Getzen Model of Long-Run Medical Cost Trends for the SOA

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The Getzen model is designed to make long-run forecasts. 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, using their local information and actuarial skills to improve accuracy and reasonability.

Section I presents baseline variable values and ranges with sources and documentation. Section II lays out the structure of the model. Section III presents historical context and sources for those who desire more in-depth understanding of the process and controversies. Section IV details the actual calculations in the spreadsheet. Section V discusses ranges of uncertainty and provides suggestions for use. Notes, references and an appendix on the size of the taste/technology (excess growth) variable are found at the end.

I) Baseline Variable Ranges for Model Forecasts

Baseline values and ranges for each variable in v2014_b of the Long Run Medical Cost Trends Model are presented below, along with the relevant data sources. The values and ranges were developed by the author and reviewed by a group of experienced health actuaries in June 2014. Annual rates of increase in medical costs are taken from the CMS Office of the Actuary *National Health Expenditure* estimates.[1] Historical values of inflation and income are from the Bureau of Economic Analysis *Current-Dollar and Real GDP* series, with projections for 2014 to 2024 from the Congressional Budget Office *Long Term Economic Outlook*.[2,3] Population data and projections are taken from the U.S. Census Bureau *Resident Population* series.[4] Many other factors (e.g., illness, aging, physician supply, plan benefits, market concentration, etc.) may affect the costs of a particular person, group, organization or plan in a specific locality or over the short-run, but the variables listed below are the only ones to have been empirically demonstrated in repeated trials to accurately predict future costs.[5] Additional analysis is still needed to determine if reliable estimates of separate trends for private insurance premiums, Medicare payments, pharmaceuticals, or other cost categories are possible or useful.

INFLATION: 2.2% (range 1.4 – 6.2). Baseline equal to average over the last 30 years with range determined by minimum and maximum values of a 5-year moving average.

INCOME: 1.6% (range 0 – 3.5). Baseline equal to average over the last 30 years with range guided by minimum and maximum values of a 5-year moving average. [6,7]

EXCESS *(Technology/Tastes)*: 1.4% (range 0.5 – 2.7). Baseline equal to average over last 15 years with range determined by minimum and maximum values of a 5-year moving average. [8,9]

SHARE & YEAR Limits to Growth: .250 (range .20 - .40) & 2075 (range 2010 to 2099). Baseline 2020 share taken from CMS projections.[1] It is generally accepted by the Medicare Trustees, CMS Actuary, CBO, OECD Health Unit and other major organizations that excess cost growth above some larger share of income will meet increased resistance, and that eventually growth must converge to match income at *GDP+0%*, the precise share or year at which such limits will begin to matter is considered unknown, and hence these parameters must be a judgment call by the forecaster. [10]

SHORT-RUN COSTS: 4.7% (2015), **5.0%, 5.3%, 5.4%, 5.5% (range 3.5 - 7.0).** Baseline rates are equal to the smoothed rate of income and inflation increases (as projected by the CBO) plus the baseline excess taste/technology cost growth rate of 1.4%.

Trend Accuracy: 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.[5] The largest meaningful source of uncertainty is the potential change in the level of excess cost growth. Excess cost growth has clearly moderated over the decades, going from 3%+ in the 1960s and 1970s to less than 1% 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.

II) Forecasting Health Care Cost Trends: The Task and Model Structure

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. (Cuckler 2014, CMS 2014, Census Bureau 2014, BEA 2014). During the 84 years for which data are available (1929-2012) total medical costs for residents of the U.S. have increased from $3.7 billion to $2,807 billion, an average increase of 8.3% per year. Regular population increase has been responsible for over 1% or 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 (1/25th of GDP before WWII to over 1/6th by 2010).

Figure 1

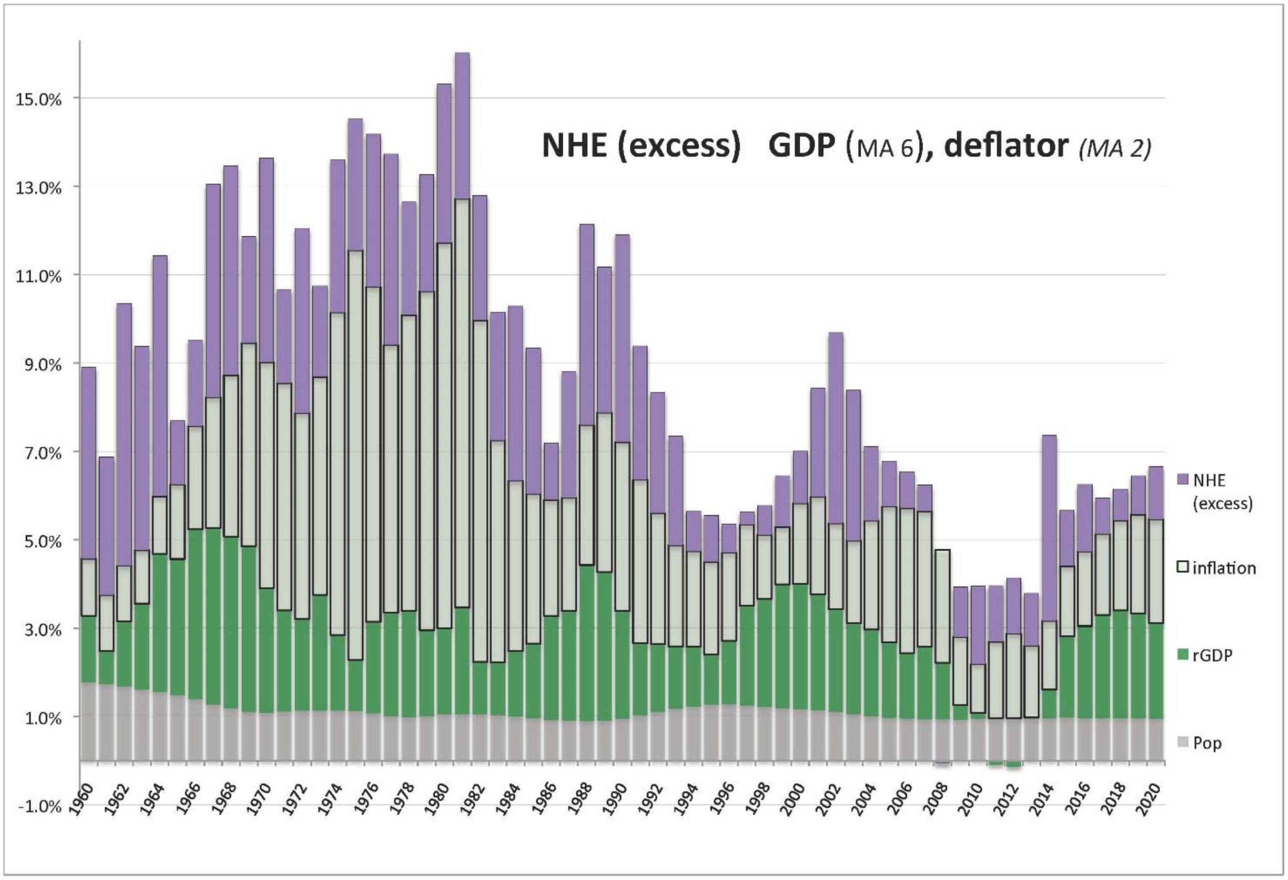


Table 1: Medical Cost Trends 1929-2012: Total and by component, in decades

	1929-1940	1940-1950	1950-1960	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	2010-2012
Total National Health $	*0.90%*	*12.20%*	*8.00%*	*10.60%*	*13.10%*	*11.00%*	*6.60%*	*6.60%*	*4.70%*
"excess"/ Share of GDP	***1.20%***	***0.70%***	***1.80%***	***3.30%***	***2.50%***	***3.10%***	***1.00%***	***2.60%***	***0.50%***
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%*	*1.80%*
population	*0.80%*	*1.40%*	*1.70%*	*1.30%*	*1.10%*	*0.90%*	*1.20%*	*0.90%*	*0.80%*

Sources: U.S. Census, Bureau of Economic Analysis, and CMS Office of the Actuary, all 2014.

A bit of algebra shows that the rate of excess growth is mathematically the same as the percentage rate of increase in share. [11] Hence the rate of excess growth between any two periods, or the difference in the rates of excess growth between any two countries, is easily determined simply by comparing "shares" and avoiding the errors and analytical inconvenience of making adjustments for exchange rates, inflation, population increase and so on.

$$\boldsymbol{X}_{\text{(excess \% increase in Health \$)}} = \boldsymbol{S}_{\text{(\% increase in Health Share of Total)}}$$

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, not the voluminous rhetoric about costs, bureaucratic waste, malpractice insurance costs, 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.

"Technology" = ***"excess growth"*** = %(Medical Costs) - %(Income)

Although it may be intellectually unsatisfying or even seem misleading to take "the remainder" and label it as "technology," this is exactly the same procedure as that used by the Federal

Reserve Bank, CBO and other government agencies or macroeconomists measure “productivity” and “technological growth” for GDP and other elements of the official NIPA accounts.

The price of surgery, population aging, positron scans, patent expirations, influenza, coinsurance rates, regulation, hospital competition, taxes 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 total costs 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” 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 “taste/technology factor.” The Getzen SOA 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.

LR Forecast % medical cost increase = (1+inflation)*(1+real per capita GDP)*(1+ “*excess*”) - 1

Ultimate and Proximate Limits to Growth. Medical costs cannot continue to grow faster than per capita incomes indefinitely, or else medical care would consume more than 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 this model in the form of the **Year Limit** and the **Share Resistance Limit**.[12]

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.

Fluctuations: Business Cycles, Inertia and Lags. As the recent recession has made clear, economic ups and downs create major short-run deviations from trend in health spending. The rate of increase in health spending fell precipitously in 2009---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 (R^2=.82) is actually related to macroeconomic forces (inflation and GDP), 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 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). Rates of growth in medical costs are compared to "smoothed" income as in Figure 5, rather than to concurrent income.

Figure 2

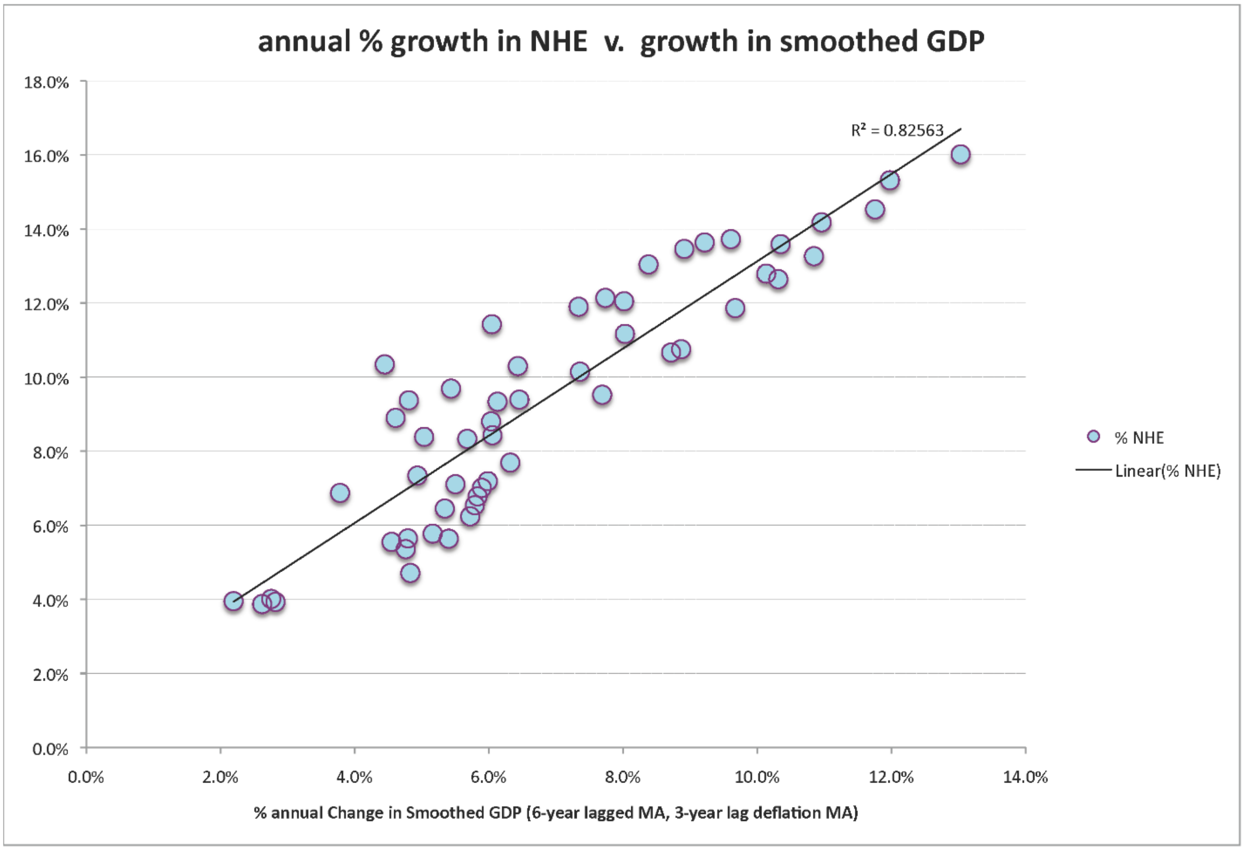

annual % growth in NHE v. growth in smoothed GDP
R² = 0.82563
18.0%
16.0%
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
0.0%
2.0%
4.0%
6.0%
8.0%
10.0%
12.0%
14.0%
% annual Change in Smoothed GDP (6-year lagged MA, 3-year lag deflation MA)
% NHE
Linear(% NHE)

Figure 3

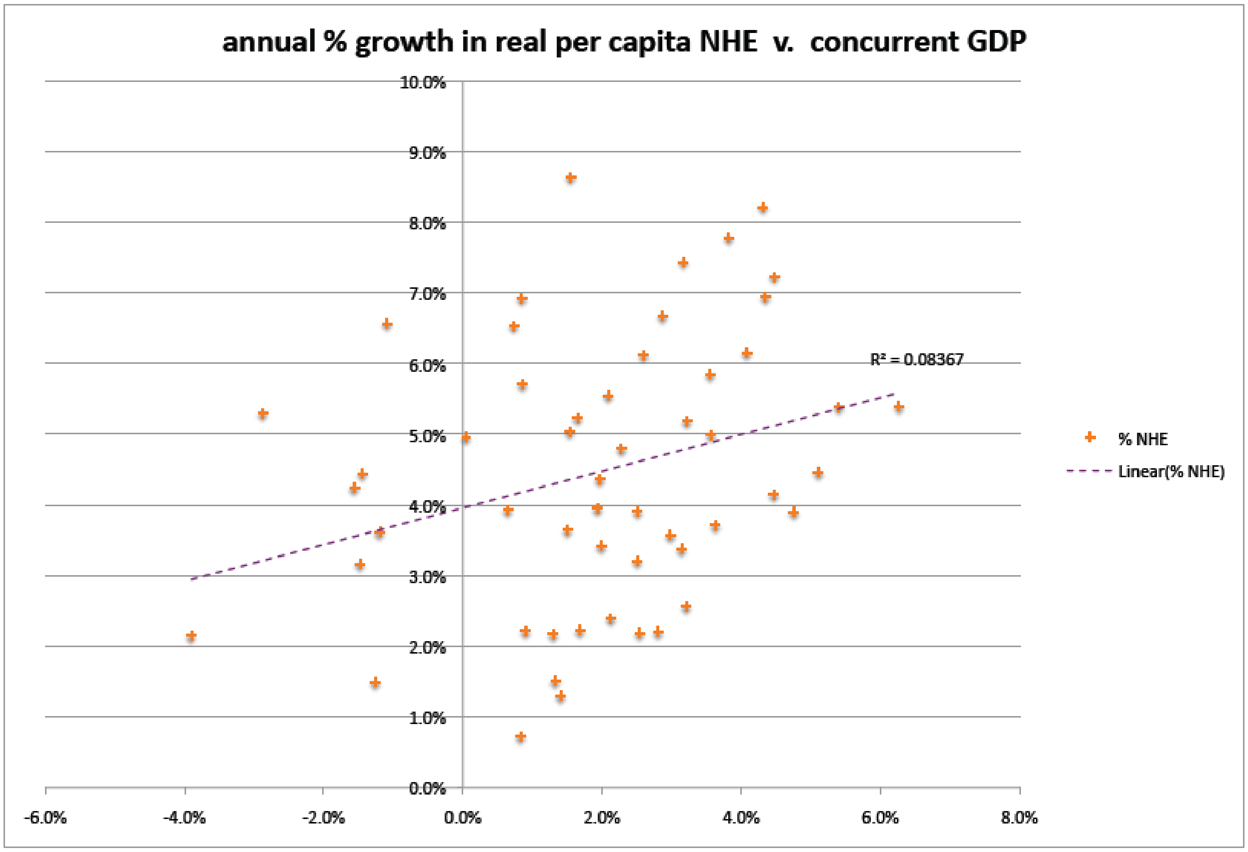
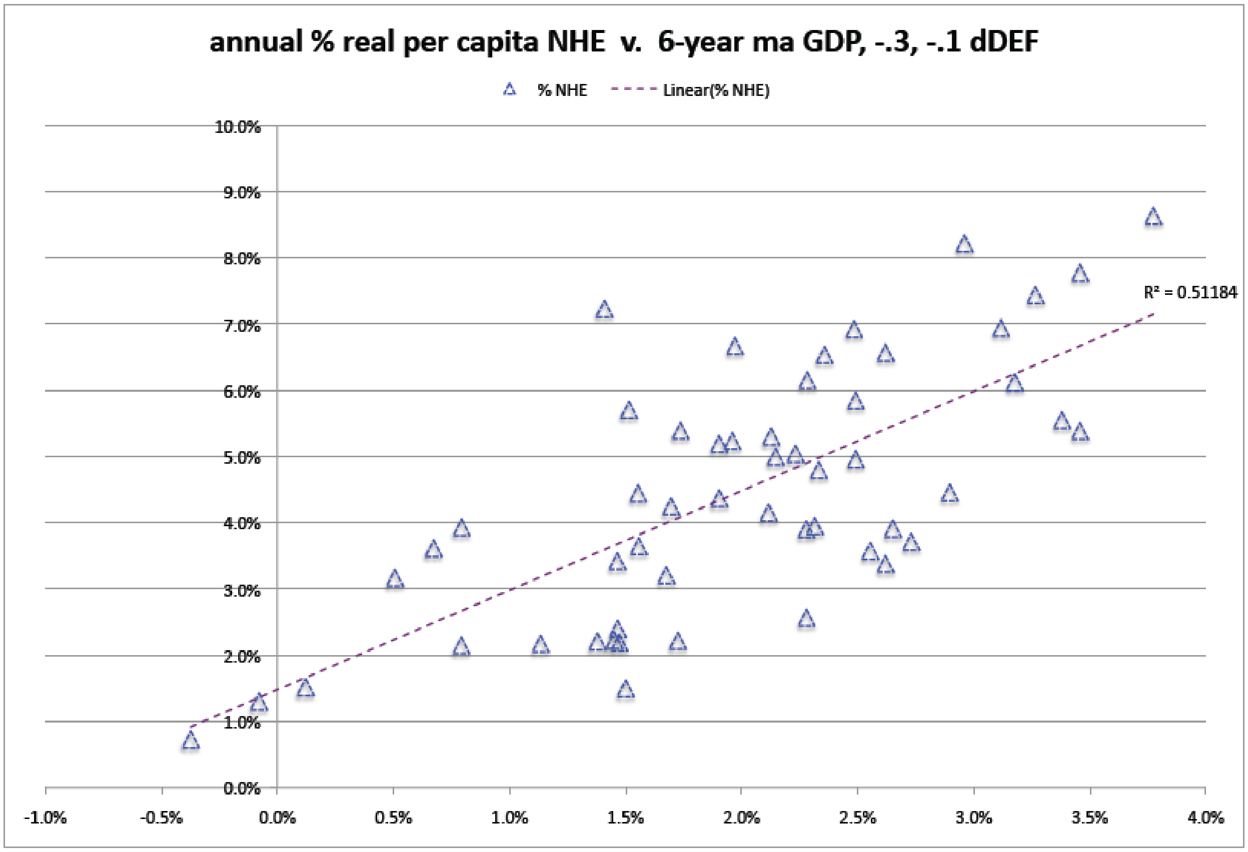
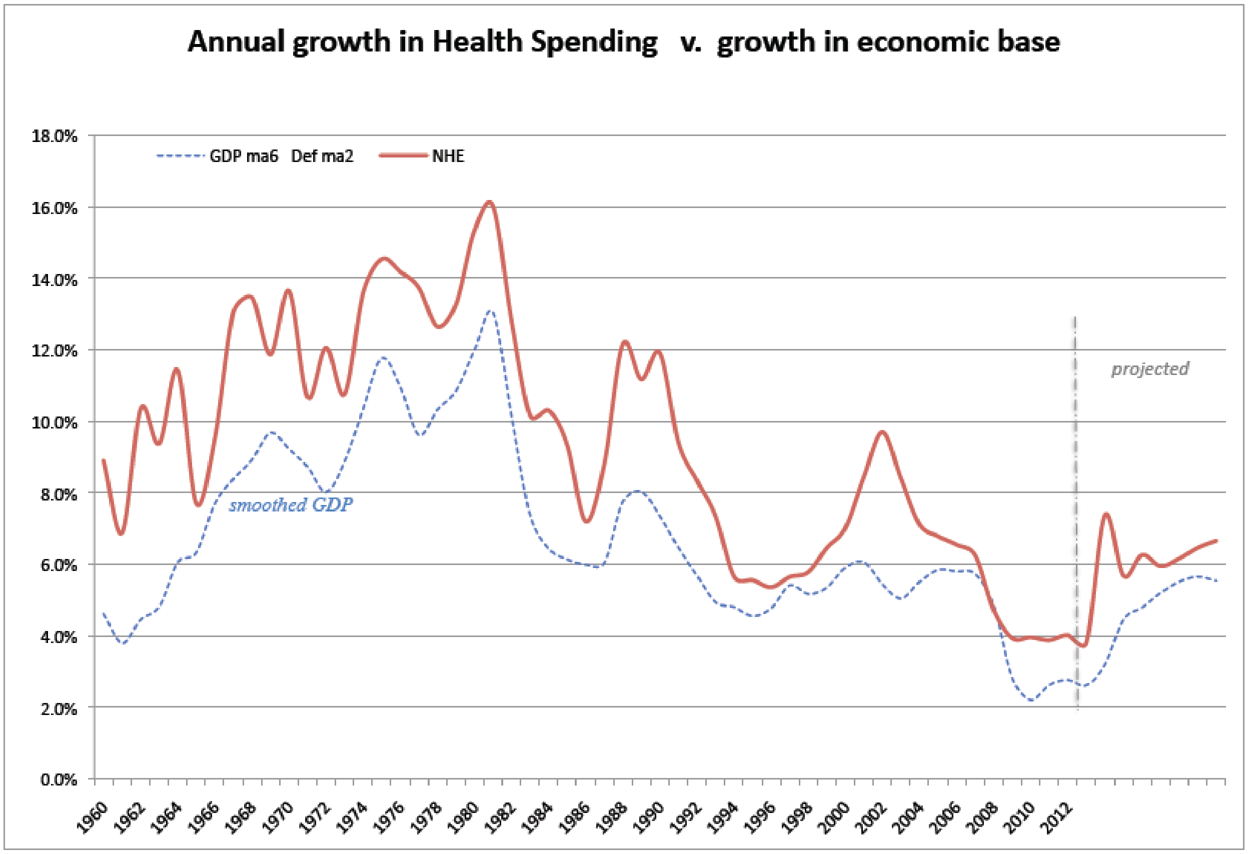

annual % growth in real per capita NHE v. concurrent GDP
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
-6.0%
-4.0%
-2.0%
0.0%
2.0%
4.0%
6.0%
8.0%
R² = 0.08367
% NHE
Linear(% NHE)

Figure 4



annual % real per capita NHE v. 6-year ma GDP, -.3, -.1 dDEF
% NHE
Linear(% NHE)
R² = 0.51184
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
-1.0%
-0.5%
0.0%
0.5%
1.0%
1.5%
2.0%
2.5%
3.0%
3.5%
4.0%

Figure 5



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 obscures, but does not change, the underlying trend. Unfortunately, the public often reacts more to the highly visible short-run fluctuation 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.

The Surge: Economic Development and Leading Academic Medical Centers. Medical costs began a sudden rise in the late 1950s, doubling their share of the economy by 1979, and doubling again by 2009. This surge is apparent in Table 2, which rearranges and extends the data in Table 1, and in Figure 6, which shows a fifteen-year moving average of the excess growth rate. Relative to national income, medical costs grew very little, if at all, during the preceding decades. The best available contemporaneous analysis of trends shows medical costs to have been relatively constant as a share of GDP from 1929 to 1956, flat near .04 (Seale 1959)]]. To double twice, as medical costs did between 1955 and 2009, had previously taken hundreds or thousands of years. [13]

Figure 6

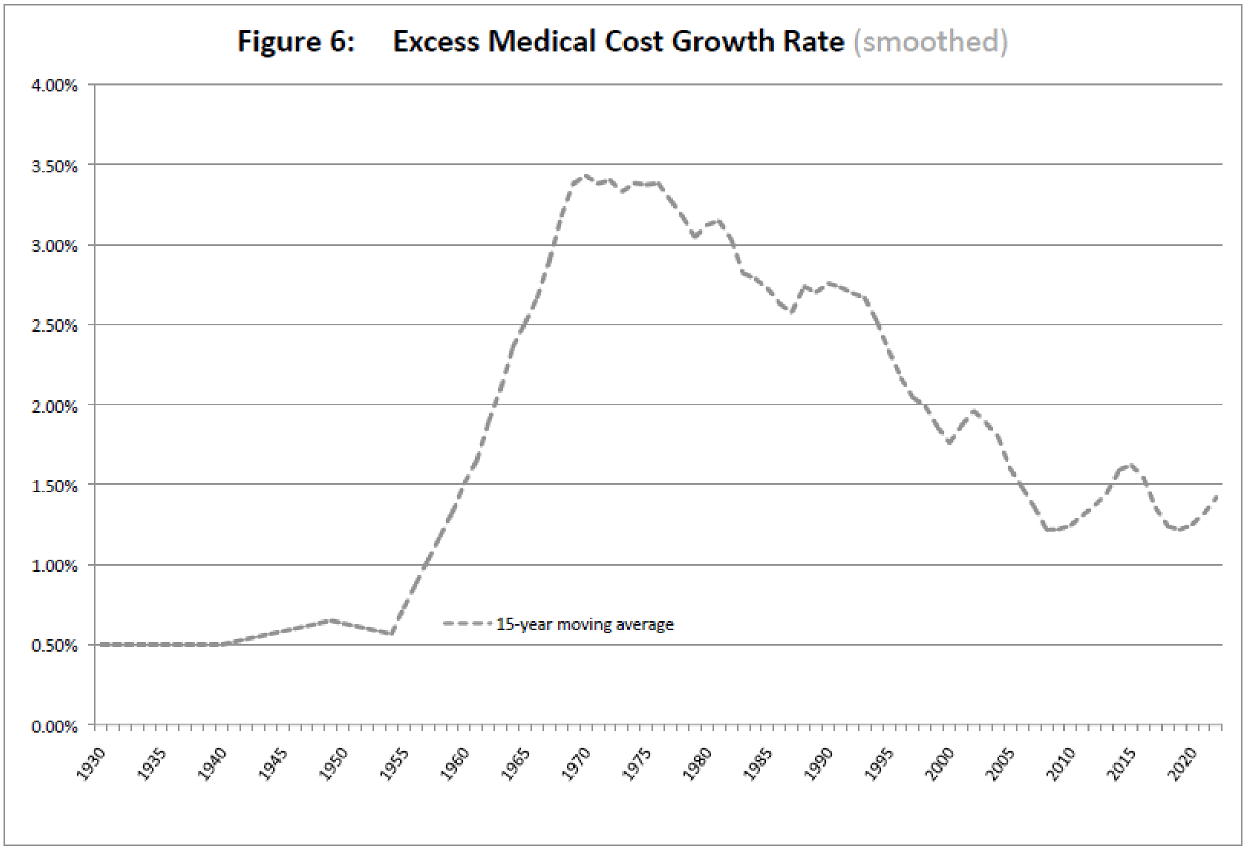


Table 2: Medical Cost Trends 1935-2012:
Total and by component, in stages

	1935-1955	1955-1970	1971-1993	1993-2012
Total National Health $	9.50%	10.10%	11.50%	6.00%
"excess" / Share of GDP	**0.20%**	**3.50%**	**2.90%**	**1.30%**
real income per capita	3.50%	2.20%	2.00%	1.60%
inflation	4.10%	2.60%	5.10%	2.00%
population	1.30%	1.40%	1.10%	1.00%

Sources: U.S. Census, Bureau of Economic Analysis, and CMS Office of the Actuary, all 2014.

The available evidence suggests excess growth averaging +3% or more above GDP (which was itself rising quite rapidly) from 1955 to 1970, then slowing gradually to less than half that rate after 1993. Similar cost surges are observed among all of the industrialized nations with modern medical systems, and now appear to be present in China and other emerging economies that have experienced extended rapid growth. This suggests that a medical cost surge 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.

Clarifications, Complications, Caveats, and Assumptions. The driving force behind the growth of health expenditures is the rise in economic productivity due to technological advancement. The same forces that give us smartphones, sustainable energy, cheap air travel and red strawberries in winter are the ones that give us orthopedic implants, cancer medications and nursing care. Note, spending for a particular individual will be determined mainly by specifics of that person's diseases and disability, and secondarily by the particulars of their insurance, wealth and educational status, yet national spending for all of us together is essentially independent of these particulars (which tend to average out for large groups).

The task of the health actuary is to forecast medical cost trends and estimate future liabilities, not to forecast investment returns, recessions, GDP or inflation. Those tasks are better left to the finance expert or government macroeconomist. While actuaries should be knowledgeable about the use of such variables, and about how to choose a reasonable range of values to prudently parameterize uncertainty, the health actuary does not have special expertise in predicting the future of the market or the economy. For this model, the inflation and GDP forecasts are taken from the Congressional Budget Office *Economic Outlook: 2014 to 2024* and the Social Security Administration *2013 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.*

III) Historical Context of Health Spending Projections.

The history of national health spending forecasts arguably extends all the way back to the 17th century efforts by Sir William Petty to estimate GDP and the surveys of consumption and government spending by Gregory King, Gottfried Achenwall, Francois Quesnay, William Playfair, Jacques Necker, Ernst Engel and others. These centuries of effort achieved a major advancement and success with the formalization of national income and product accounts (NIPA) in the 1940s. It was the great depression that made the measurement and forecasting of GDP an urgent policy crisis. Similarly, it was the surge in post-war health expenditures in the UK, and the post-Medicare surge in the USA, that made measurement and forecasting of national health expenditures (NHE) such a priority.

The first comprehensive national health expenditure estimate was made in the U.S.A. by the CCMC in 1929-1933. It was followed by sporadic government and private surveys in following years. They developed the art and expertise in national health accounting in most of the industrial nations, but did not give rise to any regular or sustained reporting until much later. In 1952, cost over-runs in the UK National Health Service led to the Guillebaud Report. By the 1960s most nations maintained regular reports on public spending, and were making attempts to merge them with estimates of private health expenditures to arrive at a comprehensive total. By 1975 both the United States and the UK were providing consistent annual estimates of national health spending. A comprehensive international effort carried out almost single-handedly by J-P Poullier at the OECD led to the landmark compendium *Public Expenditure on Health* (1977). This seminal exercise in harmonized growth accounting and reporting was the starting point for the System of National Health Accounts originally applied in 16 developed countries and that has now been extended to more than 100.

During the latter half of the 20th century the processes and procedures for national health accounting were evolving rapidly. Major revisions from year to year were more the rule than the exception. Hence there was no simple way to test the accuracy of these estimates, or of the periodic projections and forecasts of future national health spending being made by governmental agencies, NGOs, or individual university researchers or private forecasters (Getzen, 2014d). A serious attempt to provide systematic forecasts of future national health spending was carried out by the CMS Office of the Actuary during the 1980s when it was still part of a predecessor agency, the U.S. Health Care Financing Authority or "HCFA." There were twenty-plus years of consistent historical data to build on by then since the agency had recreated synthetic estimates for the pre-Medicare years back to 1960.

Most analysts were still "certain" that national health expenditures could never sustainably exceed 10% of GDP in the 1970s, 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. The rise in the consumer price index had exceeded 15% in the aftermath of the 1973 OPEC oil crises, while 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 led to models of the form ***NHE = ∑ (price) x (quantity) x (age/sex group)*** with the usually unstated assumption that quantity of services used by each narrowly defined age/sex group stayed constant, or moved in some predictable way with health status as ***NHE = ∑ (price) x (quantity) x (illness prevalence) x (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.

Budgetary Models. The reasons that future spending trends were not being predicted very well by categorical models based on prices and aging became evident in subsequent research.[14] It was determined that budgets and funding, rather than aging or illness or pricing, power 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 relative to a naïve or univariate forecast, and to significantly outperform complex categorical ∑(price *x* age x illness) models that must rely on constancy within each cell.[15] After a period of testing in the 1980s which led to models with large and growing errors, the CMS Office of the Actuary began 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.

CMS, CBO and SOA: the current health forecast models. 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.[16] 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 are similar in structure and eventually end with a stable medical cost trend that exactly matches the rate of growth in GDP.

Short-Run	:	Transition	:	Long Run	:	Steady State *(GDP+0%)*
(1 to 10 years)		*(varies)*		*(years 10+)*		*(begins in 50 to 100 years)*

IV) Getzen-SOA Model: Construction and Calculation of Annual Rates

The projection matrix (spreadsheet) for the current model version 2014_b has been streamlined to make it more transparent and easier to update. The years are in [**column A**] and aligned that **[A18]** = 2018, **[A19]** = 2020, etc. Links to the values entered on the input page are made in cells **[B15 - B19]** *(estimated short run growth rates);* **[C14]** *(starting dollar premium/cost, assumed to be $10,000 in v2014_b)*; **[D20]** *(estimated 2020 start value for health share)*; **[F7 - F9]** *(growth rates for inflation (CPI), real incomes and taste/technology factor);* and **[F11 - F12]** *(Share limit and year limit).* The short run forecasts begin in 2015 **[row15]** and extend to 2019; long run forecasts begin in 2025 [**row25**] and extend downward to 2090 **[row90].** The rates of increase in medical cost for each year are in [**column D**]. The initial medical cost ($10,000 baseline) is carried over from the input page to cell [**C14**]. Each subsequent year's projected medical cost is increased by the medical cost % in **[column C]**, extending downward to a cost of $321,749 for 2090 in cell [**C90**]. The short run percentage cost increases for the first five years (2015-2019) **[B15 – B19]** are direct user inputs carried from the input page rather than calculations within the matrix (see "**Short and Middle Term Forecasts**" below). The next five "transitional" years **[B20-B24**] are calculated as a linear extrapolation between 2019 and 2025.

The core of the model is the "adjusted excess growth rate" found in [**column F**]. It is the primary driver of the forecasts, and mathematically identical to the percentage rate of growth in share (of GDP, wages, consumption, etc.). If the excess growth rate is zero, as it is after the “year” restriction is applied, then medical costs grow at the same rate as wages, GDP, consumption, etc. This keeps the model quite simple. It also highlights the fact that the most significant driver of costs in this model (as in the CBO, CMS and other models or forecasts) is the estimated of the amount of growth due to technology, organizational change and other immeasurable factors. The basic rate of growth in medical costs each year is calculated as:

% medical cost increase = (1+inflation)*(1+real per capita GDP)*(1+ “excess”) - 1

The estimate of the long run (>10 years) excess growth in medical costs (1.4% in the current model baseline) is based on a 15-year moving average of the historical excess as measured by CMS. The estimates of inflation and per capita GDP are based on historical 50-year averages using data from the Bureau of Economic Analysis. The projected long run rate of medical cost growth appears in the projection matrix [cell **F25**] and remains constant in this model until it starts to be reduced by the year or share limits. The projected shares are placed in [**column D**]. The initial value of share for 2020 is user input and carried to the projection matrix in cell [**D20**] (the baseline value of **.192** is taken from the most recent CMS projections). It is increased each year by the adjusted excess percentage growth in [**column F**] until it reaches the year limit and stabilizes.

YEAR LIMIT: The year limit is linked to cell [**F12**]. The excess growth rate is reduced by $1/10^{th}$ each year for the nine years prior to the year limit (2075 in the baseline model). After being steadily reduced by 1/10 for nine years, it is reduced to 0% for the limit year (2075) and thereafter. In the model this adjustment calculation is made in [**column F**], multiplying long run excess growth rate in cell [**F9**] by the ten year average of the year dummy in **[column I]**.

SHARE LIMIT: Calculation of the share limit is a bit more complicated. The share restriction value is copied from the user input to cell [**F11**]. If last year's projected share exceeds the share limit (.250 in the current baseline 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.

$$\text{share limit reduces excess growth}_{t} \text{ by fraction } = [\text{share}_{t-1} - .250]^\wedge(1/2)$$

The model carries out the reduction by multiplying excess growth for that year by a factor of [1-reduction fraction]. Thus in baseline model, the excess growth for 2050 [**F50**] is reduce by .34, and becomes 0.92% (.66 x 1.4%). Note that the excess growth rate can be reduced by either the share limit or the year limit or both, but never becomes less than 0% in this model. Note also that the share limit reduction power parameter [**F10**], currently set at square root (1/2), and the baseline share value in [**D20**] can be modified, but this is usually not advisable and should only be done by a sophisticated analyst 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 and the limitations of and differences between the many data sets being used.

SHORT (1 to 5 years) AND MIDDLE (6 to 10 years) TERM FORECASTS. The forecasts for rates during the first five years (2015 to 2019) are input directly by the user, and may come from any 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. In version 2014_b, the baseline short-run forecasts are a purely technical extrapolation forecasting 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. Income and inflation projections are taken from the February 2014 *CBO Budget and Economic Outlook: 2014 to 2024*. The six-year moving average of real per capita income rises from 1.7% in 2015 to 2.0% by 2019, while the three-year moving average of inflation rises from 1.5% to 2.0%. The expected excess growth rate, as shown on the input page, is 1.4%. The calculated medical cost increases for 2015 to 2019 are 4.7%, 5.0%, 5.3%, 5.4% and 5.5% respectively. Mid-term forecasts for 2020 to 2024 are a linear extrapolation between the final short-term rate in 2019 and the long run rate in 2025, declining from 5.5% down to 5.3%

This model is designed to forecast long run medical cost trends, and to be relied on for projecting liabilities ten, twenty or more years into the future. There are many other sources for short-run forecasts of the next one to five years. Often the actuary using the model has deep insight into local conditions, current trends and fluctuations, or the particularities of a particular package of benefits, and thus does not need to depend upon a general purpose model for short-term forecasts. A casual user could simply input rates for the first five years taken from the Medicare Trustees Report, the CBO Outlook, or the posted CMS OACT projections, or use a set of five annual forecasts generated by some other data set. The focus of this model is on long run costs, rather than particular short-run variations or local conditions. However, it is important that a long-run model have a neutral set of short and mid-term forecasts as a baseline.

V) Accuracy, Uncertainty and Suggestions for User Inputs & Interpretation.

Accuracy of the CMS OACT projections has been the subject of an internal CMS study of single-year projection errors (CMS, 2010), which concluded that on average such errors were about ±1%. Subsequently, an external study of multi-year accuracy up to 10 years was conducted by Getzen (2014), 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.[17] 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 v2014_b is by +1.4% and for about 60 years. Since there are no long run data in which old forecasts can be reliably compared with actual results 50 years later under varying conditions, any confidence interval is necessarily speculative. That said, variation by a factor of 2 (i.e., between +0.6% and +2.6% for between 30 and 120 years) probably provides a range of uncertainty that will include the actual future 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 first necessary to recognize that the biggest source of uncertainty regarding medical spending is uncertainty regarding future economic growth –but also that such uncertainty can be avoided by leaving the task of predicting economic growth to Fed or some macroeconomic forecaster, and focusing on "excess growth" as measured by the percentage increase in share (i.e., benefits relative to total compensation or wages, medical consumption relative to median household income, health share of GDP, etc.). [18] The real task of the health actuary is take (not make) the best available estimates of economic growth (inflation, population, income), forecast the rate of excess cost growth for medical care, establish prudent ranges, and use them to provide reasonable and defensible estimates of future liabilities.

Summary Points:

- Economic growth is the primary driver 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.
- Other variables (including illness, payment rates, physician supply, aging, elections, policy, etc.) are not able to consistently explain or improve long-run 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., 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% - +2% and appears to be headed downward.
- Uncertainty of about 1% per year (compounded) is plausible.

Notes

[1] CMS, Office of the Actuary *National Health Expenditures by type of service and source of funds, CY 1960-2012* and *National Health Expenditure Projections 2012-2022* accessed May 5 2014 at http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/

[2] U.S. Department of Commerce, Bureau of Economic Analysis, *Current-dollar and "real" GDP* (excel spreadsheet) downloaded May 5 2014 from www.bea.gov. The 2013 nominal and real GDP figures of $16,769 billion and $15,736 billion respectively are taken as the historical base for 2013.

[3] U.S. Congressional Budget Office, *The Budget and Economic Outlook: 2014 to 2024*, www.cbo.gov/publication/45010 dated 04 February 2014, excel file for Table 2-1 downloaded 16 June 2014. The historical BEA 2013 real GDP base of $15,736 billion is projected to increase for each subsequent year by the percentage estimated by the CBO (3.1% in 2014, drifting mostly downward toward 2.0% by 2024, and extrapolated to be 2.0% for 2025). The historical BEA 2013 nominal GDP base of $16,769 billion is projected to increase for each subsequent year by the compounded percentage estimated by the CBO (the annual % increase in real GDP and the increase in inflation (1.5% in 2014, drifting upward toward 2.0% by 2024, and extrapolated to be 2.0% for 2025).

[4] U.S. Census Bureau, Table B-34, Population by age group, 1939-2011. Table 1. Annual Estimates of the Population for the United States, April 1, 2010 to July 1, 2012 and Table 2. Projections of the Population by Selected Age Groups and Sex for the United States 2015 to 2060, December 2012 [downloaded May 5 2014 at http://www.census.gov/topics/population.html] . The historical baseline is the reported 2010 population of 309.3 million. The projection for each subsequent year is the percentage as published in the December 2012 version of the census projections for 2015-2060 (approximately 0.75% per year gradually declining).

[5] see Getzen, T.E. (2000). "Forecasting Health Expenditures: Short, Medium and Long (long) Term." *Journal of Health Care Finance* 26(3):56-72, 2000; and also Getzen, T.E. (2014c) "Accuracy and Range of Actuarial Projections of Health Care Costs" *forthcoming*, currently available at SSRN#2213648.83.

[6] 6. For a recent discussion of the growth trend for U.S. income per capita, and the possibility of substantial deviations from trend, see J.G. Fernald and C.I. Jones C.I. (2014) "The Future of US Economic Growth." *American Economic Review* 104(5):44-49.

[7] Changes in income *distribution* may affect medical cost trends as much as changes in the rate of average growth per capita. Since 1980, the real earnings of middle-class working households have grown by less than 1%, and has actually declined significantly 2001-1012, while the income of top earners has soared (U.S. Bureau of the Census, http://www.census.gov/hhes/www/income/ and "Household Income: 2012" http://www.census.gov/prod/2013pubs/acsbr12-02.pdf; Thomas Piketty, *The Cost of Capital in the 21st Century,*

Belknap Press, 2014). The ability of regular employee benefits and taxes to support growth in medical technology may therefore be less than the growth in the average would indicate. Indeed, it is not impossible that over time the United States may devolve into more of a two-tiered system with the top layer receiving all the latest technology in luxury settings, while most employee plans provide only "regular" benefits with fewer choices using well-tested (i.e., older and less-expensive) technology within a narrow network of providers (see note 9 below).

[8] "Excess" medical costs are measured as a residual, the amount of total cost growth above the rate of growth in current or smoothed income. Measurement by residual is the only method currently available, and is accepted by the CBO, CMS and other agencies and analysts as the most valid measure of excess cost growth. Research supporting the use of smoothed income to capture the distributed lag response of health expenditures to economic fluctuations and to forecast future health spending and insurance premiums is provided in a series of articles referenced in the accompanying *Technical Manual for Model 2014_b* (Getzen 1990, 1992c, 2000, 2014a,b,c,d). The income smoothing function used here is a 6-year trailing moving average of real income per capita with a trailing 3-year moving average of the GDP deflator. For the year 2010, the smoothed economic base is calculated as

***smoothed* 2010 income =**

(% annual growth real per capita income 2004-2010) x (% annual price increase 2007-2010) -1

[9] See "Factors Influencing the Size of Taste/Technology Component of Healthcare Trend," in the appendix of this manual prepared by members of the project oversight group of health actuaries reviewing this model. While short-run projections commonly use different growth rates for different categories of patients or treatments, convergence toward a single underlying growth rate applicable to all types of care and patients over the long run has been usual for forecasts of more than twenty years, such as those by the CBO, Medicare Trustees and the SOA. However, increasing disparities in income growth between households, and increasing disparities in prices for treatment (as, for example, between generic drugs and the new personalized pharmaceuticals like Gleevc, Kalydeco and Solvadi) will place more strain on medical care financing—strain that may bifurcate the system into upper and lower tiers, or make use of separate cost increase rates by type of care more attractive and accurate. No conclusions have yet been reached, but the SOA intends to continue study of the usefulness of differential rates of cost increase over the long term, which may lead to separate "taste/technology" growth rates for different categories of patients and/or treatments in the future.

[10] Since the excess cost rate has clearly trended downward over the last 30 years (see Figure 6 in the Technical Manual), it could be argued that budgetary limits are already playing a role, and have being doing so for decades.

[11] The rate of increase in health spending (h) is decomposed as *growth in health* = *inflation* + *real gdp growth* + *excess* and taking account of compounding: $\boldsymbol{h} = (1+d)*(1+r)(1+x) -1$

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

$$\boldsymbol{s} = (\mathrm{H}*(1+d)*(1+r)(1+x)/\mathrm{Y}*(1+d)*(1+r)) / (\mathrm{H/Y}) - 1 = \boldsymbol{x}$$

[12] This constraint is necessary to make the model stable in the long run. Any model with growth consistently above GDP eventually grows to consume everything, while any model with growth consistently below GDP eventually shrinks to irrelevance. Note that cast in regulator terms, it is quite like the SGR reimbursement restriction so hated by most physicians, and especially by procedural specialists.]]

[13] There are few records of average medical costs prior to the 20th century, but payments for treatment show up even in the Sumerian cuneiform tablets from millennia ago, and were clearly common in the classical Greek and Roman economies. Extrapolating from calculations of physicians as a percentage of the workforce, it appears medical expenses were usually small but never insignificant, probably between 1% and 3% of total spending in the monetized economies of urban markets---within the range of the earliest regular studies of consumption carried out during the 19th century (Stigler, 1957). It is not possible to determine annual growth rates from 1930 to 1960 with precision, but the excess seems to have been somewhere between ¼ and ¾ -- rates consistent with doubling every 150 years.

[14] Abel Smith (1967), Newhouse (1977), Getzen (1990), Gerdtham (1992) and others showed that per capita income was the primary determinant of per capita medical costs. Getzen (1992b) showed that medical prices were not related to spending. Getzen (1992a), Barer (1989), Cutler and Meara (1997) and others showed that spending for the elderly was driven not because more 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.

[15] 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.

[16] Medicare, SSI, CBO and many other government and private projections make use of the CMS ten-year projections, as did some previous versions of the Getzen SOA model. However, these three are the only each year with sufficient past records and documentation to allow their forecast errors to be reliably quantified and compared. Even so, it must be admitted that the track record is quite short and any assessment must be taken with several grains of salt.

[17] That is, about ±4.6% after five years, or ±9.4% over ten years. See Getzen [2014d].

[18] 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.

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Appendix 1: Consistency of Baseline Assumptions with Actuarial Standards of Practice

Prepared by members of the Project Oversight Group

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 the 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.

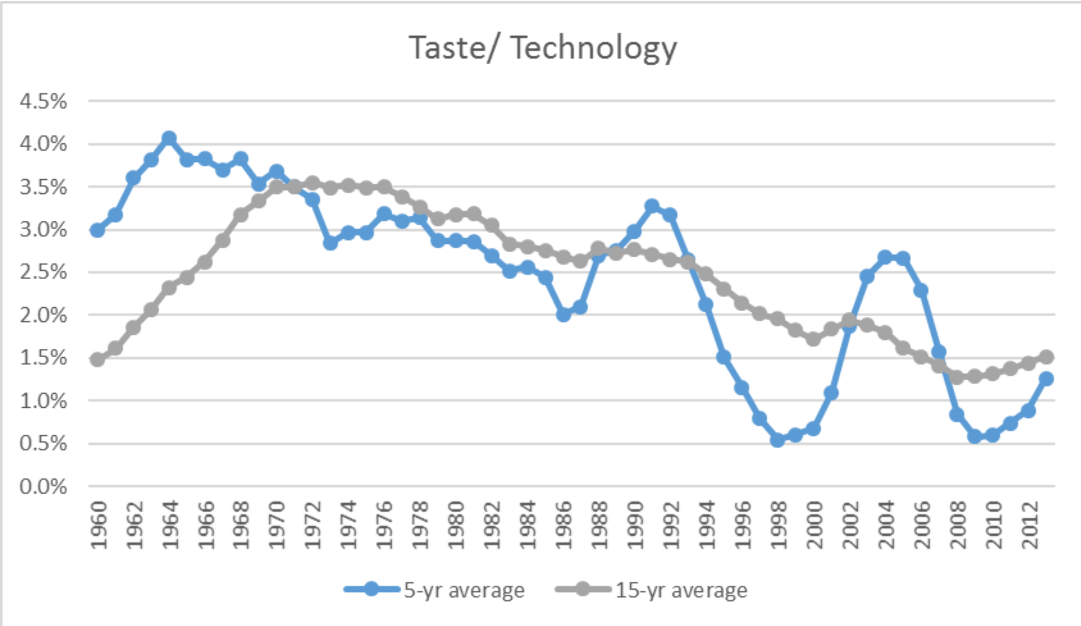
The POG recommends that the actuary consider the selection process for the other economic assumptions and use inputs to the SOA long term trend model that are consistent with the other economic assumptions. For example, the other economic assumptions will generally include either implicitly or explicitly 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 2: Factors Influencing Size of Taste/Technology Component in Healthcare Trend prepared by members of the Project Oversight Group of health actuaries, June 2014

The third component of the model is the taste/technology parameter. The chart below shows the 5-year and 15-year moving average historical values. From a peak of 4 percent in the early 1960's the 5-year moving declined gradually to about 2 percent in the mid-1980's. Since then, the taste/technology component has experienced cyclical increases and decreases in the range of 0.50% to 3.5%. The 15-year average has declined from a peak of 3.5% to about 1.25%.



Healthcare technology has created new procedures, durable medical equipment, and an array of prescription drugs that have improved health and replacing expensive and invasive surgery. Healthcare delivery is moving, albeit gradually, to a more coordinated system. A significant proportion of the Medicare population now receives their care through Medicare Advantage plans which coordinate the Part A and Part B services. Medicare enrollees average length of stay in hospital has declined significantly over the last 20 years. Working age population has increased the usage of retail clinics and urgent care centers. There has been a decades long shift in care from hospital-based care to "outpatient" ambulatory care centers. Generic drug usage has increased steadily, with a rapid increase in the last five years due to the expiration of several blockbuster drug patents.

The size of the taste / technology component will be influenced by several factors, some of which will likely increase the parameter and others that will likely cause it to decline. Practitioners should consider these factors when selecting the taste/technology component.

1. Electronic Medical Records
2. Telemedicine
3. New drugs
4. Use of smartphones and apps
5. 3D Printers

6. Hybrid Operating Rooms
7. Digestible sensors
8. Personalized medicine

Descriptions of the likely influence on costs and usage are provided for some of these factors below.

Lastly, other social behaviors can affect the taste/technology component, such as the prevalence of Advance Directives. Studies have shown large last-year-of-life cost differences between patients who have and those who do not have Advance Directives. As life expectancy increases, there is likely to be a growth in the prevalence of Advance Directives, and with improved electronic medical records, this information will be stored and available to be referenced in all settings. Increased usage of AD's can have a material impact on the volume of healthcare services, which in this model is reflected in the Taste/technology component.

<u>3D printers</u>

Applications of 3D printers in healthcare that could have an important impact in the future.

- Embryonic Stem Cells: These cells have already been successfully printed in a lab and could be one-day use to create tissue that could help test drugs and assist in the growth of new organs.
- Printing Skin: There have been many advances in the areas of developing skin to help burn victims and skin disease patients, 3D printers can help further jumpstart these advances with the addition of laser-printed skin cells.
- Blood Vessels & Heart Tissue: A company that has already successfully printed blood vessels and sheets of cardiac tissue that actually beat along just like a real heart.
- Replacing Cartilage & Bone: 3D printers have also helped scientists and doctors create stem cells that could eventually develop into both bone and cartilage in the long-term.
- Studying Cancer: Printing cancer cells is a way of growing these cells on tissue in a lab to study, test drugs on and to eventually find a cure for.
- Patching a Broken Heart: Printing cells with a 3D printer proves useful in a recent study of rats that had previously suffered heart attacks and were given these patches of cells to help slowly help improve their heart function overtime.
- Replacement Organs: Printing new part for organs or entire organs all together will help solve an ongoing medical need and help save hundreds or thousands of people every year waiting for an organ donation to come thru.

<u>Hybrid Operating Rooms</u>

With the addition of new technology, comes the integration with established technology and systems that either needs to be replace completely or connected with to improve their performance or build upon the brand new technology's use. This is a difficult task for healthcare professionals due to the complexities of the systems, technologies and operations currently in place at all healthcare facilities, hence why this industry is often the slowest moving when it comes to impactful change.

A hybrid operation room is a new innovation where a traditional OR is outfitted with advanced medical technology to improve the care delivered to patients and enhances the skill-sets of medical practitioners when it comes to administering treatment. The Lakeland Regional Media Center is an example of a hybrid operating room, one of the first in its area, but definitely an indicator of more widespread changes to come to operating rooms around the country innovating on existing processes and technologies with traditional surgical procedures and treatment options. Technologies used in hybrid operating rooms have typically helped reduce trauma, scarring, spurred faster rehabilitation and has helped decrease hospital stays. The technologies used at the LRMC that helped improve a patient's experience at a hospital included advanced imaging technologies that allowed for real-time intra-operative image guidance, as well as tools to help perform high-risk minimally invasive cardiac procedures.

Digestible Sensors

Approved in 2011, digestible sensors will continue to provide healthcare professionals with more information about the human body and how various treatment solutions affect each system of organs. A digestible sensor is a sensor that transmits information about a patient to medical professionals to help them customize the care to the individual as well as the care provided to other individuals experiencing similar health conditions or ailments.

This technology would eventually allow an individual to swallow a pill provided by their doctor and skip their physical because the digestible sensors, that look like regular pills, could perform all the same functions a doctor typically handles in a standard physical and then some. Digestible sensors will monitor your bodily systems and wirelessly transmit what's happening in your body to another device like your smartphone or computer for your own review or the review of your doctor. Latest innovations with digestible sensors don't even require a battery source since they solely rely on the human body as an energy. An innovation of this nature could have far reaching effects for healthcare by helping detect diseases and conditions at earlier stages in people digesting these sensors that are in turn, constantly monitored wirelessly.

Apps for Patients

Some cutting edge apps include:

- **iTriage** helps users to evaluate their symptoms and can suggest the nearest hospitals
- **iBGStar Diabetes Manager** includes an iPhone-enabled meter to track blood glucose and insulin levels through an app. The collected data is then shared automatically with your doctor's office
- **iHealth Blood Pressure Dock** measures blood pressure as well as heart rate and reports its finding in interactive graphs displaying your vital signs.

Apps for Doctors

There are quite a number of useful medical apps already relied upon by physicians, such as:

- **Epocrates** is a well-known medical app that provides physicians with basic information about different drugs, proper dosages for adults and kids as well as warnings about harmful combinations of medications. This is truly an electronic version of the Physician's Desk Reference.
- **UpToDate** is a reference for when doctors are making treatment choices.
- **Isabel** is an app that allows doctors to input symptoms and see a list of possible diagnoses along with another list of medications which could cause these symptoms.

- **Alivecor** works as a heart monitor that can produce electrocardiograms when patients place their fingers on the monitor's sensors, "which wirelessly communicate with the phone to produce the EKG."
- **iHealth Wireless Pulse Oximeter** is an app that helps people struggling with sleep problems record their own blood-oxygen levels throughout the night. This data then helps doctors diagnose sleep apnea. This app utilizes a fingertip sensor which is worn by the patient and communicates wirelessly with the phone.
- **Resolution MD** allows doctors to view X-ray images on their smartphones or tablets.
- **CellScope Oto** transforms a smartphone into an otoscope to view inside the ear. An optical device accompanies the app and allows doctors to record video from inside the ear.
- **referralMD** is a web/mobile application that offers a comprehensive business management solution designed to track and help monetize healthcare referrals. Similar in structure to a Customer Relationship Management (CRM) program, referralMD manages healthcare referral network exchanges, economic and new business development efforts. It's an application to specifically track referral sources, collaboration opportunities, follow-up activity and measure localized network growth.
- **iScrub** helps to control infections by rapidly displaying data about how well hospital staff are doing washing their hands. Hospitals often hire observers to check on how doctors, nurses and other staff are doing in the cleanliness department. This app provides a simple way for the observer to share observations with a central database. The speed with which the app communicates and updates can help change behavior right away.
- **Breast Cancer Diagnosis Guide** is an app that helps "breast-cancer patients enter and track details of their disease and treatment, from the size of the tumor to the presence or absence of estrogen receptors."
- **Clinicam** works when a physician takes a picture of a patient's condition, i.e. a rash or wound. The images are then uploaded to the individual's electronic medical record without storing the pictures on the doctor's personal mobile device which helps doctors keep the health-care privacy laws while still benefitting from a photo reference because a picture is worth a thousand words.

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