reversal occurred because the health sector is inertial and responds very slowly to changing economic conditions. Differential lags alter the temporal alignment of income and medical spending, and thereby create econometric problems that obscure the strong (but inertial) link between medical costs and economic growth.

Most of the variation in annual growth rates is actually related to macroeconomic forces (inflation and GDP, R^2=.82), albeit with variable lags (**Figure 2**). However, **Figure** 3 shows that the concurrent (lag 0) association of growth rates in real income per capita and health expenditures is fairly weak (R^2=.08). **Figure 4** shows how much more visible the relationship becomes when income is lagged (R^2=.51). When the time trend and inflation lags are included along with the income lags, over 90% of the annual variation is accounted for. The mechanics of time series analysis and statistical packages can be quite complicated. However, most of the econometric benefits can be gained by using a simple smoothing process (a six-year moving average of real per capita income and a three-year moving average of inflation). Thus, it is better to compare the rates of growth in medical costs to “smoothed” income as in **Figure 5**, rather than to concurrent income.

Some markets, such as housing and finance, respond very quickly to future economic conditions, anticipating and amplifying business cycles. Health care is just the opposite, responding slowly and lagging behind so as to smooth and dampen cycles to the point that they become almost unnoticeable (unless the recession is very deep and sharp, as it was in 2009). It is not that health spending does not respond to GDP, it just responds slowly, taking three to six years to react to changes in inflation or real income. Indeed, there are some structural elements of the medical system (reimbursement formulas, Medicare, physician licensure, and supply) that reflect economic conditions from many decades ago when they were first put in place.

Business cycle fluctuations complicate and obfuscate the analysis of long-run medical cost trends. However, they are quite useful in forecasting short-run fluctuations. Using smoothed GDP growth trends as a base, it was fairly easy to predict in 2009 that there would be a significant upturn in medical costs three to five years after the recession ended (i.e., by 2015).

Short-run fluctuations are mostly irrelevant for long-run forecasts. They are noise that may obscure the long-run trend, but does not change it. Unfortunately, the public often reacts more to highly visible short-run fluctuations than the more important but almost imperceptible changes in trend. In 2011, for example, pundits began to comment on how low the increases in medical costs were, yet an analyst with a long-run view taking account of temporal dynamics would have noted that medical costs were still growing 1%-2% in excess of smoothed GDP and that employment in health care far outpaced that in the rest of the economy.

Figure 2

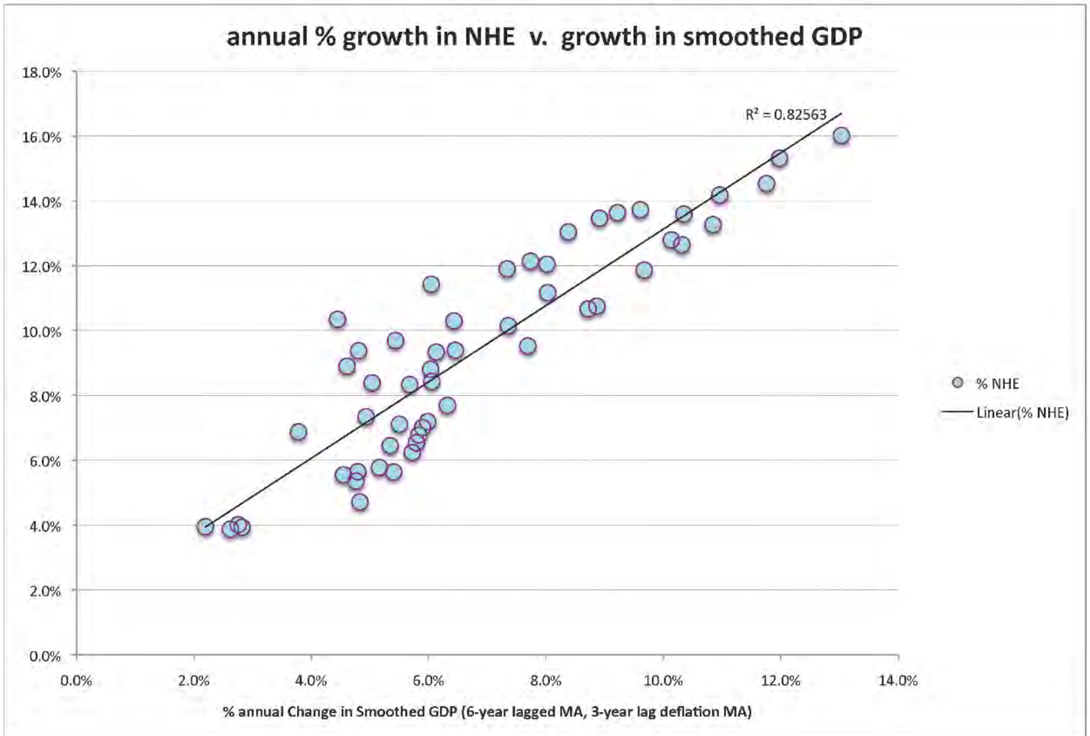


Figure 3

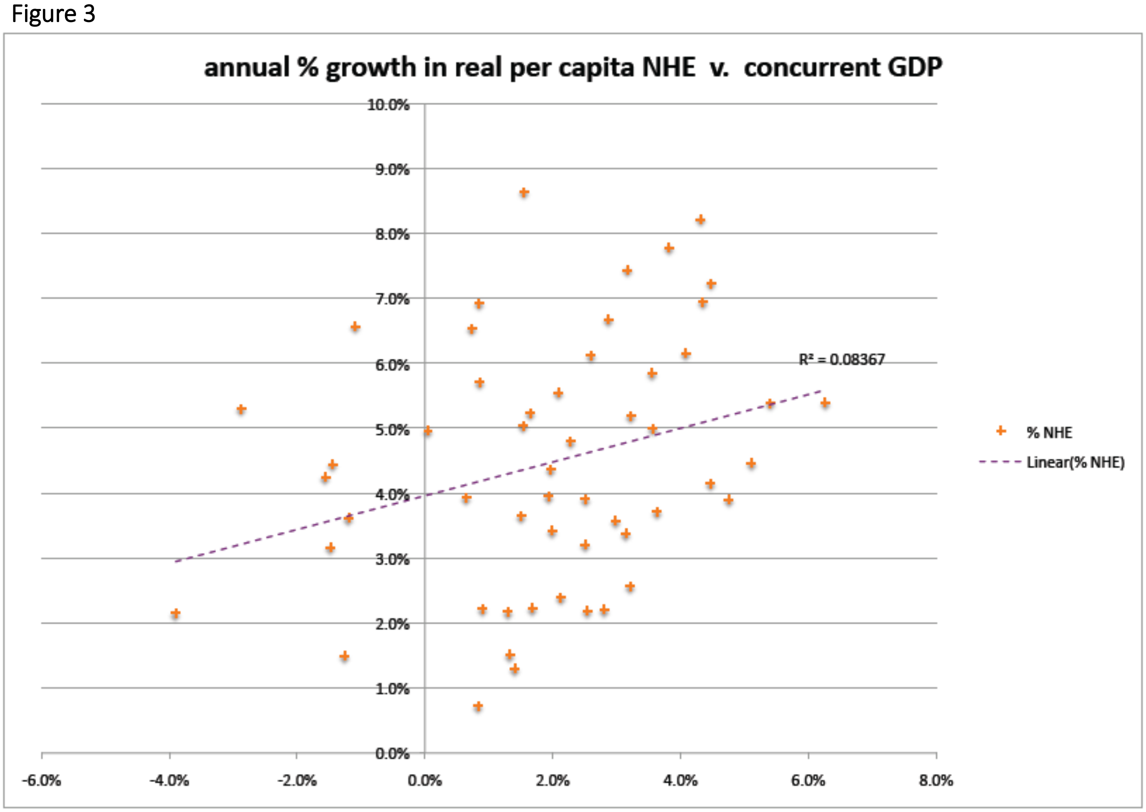


Figure 4

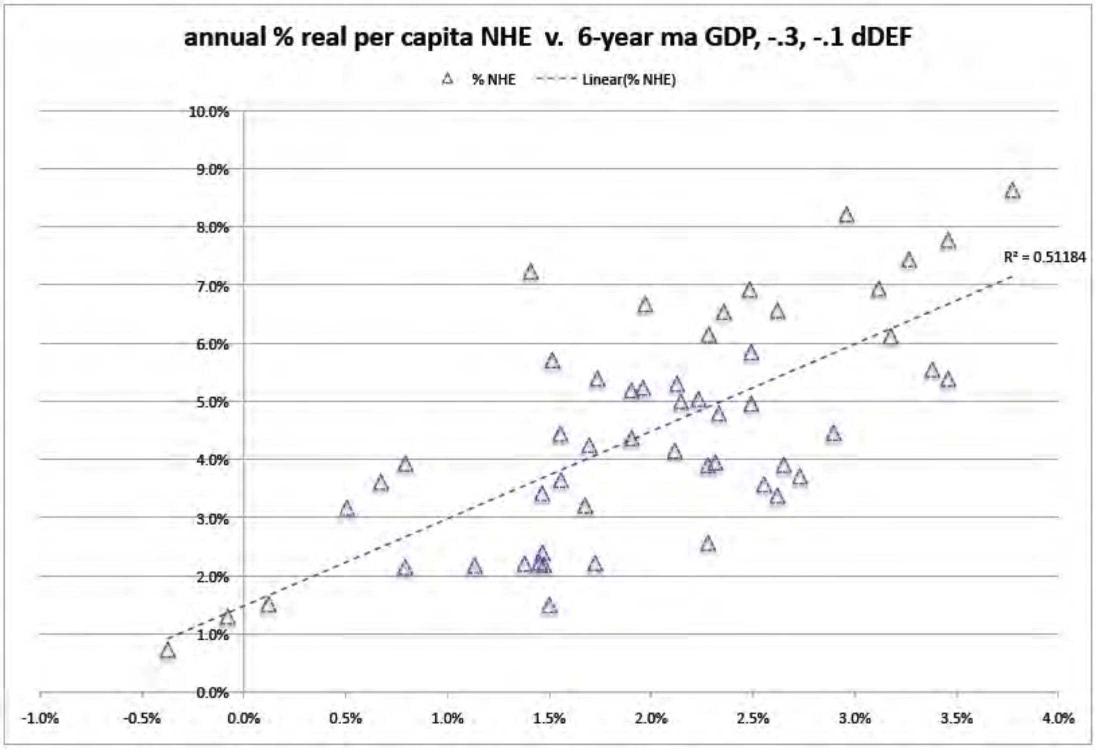
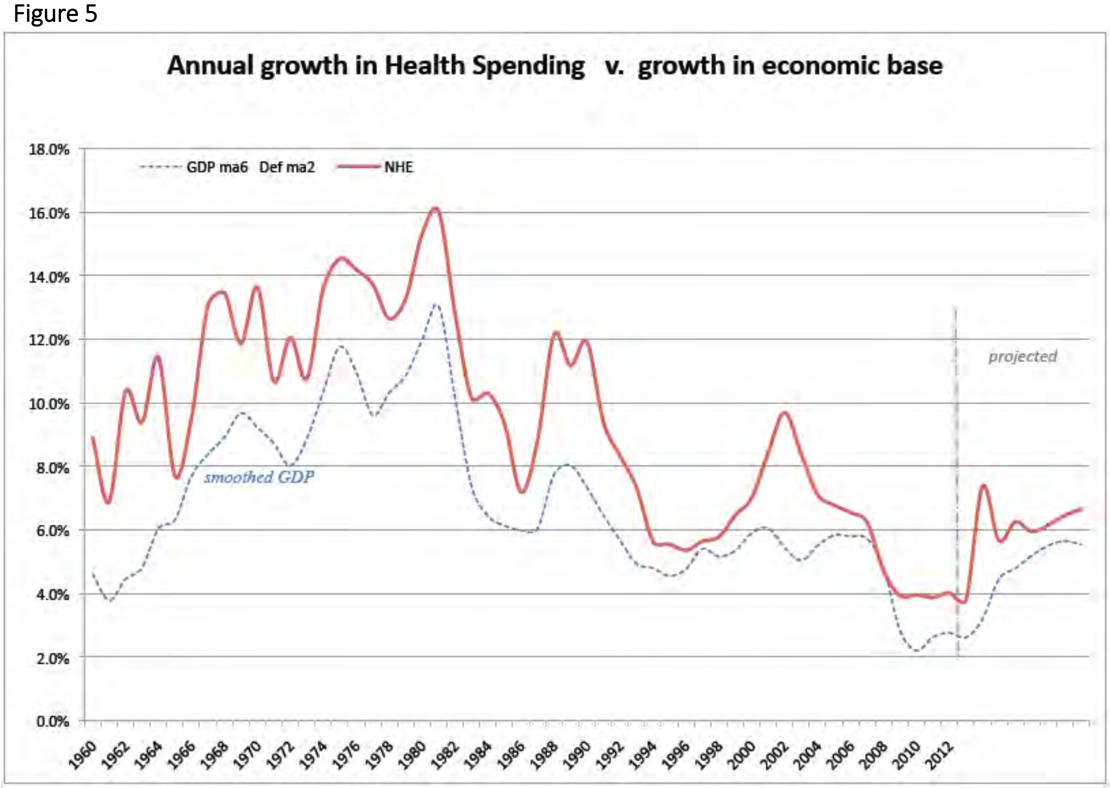


Figure 5

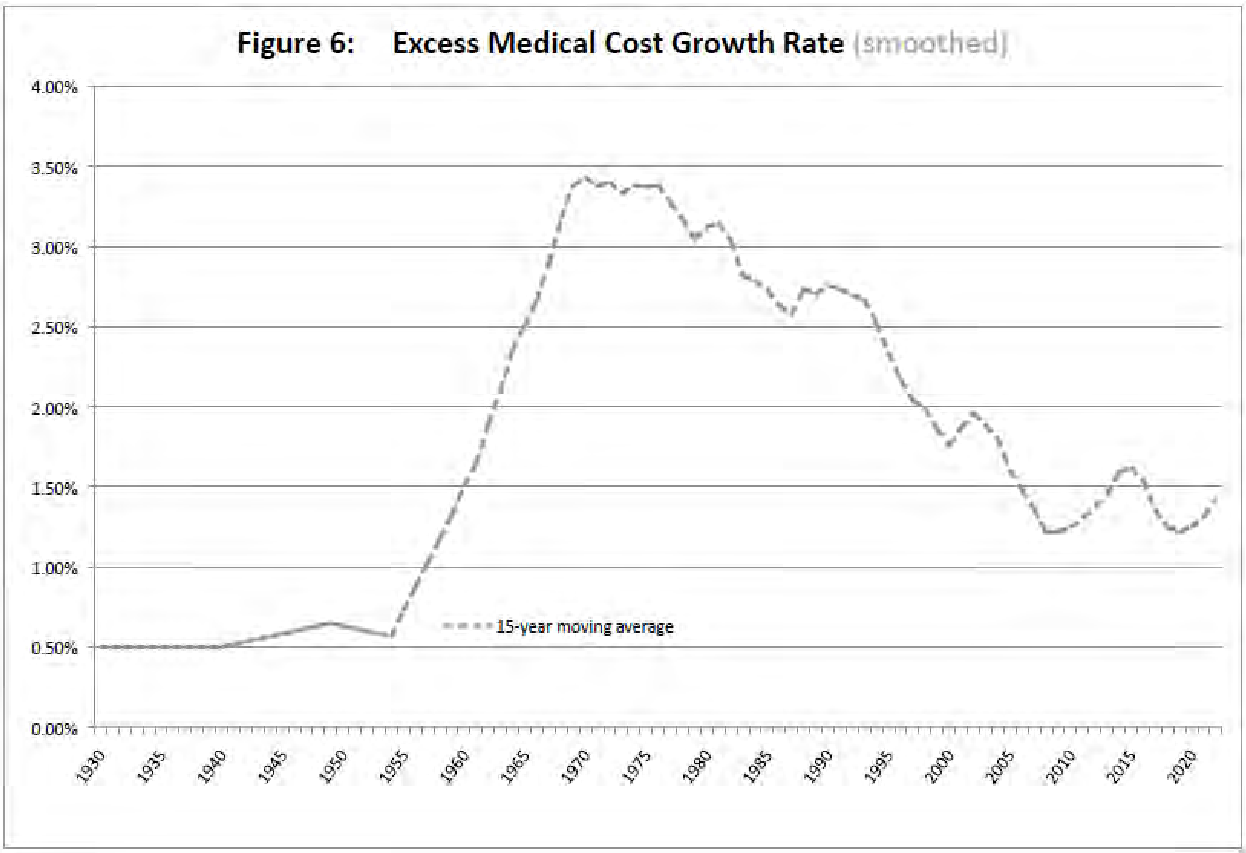


VII. Likelihood of a Major Disruption of Medical Care and a Break in Trend during the next 20 years

It is hard to predict the likelihood of a 100-year flood occurring within the next twenty years. Most probably there would not be such a flood, but there could be two or even more. All trend models are based on extrapolations of past behavior. The slow evolution of the U.S. health care system makes it unlikely that there will be a major disruption in the near future, but the current rate of growth seems to be unsustainable, indicating that a break in trend is almost inevitable. Given the inertia in the health financing, care system, it is even possible that a bending of the cost curve bringing the long-run trend close to GDP+0% within a few decades may have already started but is just not yet clear enough to be visible.

The first major disruption of medical care financing and organization occurred around the turn of the century in 1900.[13] Advances and developments occurred quite rapidly over the following decades, but the next major financial transformation did not occur until 1965 with the passage of Medicare and Medicaid. Medical costs increases had begun to accelerate in the late 1950s and peaked in the late 1960s, adding excess growth of more than +3% a year on top of an already expanding GDP, then began to moderate after 1975. This cost surge is apparent in Figure 6 graphing a fifteen-year moving average of the excess growth rate.

Figure 6



Since 1980 there have been a number of new therapies and changes in the details of health insurance coverage, but no major revolutions, and growth has slowed to less than half the peak rate. Similar medical cost surges that quickly expand the size of the health sector are observed among all of the industrialized nations with modern medical systems, and now appear to be present in China and other emerging economies as well. This suggests that consolidation of a modern medical system accompanied by a surge in costs could be viewed as a regular part of economic development, one aspect of a complex phenomenon that occurs during the shift from an agricultural society to one based on technology and information.

It is plausible to expect that in coming decades information technology, gene editing, organ regeneration, or other biomedical innovation will bring significant change. However, since the Getzen model is designed to project future cost trends rather than therapeutic advances, it is most appropriate to focus here on the purely financial pressures that are likely to disrupt medicine. In the 1950s, health expenditures were about 4% of income and middle class families could readily afford to purchase health insurance. By 1975, expenditures had risen to 8% and most of the 88% of the U.S. population that were covered relied on Medicare and Medicaid or benefitted from the implicit tax subsidy of employer-provided health insurance. This allowed providers to cost-shift toward public financing. In 2010 medical expenditures had more than doubled as a share of income, coverage had fallen to 85%, and cost-shifting went the other direction, increasing the burden on private health insurance premiums. The rise in expenditures as a share of income and a widening disparity of wealth between the median and the top meant that an average middle-class household could no longer afford health insurance without substantial assistance. Implementation of the Affordable Care Act in 2010 increased coverage for a few years, but the number of uninsured has recently grown while medical costs have continued to rise faster than wages or per capita incomes. To say that this combination of forces has put a strain on the financing system would be an understatement.

By 2040 health spending is projected to exceed 23% of income, even less affordable but perhaps reasonably justified by the gain in life expectancy. One-fifth of the U.S. population will be age 65 or older and account for more than one-half of all personal health care expenditures. Quantification is speculative, but the probability of abrupt change and a break in trend within the next twenty years is apt to be more than 50-50. As the current patchwork process of muddling through with premium increases, cost-shifting, indirect subsidies, and deficit financing breaks down, significant alteration of healthcare financing mechanisms will occur.

VIII. Summary

For this model, the inflation and GDP forecasts are taken from the Congressional Budget Office *Economic Outlook: 2018 to 2028* and the Social Security Administration *2017 Medicare Trustees Report*. Rather than focusing on the noisy fluctuations in inflation and income, a long-run actuarial forecast of medical trends and plan liabilities should concentrate on the primary signal, *the rate of excess medical cost growth.*

Summary Points:

- Economic growth and advancing medical technology are the primary drivers of medical cost trends.
- Current events and business cycles can be used to make better short-run forecasts, but do not meaningfully affect long-run trends.
- Many variables (including illness prevalence, provider supply, market competition, payment rates, benefit structure, high-cost pharmaceuticals, regulatory changes, demographics, policy, elections, etc.) significantly affect projections for specific group or plan costs, but are not able to consistently explain or improve long-run national forecast accuracy.
- "Excess" growth, the difference between medical cost and income trends, provides the most accurate and useful forecasts (and is mathematically equal to the percentage growth in the medical share of total spending).
- Eventually, the rate of growth in medical costs must be matched to the resources available to pay for them (i.e., in the very long-run = *GDP+0%*).
- Excess medical cost growth began to surge in the late 1950s, but has been moderating over the last 20 years. It is now +1% to +2% and appears to be headed downward.
- Uncertainty of about 1% per year (compounded) is plausible.

###############

End Notes

1. The National Income and Product Accounts maintained by the U.S Bureau of Economic Analysis and the CBO and CMS sources are listed among the reference. The Medicare Trustees Reports are now issued by CMS.
2. See Boskin et. al. (1997), Feldstein (2017) and Getzen (1992).
3. CMS (2018).
4. See CMS (2018)- "Projected", CBO projections are contained in the Long-Term Budget Outlook for each year, and the SOA forecast is presented on the SOA research website.
5. See CMS (2011) and Getzen (2016a).
6. The expected future rate of regular economic growth (real per capita income) has itself recently become a subject of controversy. One side argues that the post-millennial weakness and great recession indicate the advent of a "new normal" with annual productivity increases of less than 1% a year, while the other side argues that the information age, internet connectivity and a massive trade boost from China, India, Brazil and other emerging economies will push future gains to equal or exceed the 2% annual average of the last century. Another macroeconomic debate currently raging is whether average expenditures are affected by distribution, depending more on median incomes (fairly modest since 1980) rather than the mean (which has been accelerating due to rapid growth at the top). Health actuaries should definitely be aware of and perhaps even able to parameterize each of these issues, but are not particularly expert at forecasting future shifts in the trend or distribution of personal incomes. To the extent that estimates of these variables is required, reliance on official projections provided by BEA, CBO, SSA or accepted industry sources are usually preferred.
7. Similar component breakdowns are provided by CMS and CBO, but will vary slightly in details.
8. See Getzen (2017), Cooper, Worthington and McGee (1973).
9. The rate of increase in health spending (h) is decomposed as

   growth in health = inflation + real gdp growth + excess

   and taking account of compounding:

   $$h = (1+d)*(1+r)(1+x) - 1$$

   then (s) the growth rate in the share of GDP, is readily seen to equal (x) the excess growth rate in health spending.

   $$s = (H*(1+d)*(1+r)(1+x)/Y*(1+d)*(1+r)) / (H/Y) - 1 = x$$
10. Getzen (1990, 1992, 2000, 2014b, 2016b)) showed that medical prices were not related to spending. Reinhart (2003) and many other have shown that spending for the elderly was driven not because older people used more services, but because the amount spent for the same age/illness group kept rising as insurance and government financing became more generous.
11. A series of simple tests for accuracy have been developed by professional forecasters, including those at the U.S. Bureau of Economic Analysis responsible for maintaining the GDP (NIPA) accounts and those at the Federal Reserve Bank responsible for maintaining interest rates and price stability. The most basic benchmark is called a "naïve forecast:" that the percentage change next year will be the same as last year. A forecast worse than simply positing growth rates would remain the same is not very valuable. A more demanding test of accuracy is to compare any new forecast to a univariate forecast made by applying standard statistical techniques (ARIMA, frequency analysis, regression) to data solely on the past history of that variable (i.e., without any information or data on other variables or conditions). Such univariate forecasts, maximized for accuracy, are now readily available in seconds with inexpensive software running on a laptop.
12. Smith et al, (1998).
13. Anderson (1995), Getzen (2017), Starr (2008).

Sources and References

Altarum. (2017) "Health Care Spending Growth Appears to Stabilize in 2016, 2017." http:/altarum.org/health_indicators.

Anderson, Odin W (1990) *Health services as a growth enterprise in the United States since 1875*. Ann Arbor, Mich: Health Administration Press.

BEA (U.S. Bureau of Economic Analysis) *Current-Dollar and 'real' GDP*. https://www.bea.gov/national/xls/gdplev.xlsx

Boskin, Michael, Ellen R. Dulberger, Robert J. Gordon, Zvi Griliches, and Dale W. Jorgenson. 1997. "The CPI Commission: Findings and Recommendations." *American Economic Review* 87(2):78–83.

Blumenthal, D., Stremikis, K., Cutler, D. (2013). "Health Care Spending—A Giant Slain or Sleeping?" *New England Journal of Medicine* 396(26):2551-2557.

Catlin, A.C. and Cowan, C.A. (2015). "History of Health Spending in the United States, 1960-2013." https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/HistoricalNHEPaper.pdf

CBO. (2017). *The 2017 Long-Term Budget Outlook*. Washington DC: Congressional Budget Office; https://www.cbo.gov/publication/52480.

Chandra, A., and Skinner, J. (2012). "Technology Growth and Expenditure Growth in Health Care." *Journal of Economic Literature*, 50(3):645-680.

Chandra, A., Holmes, J. and Skinner, J. (2013). "Is This Time Different? The Slowdown in Healthcare Spending," NBER wp#19700 and *Brookings Papers on Economic Activity*, vol. 47(2 (Fall)), pp 261-323.

Chen, A., and Goldman, D. (2016). "Health Care Spending: Historical Trends and New Directions." *Annual Review of Economics* 8(1):291-316.

Chernew, M. (2014). "Examining the Present and Future of the Health Spending Growth Slowdown." *Health Affairs Blog*, http://healthaffairs.org/blog/2014/09/03/examining-the-present-and-future-of-the-health-spending-growth-slowdown/.

CMS. (2010). "2010 Comprehensive Revision." U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services, Office of the Actuary. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/2010ComprehensiveRevision.pdf.

CMS Office of the Actuary. (2011). Accuracy Analysis of the Short-Term (11 year) National Health Expenditure Projections. http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/ProjectionAccuracy.pdf.

CMS. (2015) *National Health Expenditure Accounts: Methodology Paper, 2015: Definitions, Sources and Methods*. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/DSM-15.pdf.

CMS. (2017). *Projections of National Health Expenditures: Methodology and Model Specification.* 2/15/2017. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/ProjectionsMethodology.pdf.

CMS Office of the Actuary (2018) National Health Expenditure Data.https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData

Congressional Budget Office (CBO), (2018) *The Budget and Economic Outlook: 2018 to 2028. (April 2018).* www.cbo.gov/publication/53651.

Cooper, B., Worthington, N. L., and McGee, M. F. (1973) *Compendium of national health expenditures data*. Social Security Administration, Office of Research and Statistics, USDHEW, Pub. No. (SSA)73-11903, Washington DC: USGPO.

Cuckler, G., et. al. (2018) "National Health Expenditure Projections 2017-26: Despite Uncertainty, Fundamentals Primarily Drive Spending Growth." *Health Affairs*, 37(3): 1 -11.

Cutler DM, Rosen AB, Vijan S. 2006. "The value of medical spending in the United States, 1960–2000." *New England Journal of Medicine* 355: 920–927.

Feldstein, Martin. (2017) Underestimating the Real Growth of GDP, Personal Income, and Productivity *Journal of Economic Perspectives* 31(2):145-164.

Gerdtham U-G, Jonsson B. (2000). “International comparisons of health expenditure: theory, data and econometric analysis.” *In Handbook of Health Economics*, Culyer AJ, Newhouse JP (eds.)Vol. 1A, Elsevier: Amsterdam; 11–49.

Getzen, T.E. (1985). "Reducing Health Care Costs: Is being poorer better?" *Journal of Healthcare Financial Management*, 39(3):34-38, March 1985.

Getzen, T.E. (1990). "Macro Forecasting of National Health Expenditures." *Advances in Health Economics*, Volume 11, pp.27-48, 1990.

Getzen, T.E. (1992). "Medical Care Price Indexes: theory, construction and empirical analysis of the U.S. Series 1927-1990." *Advances in Health Economics* (L Rossiter & R Scheffler, eds.), Volume 13: 85-128, 1992.

Getzen, T.E. (1998). “Health care is an individual necessity and a national luxury: applying multilevel decision models to the analysis of health care expenditures.” *Journal of Health Economics* 19(2): 259-270, 2000.

Getzen, T.E. (2000). “Forecasting Health Expenditures: Short, Medium and Long (long) Term.” *Journal of Health Care Finance* 26(3):56-72, 2000.

Getzen, T.E. (2006) “Aggregation and the Measurement of Health Care Costs.” *HSR: Health Services Research* 41(5):1938-1954, October 2006.

Getzen, T.E. (2014a) “Modeling the Cost of Medical Care for the Elderly” *Health Watch*, N.74:22-25, Jan 2014.

Getzen, T.E. (2014b) “Macroeconomic Dynamics of Health: Lags and Variability in Mortality, Employment and Spending,” in Anthony J. Culyer, (ed) *Encyclopedia of Health Economics*, Vol 2,San Diego: Elsevier; 2014, pp.165-176.

Getzen, T.E. (2016a) “Accuracy and Range of Actuarial Projections of Health Care Costs” *North American Actuarial Journal,* 106(2): 101-113*.*

Getzen TE. (2016b). “Measuring and forecasting global health expenditures.” In *Global Handbook of Health Economics Public Policy*, Scheffler R (ed.), World Scientific Publishing Co: Singapore; 177–215.

Getzen, T.E. (2017) “*The Growth of Health Spending in the USA: 1776 to 2026.”* Available at SSRN #303401, December 2017, forthcoming 2018 in *Oxford Research Encyclopedia of Economics and Finance.*

Getzen, T.E. (2019) *The Global Evolution of National Health Expenditures.* London: World Scientific, *forthcoming* 2019.

Getzen, T.E. and Okunade, A.A. (2016) “Modeling National Health Expenditures.” *Health Economics* 26(7): 827-833.

Getzen, T.E. and Poullier, J.P. (1992). "International Health Spending Forecasts: Concepts and Evaluation." *Social Science & Medicine* 34(9): 1057-1068, 1992.

Hartman, Micah et. al. (2014) National Health Spending In 2013: Growth Slows, Remains in Step With the Overall Economy. *Health Affairs*, 34, no.1 (2014):150-160.

Holohan, John and Stacey McMorrow, “Is the Recent Health Care Spending Growth Slowdown Sustainable Over the Long-term?” Health Affairs Blog. May 7th 2013. http://healthaffairs.org/blog/2013/05/07/is-the-recent-health-care-spendinggrowth-slowdown-sustainable-over-the-long-term/

Horenstein AR, Santos MS. (2016). Understanding Growth Patterns in US Health Care Expenditures. SSRN#2942535.

Keehan, S. P., et al. (2017). “National Health Expenditure Projections, 2016-20125: Price Increases, Aging, Push Sector to 20 Percent of Economy.” *Health Affairs* 36(3):1-11.

Keehan, Sean P. et. al., (2015) National Health Expenditure Projections, 2014-24: Spending Growth Faster Than Recent Trends. *Health Affairs,* 34(8):1407-1417.

Levitt, L., et al. (2013). “Assessing the Effects of the Economy on the Recent Slowdown in Health Spending.” Kaiser Family Foundation April 22, 2013. http://www.kff.org/health-costs/issue-brief/assessing-the-effects-of-the-economy-on-the-recent-slowdown-in-health-spending-2/ also http://tinyurl.com/lo3sgh3.

Medicare Trustees. (2018) *2018 Annual Report…* https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/TR2018.pdf

Moore, Geoffrey H. (1980) Business Cycles, Inflation and Forecasting. *NBER Research Studies in Business Cycles No. 24*. Ballinger: Cambridge, Mass.

Ramey, V. (2016). "Macroeconomic Shocks and their Propagation." NBER wp#21978.

Reinhardt, U. (2003). "Does the Aging of the Population Really Drive the Demand for Health Care?" *Health Affairs* 22(11):627-639.

Roehrig, C. (2014). National health Spending in 2014—Acceleration Delayed. *New England Journal of Medicine* 371(19):1767-1769.

Silver, Nate (2015) *The Signal and the Noise: why so many predictions fail – and some don't*. Penguin: New York.

Smith, S., et. al. 1998. "The Next Ten Years of Health Care Spending: What Does the Future hold?" *Health Affairs* 17 (5): 128-140.

Smith, Sheila, Joseph Newhouse and Mark Freeland, (2009) "Income, Insurance, and Technology: Why Does Health Spending Outpace Economic Growth", *Health Affairs*, 28(5): 1276-1284.

Starr, Paul. (2008) Social Transformation of American Medicine: *The rise of a sovereign profession and the making of a vast industry*. New York: Basic Books.

White, C., and Ginsburg, P. (2012). "Slower Growth in Medicare Spending—Is this the new normal?" *New England Journal of Medicine*. March 7, 2012.

Appendix A: Consistency of Baseline Assumptions with Actuarial Standards of Practice

Prepared by members of the Project Oversight Group (POG) of health actuaries recruited by the SOA

In the POG's opinion the long-term medical trend model baseline assumption inputs are reasonable long-term economic assumptions. The baseline inputs are updated annually based on emerging economic trends to be as current as possible. However, the user of the model should understand each economic input assumption used by the model and consider modifying the baseline assumptions if they are not consistent with other economic assumptions used for a retiree medical valuation.

The long-term medical trend model is typically used to select medical trend assumptions for retiree medical valuations to present liabilities disclosed under the appropriate accounting standards, or to determine contributions under a funding policy. In addition to the long-term medical trend, retiree medical plan actuaries must select other economic assumptions. In particular the discount rate assumption, but there may also be assumptions for expected rates of returns, salary increases, and/or overall payroll increases.

The POG recommends that the actuary consider the selection process for the other economic assumptions and use inputs to the Getzen long-term trend model that are consistent with the other economic assumptions. For example, the other economic assumptions will generally include either implicitly or explicitly an inflation component. The inflation input to the model should be consistent with the inflation component of the other economic assumptions. Similarly, the combination of inflation and real growth used for the model should be consistent with the long-term assumption for wage growth unless the assumption is not material.

In some cases, economic assumptions are selected on the basis of an experience study on a periodic basis (e.g. every 5 years) and the economic assumptions are not typically modified until the subsequent experience study. In such cases, the actuary should consider a similar schedule in setting the economic assumption inputs to the long-term medical trend model.

The POG believes that this recommendation is consistent with paragraph 3.12 of ASOP27 which states that "each economic assumption selected by the actuary should be consistent with every other economic assumption selected by the actuary for the measurement period…." And paragraph 3.12.5 of ASOP6 which states that "…. The actuary should consider the reasonableness of each actuarial assumption independently on the basis of its own merits and its consistency with the other assumptions selected by the actuary…"

Appendix B: ANNUAL SPREADSHEET UPDATING

Yearly updating of the model occurs in four steps:

i. Change the beginning year number in column A of the projection matrix (tab page 4) by one year.
ii. Change the text labels on all four tab pages one year forward.
iii. Put the new parameter values on the input page (tab 2)
    - *Short-term rates for the next 4 years.*
    - *Income, Inflation, Excess Medical Cost Growth (Technology factor) values expected for years 10+.*
    - *Expected Health Share of GDP in ten years*
    - *Share Resistance Level*
    - *Year Limit*
iv. Copy the new baseline results (grey numbers) as values (not formulas) on the input page (tab 2), the output page (tab 3) and the projection matrix (tab 4).

Steps 1, 2 and 4 are mechanical and take only a few minutes. Step 3, determining new input parameter values, takes experience and judgment, and thus may require significant work unless the user is willing to accept the POG consensus baseline values. The POG derives these values by analysis of current data and a series of consensus meetings. While it is useful for a user to try out values differing from the baseline in order to get a feel for the model and how different input affect future cost trends, significant modification of the baseline values should be approached cautiously. In addition to the updated spreadsheet model, model documentation includes an update document each year that is posted alongside the model on its landing page and provides a review of basic analytic information and rationale for each input value and overall trend outlook.