Measuring and Forecasting Global Health Expenditures

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Abstract

Section I of this chapter briefly reviews the literature on medical spending, which suggests that health expenditures began small but steadily increased throughout history (from 1 percent to 4 percent of GDP), then began to increase rapidly among wealthier developed countries after 1950. Section II examines temporal and spatial dimensions of measurement, which suggest that the evolution of global health expenditures may be best observed by tracking health expenditures as a share of GDP over decades. Nominal and real per capita amounts are subject to distortions created by lags and currency valuation. Months and years are too short a span, while persons, households and provinces are too small. Section III covers growth in the components of health expenditures (population, income, inflation, excess due to technology and other factors). A model of national health expenditure decisions over time is presented and used to explain empirical findings of varying distributed lag responses to macroeconomic growth and development. Section IV considers the methods and accuracy of national health expenditure forecasting. Section V addresses some problems of variable identification, with specific applications to population aging and the aggregate fiscal burden of care for the elderly. Section VI discusses the sustainability of current trends and the boundaries between long-term care, retirement and medical expenditures. It concludes by proposing that rising longevity and medical costs are best viewed as aspects of a process of economic and human development transforming the 20th and 21st centuries, rather than as isolated phenomena. The six sections each conclude with a discussion of policy implications, even the most technical sections regarding measurement, aggregation and lags, where the policy implications may not be immediately apparent. While nominal policies are publicly stated, it is often these "technical details" regarding boundary definition, timing and measurement that show how policy actually operates, that shape public opinion, and that drive future financial decisions.

I. Introduction and Historical Background

Medical Spending: the first 5,000 years

For as long as there has been money to spend, there have been health expenditures. The earliest financial records are those inscribed in Sumerian cuneiform tablets circa 5000 BC. Listed there are prices for medical treatment; ½ mina of silver for a slave, 1 mina for a worker in the household, and 2 minas for a member of the family (Pritchard 1958). The Code of Hammurabi (circa 1772 BC) spells out fines for different types of medical malpractice (botched surgery, substitution of inferior drugs). Later, the Hippocratic Oath refers explicitly to payments from patients and the conditions for free care. The conclusion that medical care has been an economic activity with market prices (and subsidized government care or free care through religious institutions) throughout human history is inescapable. A quick review of economic history indicates that medical care was a steady but relatively small part (1 percent - 4 percent) of total market activity until about 1950. However, it is difficult to compare Sumerian silver minas to millions of Euros, or even the "Geary-Khamis" dollars in the Maddison estimates of historical global economic output (Maddison Project, 2014). It could be questioned whether it is even possible to estimate comprehensive measures of "health expenditures" prior to the construction of national income and product accounts in the 20th century.

Prior Literature

Seminal publications on health expenditures include the 36-volume *Report of the Committee on the Costs of Medical Care* in 1933, the 1956 *Guillebaud Report* on the costs of health care in the UK , Jean-Pierre Poullier's 1972 OECD publication *Public Expenditures on Health*, and Robert Fogel's *The Escape from Hunger and Death, 1700-2100: Europe, America and the Third World*. Archival information exists allowing estimation of health spending in absolute and relative terms using methods familiar to cliometricians. On the production side, the fraction of labor devoted to medical work yields a rough estimate of the health share of total economic output when combined with some reasonable assumptions about wages and non-labor inputs. On the demand side, the fraction of household spending devoted to health is used as a starting point, keeping in mind the importance of non-private funding and the difference between these "typical" families and a true national average.

The first comprehensive and rigorous estimate of total national expenditures on health was made by the researchers in the United States under the Committee on the Costs of Medical Care (CCMC, 1933).[1] Their estimate of 3.5 percent for the year 1929 is still taken as having established a standard for this era and is incorporated into the official national health expenditure accounts maintained by the Office of the Actuary and reported to the Organisation for Economic Co-operation and Development (OECD, 2000). Nothing comparable was done until Brian Abel-Smith and Richard Titmuss produced the Guillebaud report on the costs of the National Health Service (NHS) in the United Kingdom in 1952 (Abel-Smith an Titmuss, 1956). A decade later, Abel-Smith organized the available international data on expenditure in a report for the World Health Organization (WHO), an exercise repeated in 1968 (Abel-Smith 1963, 1967). Similar data was used by Joseph Newhouse to analyze the determinants of national health expenditure in 1977, reporting that after per capita income is accounted for as a determinant of health expenditures, "there is little left to be said," a result confirmed by a number of others over the next 30 years (Newhouse, 1977; Maxwell, 1981; Gerdtham *et al.,* 1992; Getzen, 1990, 2014).

The OECD health data set providing comparative annual health expenditure estimates for most developed nations from 1960 to the present has now become familiar to most health economists. Organizing, collating and harmonizing data from many sources and different periods was a tremendous advancement in methodology, carried out almost single-handedly by Jean-Pierre Poullier during the 1970s and 1980s. After he regularized this effort within the OECD structure, it was passed on to a group of economists who now perform annual updates and periodic benchmark revisions. The solid line in Figure 1 uses this OECD data set to graph the average rate of growth in the health share of Gross Domestic Product (GDP) among selected countries since 1960. The dotted line before 1960 represents a reasonable set of estimates for growth prior to the postwar surge in spending that will be discussed in Section VI. The dotted line after 2015 represents a forecast indicating that growth is expected to moderate over the coming decades, as will be discussed in Section IV.

Figure 1: Health Share of GDP (source: OECD Health Data 2014 and author calculations)

With detailed data available for the past 50 years, empirical research has been able to determine that national health spending is highly related to a country's state of economic development and per capita GDP, as well as to some specific elements of the medical workforce and organization, but is not determined or is only weakly affected by life expectancy, morbidity, population aging, the division between public and private financing, or available measures of per unit medical prices. The more limited historical records available for previous millennia cannot be reviewed in detail here, but indicate an average health expenditure within a range of 0.5 percent to 5 percent of total spending, which grew more slowly than in recent decades and differed widely across locations and between urban and rural areas, and would also support the following generalizations:

<u>Historical generalizations for medical expenditures in prior millennia (5000 BC to 1960)</u>

- Medical expenditures were small but significant since the start of history.
- Expenditures were concentrated on drugs and procedures, not "care."
- The transformation to modern scientific medicine with rapid increases in spending during the 20th century was preceded by and dependent upon the industrial revolutions of the 19th century, as well as the demographic transition that began in the 18th century.
- Expenditures varied widely by the type of health system and the patients they served (for example, urban vs. rural; India vs. Europe; poor vs. rich; or factory worker vs. farmer). There were a multiplicity of "systems" within each nation, and price discrimination was used inside and between systems.
- Medical leadership in research and innovation shifted from France to Germany, then to the UK, then to the US, and is now drifting toward India and China.
- Pharmaceutical firms have been the most international and future-oriented segment of the health care industry.
- Academic medical centers with expensive research programs, while nascent in the 19th century and earlier, started to become dominant around 1960.
- Health expenditures had begun to rise rapidly in many developed countries by 1960.

<u>Generalizations for modern health expenditures (1960 – 2015)</u>

- Increased spending reflects economic growth.
- Health care spending responds slowly and with a lag to major macroeconomic shifts.
- Population aging has been concurrent with but not a major cause of the rise in health expenditures.
- Twenty years is not long enough to judge historical trends.

Policy Implications. The premise of this chapter is that lessons gleaned from the study of health expenditure growth across countries over long periods of time growth will help to make policies more effective and reduce the number of times that failed policies are retried. The most important lesson is that the major health policy objective of the 20th century was reached – science advanced extending the lives of people across the world as the ravages of disease were reduced. However, there have been unintended consequences, mostly notably the continued and unsustainable increase in costs. Long-range planning and management of systems has become a critical necessity as longevity of 75 or 100 years becomes widespread. Workers currently entering the labor force will not retire until 2050 or later, yet retiree health benefits already impose a heavy fiscal burden on governments. Research to find out why expenditures move up or down over time (or why they do not) and how long it takes to know the difference, may or may not make cost cutting less painful, but it may well make the process of managing expenditures more rational and accurate. It might also stop the false demonization of some purported "causes" of expenditure increases (e.g., longevity, drug abuse, obesity, and pollution) and prevent the application of policies that have repeatedly failed in the past. Better analysis of the past 150 years will create better public understanding of the extent to which excess growth has already moderated and perhaps reduce the panic response that engenders bad policy. "Technical" refinements in methodology, such as better measurement of trends and variance, will enable more distinctions between good and bad policy to be made on the basis of evidence rather than ideology, bias, or advantage to a particular interest group.

II. Measurement: Temporal, Spatial and Administrative Units of Observation

Data is sometimes analyzed because, like Mount Everest, "it is there." The availability of administrative data is no substitute for careful thinking about what units of observation would be best suited to the study of a particular subject of interest, or how different geographic and temporal spans of observation may make some phenomena very prominent while hiding or obscuring others. The unit of observation should be matched to the span of the phenomena that is to be observed (usually somewhere between 0.1 times and 10 times the length). It is not helpful to study global warming with daily temperature observations, much less hourly or second-by-second observations, since the signal would be overwhelmed by noise. Conversely, the dynamics of a lighting bolt from the clouds cannot be observed with annual or monthly observations, but in this case photographs taken every second are useful and multiple observations over a fraction of a second even more so. The choice of spatial units poses similar issues (see Getzen 2000a, 2006).

Employment offers a useful starting point for studying health system change because it is not subject to many of the problems inherent in financial measures (such as adjustments for inflation, taxation, exchange rates, timing of payments, or the border-crossing funding flows that occur when local expenditures are covered by NGOs, federal insurance plans, or other payments originating from out-of-area). The health shares of labor can sometimes even be calculated for pre-market agricultural economies. Furthermore, a wide range of temporal units are available (by month, year, decade, or century) for different geographic units (precincts, towns, cities, provinces, nations). Figure 2 plots total employment and health employment for the US from 1990 to 2014. It is evident that health employment is growing more rapidly and is much less variable. The difference in variance is even more apparent in Figure 3 showing the month-to-month change. Figure 4 graphs the percentage change over the preceding 12 month span, removing seasonal variation and smoothing the series.

Figure 2: Employment in Health & Total Employment: US 1990-2014

Figure 3: Monthly % Change in Employment, Health & Total: US 2005-2014

Figure 4: 12-Month Change in Employment: US 2005-2014

(source for Figs 2, 3,4: BLS Data 2014 and author calculations)

Technological Dynamism and Fiscal Inertia

Medical knowledge changes quite rapidly, but changing the organization and systems of payment is a slow and drawn-out process. Coordinating thousands of patients, doctors, hospitals and payers is time-consuming. Hence, the response to any sudden change in the environment (such as a recession) tends to be delayed and extended. The public and political consensus required to re-structure medicine cannot be formed very quickly.

Investments in physical and human capital build delays into the structure of medicine. Hospitals take years to construct, and the education of doctors and other health professionals place them into occupational categories that remain rigid for decades. **Figure 2** indicates how inertial the modern medical system has become. The sluggish response to changes in the macroeconomic environment are also clear in **Figure 5a,** which shows how health spending in Finland declined in response to that country's sharp recession in 1991, but only after a lapse of two years. The response to inflationary shocks is similarly slow and delayed, as can be seen in **Table 1,** presenting Canadian data around the time of the OPEC (Organization of the Petroleum Exporting Countries) oil embargo and attendant spike in prices.

Fig 5 Finland 1980 -2000 **a)** annual % growth in real GDP and Health Spending

b) Correlation with current growth **c)** correlation with lagged growth

Source: OECD Health Data 2014 and author calculations.

Table 1: Inflation and Health Employment in Canada

Decomposition: Inflation, Population, GDP, and Excess Growth

Reports on spending typically make the distinction between total and per capita amounts and separate the growth rates into real and inflation components. Comparisons of health expenditures over time are often expressed in terms of the share of GDP or fraction of total wages. Decomposition shows that growth in the share is computationally identical to the excess growth in health spending (as compared to growth in GDP or wages). Let:

Y = nominal GDP
- *g = growth in nominal GDP*
- *r = growth in real GDP*
- *d = inflation rate* (GDP deflator)

H = nominal health spending
- *h = growth in nominal health spending*
- *x = "excess" growth (h – g)*

S = health share of GDP (H/Y)
- *s = growth rate of health share*

Health spending is decomposed as:

growth in health spending = inflation + real GDP growth + excess growth

Taking account of compounding:

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

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

$$s = (H*(1+d)*(1+r)(1+x)/Y*(1+d)*(1+r)) / (H/Y) - 1 = x$$

Since the percentage growth in share is identical to excess growth, the two terms will be used interchangeably here. Graphs of shares are often more intuitive and quickly grasped than plots of nominal spending or excess growth rates since they are comparable across time periods, regions, countries and groups without regard to population, price levels, exchange rates or other factors that would require adjustment. Share estimates tend to be more reliable and available than spending estimates for historical periods and organizational sub-groups, and illustrate:

- Spending relative to total resources available (budget constraint) at each point in time.
- Where growth is equal to GDP+0% (curve is flat and horizontal).
- The rate of excess growth (slope is steeper where excess growth is larger)..
- The point of maximum excess growth (located at the inflection point of the curve).

Excess growth is the best general measure for comparing health spending across time and place, but care must be taken since share is calculated as a *Health:Total* ratio, and hence any mismatch between numerator and denominator in definition or boundary will distort the ratio. Most importantly, the lags between a rise (or fall) in GDP mean that most of the month-to-month and year-to-year variation in growth rates are due to temporary changes in GDP rather than changes in the long run trend of health spending (which are inertial and occur much more slowly). Table

1 illustrated how a measure of physical resource use (labor) can avoid the distortions arising from delayed adjustment to price levels. However, the delays in labor adjustments due to shifts in real GDP growth remain. Researchers intend to determine how health consumption changes in response to permanent income changes, but current data correlations show primarily the response to transitory income changes (Friedman, 1957; Getzen 2014). This mismatch in timing can be reduced econometrically by using a smoothed version of GDP that more closely approximates the "true" rate of income growth as perceived by the public and policy makers. A moving average of growth over the preceding years appears to remove most, but not all, of the distortions caused by transitory GDP fluctuations, and is discussed in greater detail later in Section III

<u>A Model of Health Spending: Decisions and Transactions</u>

Spending occurs when a transaction takes place. Sometimes, a transaction is as simple as the exchange of money for services at a point in time, but most medical transactions are embedded in a complex web, with most cash flows determined by private and government insurance contracts with agreements, rules and specifications that may run for many years. Only a small portion of medical exchanges are as simple as buying a bottle of aspirin or paying $1,200 to have a tooth capped. A skeletal description of the complex medical care spending process can be modeled as follows. Let:

$_i$ = individuals	$_N$ = Nations
y = individual income	Y = National Income
ψ = individual decisions	Ψ = National Decision
h = individual medical spending	H = National Medical Spending

M = Medical System
δ = tax rate
$_t$ = time (in years)

Although individuals and nations must make expenditures from current income (supplemented by savings or debt), those decisions are usually based on their expectations of long-run permanent income, denoted by ɏ_t for individuals and Ɏ_t for the nation as a whole.

Expected Permanent Income:

$$\text{ɏ}_t = f(y_t, y_{t-1}, y_{t-2}, \ldots y_{t-n}, z)$$
$$\text{Ɏ}_t = f(Y_t, Y_{t-1}, Y_{t-2}, \ldots Y_{t-n}, Z)$$

National health expenditures are a combination of government and private spending. The government budget is a fraction of total current national income, determined by the tax rate δ. Individual budgets are determined by earnings less taxes. However, government strongly influences individual spending through the regulation of medical care and insurance. Most individual spending is a residual response to collective rules, subsidies and risk-pooling, rather than a personal expenditure commensurate with their own personal assessment of the value of treatment (i.e., premiums, co-payments, mandates, inflation). Individual citizens have some power over how the national budget is spent, but only through the political process.

Government Budget: $\delta Y_t = \delta \Sigma y_{it}$

individual budgets: $(1-\delta)\, y_t$

The medical care system (M) at a point in time (t) is determined by the individual and national decisions made in prior years and also by some exogenous parameters (Z), such as technology, biology, historical accidents, trade, and so on. Decisions are made atomistically by individuals (ψ_i) and politically by nations (Ψ) in each year. An individual making a decision at a point in time ψ_{it} does so based on the medical care system as it then exists (M_t), their estimated permanent income at that time ($\cancel{y}_{it}$), the decisions they have made in prior years, and other factors such as tastes, preferences, and health status. National decisions are made each year (Ψ_t) and the budget is allocated with the goal of optimizing current and future states of the medical care system balanced against other goals and objectives (defense, education, debt, etc.). Similar to individuals, the nation must take the current overall state of the medical system as a given, but it is also attempting to optimize based on the nation's estimate of how those decisions will affect the system in future years $\cancel{M} = (\cancel{M}_{t+1}, \cancel{M}_{t+2}, \ldots \cancel{M}_{t+n},)$ The estimated future state of medicine in each future year is indicated by a single strike as $\cancel{M}_{t+n}$. The rolling cumulative estimate of the path of medical care over all future years is indicated by double-strike as $\cancel{M}$,.

$$h_{it} = f\,(\psi_{it}, \{1\text{-}\delta\}y_t, M_t, \cancel{y}_t, z)$$
$$M_t = f\,(M_{t-1}, \Psi_t, \delta Y_t, \cancel{Y}_t, Z)$$
$$H_t = f\,(\delta Y_t, \Psi_t, M_t, \cancel{Y}_t, \cancel{M}, Z) + \sum h_{it}$$

Thus, individual health spending (h_{it}) depends on a set of individual decisions, disposable income, the state of medical organization/technology, and other factors (including health status). The current state of medicine (M_t) depends of the state of medical organization/technology inherited from the prior year, supplemented by new decisions and financed with current (and future) national budgets. The nation's health spending (H_t) is determined by its current and permanent income, the current state of medicine, as well the expected effect of the decisions taken on future states of medical care, with a stub added to account for individual health spending.

These equations are largely recursive and cannot be solved — medical spending depends on a medical care system that is a complex function of prior and expected future states, which are themselves determined by decisions affecting organization and technology that are only intermittently and incompletely observable, and virtually never quantifiable. What these equations can do is to isolate those variables that are observable, and provide some insights into a temporal structure that must then be estimated.

The state of the medical care system (M_t), is a convenient construct, but not observable or quantifiable. Decisions (Ψ_t) are only occasionally visible, and have effects that may only become apparent with the passage of time. The two variables within the model that are observable and measurable are income and health spending. Everything else resides within a black box. Thus, the only reduced form that can actually be estimated is:

$$H_t = f(Y_t, Y_{t-1}, Y_{t-2}, \ldots Y_{t-n}, Z)$$

Even though most of the internal structure is unobservable, the model does suggest why the health care system has such a long memory and where that memory resides — in the structure of the medical care system itself. It takes a long time to craft and implement major changes. Once established, the residual effects of a major policy shift will linger for decades. The fiscal impact will eventually decline, but a pattern of delays or lingering effects is itself evidence that the change was structural. Empirical estimates of such delays and interactions may provide insights into the interior workings of the healthcare system that are hidden behind the details available on the surface. This model does not provide much additional empirical content, but it does provide a way to conceptualize how change occurs and how it is (or is not) reflected in measures of total health expenditure. It provides a means for understanding why the patterns of spending resulting from business cycles would not be the same as those resulting from productivity shocks, and why patterns will differ across countries whose medical organization differs, or across categories of spending for which the transactions are very different (for example, contracts for hospital construction compared to out-of-pocket spending for drugs).

Aggregation, Cross-Sections, Time Series and Uncertainty

The creation of double-entry National Income and Product Accounts (NIPA) was a major accomplishment, part of the work for which Simon Kuznets and Richard Stone were awarded Nobel prizes. It rests on a fundamental accounting identity: *Income = Consumption + Investment* (with relevant supplemental additions and subtractions for taxation and government expenditure, foreign trade, and so on). Empirical analysis of macroeconomic phenomena and trends, a topic made critical by the great depression in the 1930s, blossomed with the availability of data on GDP, price levels, productivity, and other variables that were comparable over time and across countries. Similarly comparable data series for health care were generally lacking until recently, and are still less regular and homogeneous. Hence, the OECD health data set constructed by J-P Poullier was also major achievement in this regard, even though it does not begin until 1960 and still has a number of gaps and discontinuities. Collating and harmonizing information from so many disparate sources is difficult. National statistical agencies must rely on reports from hospitals, physicians or insurance plans to supplement any direct observations on patients, which are often limited to queries regarding illness episodes or out-of-pocket payments. Definitions, nomenclature, categories, organizational and geographical boundaries, even the dating of a fiscal year, may all be different from one country to the next, and usually change over time. Many adjustments and judgment calls are required to collate and harmonize data sets, as well as significant effort and hard choices between conflicting estimates.

Most expenditure measurements in health economics come from administrative records or surveys rather than experiments or field trials. Observations are often bounded by the vagaries of regulatory procedures, functional limitations, managerial goals or historical precedent rather than designed to match the expected span of impact or the phenomenon of interest to the researcher. The level of temporal and spatial aggregation must be chosen carefully to avoid misleading results. Time series and cross-sectional analyses each have strengths and weaknesses, but the combination in panel data is more technically challenging, more prone to misinterpretation and error. Aggregation and extrapolation from a limited number of observations to make a national estimate is difficult; to make such data internationally consistent across a number of years is a heroic effort. However, once the OECD health data set was created, it was easy to use and there was no way to forestall casual analysis by researchers with little understanding of the assumptions, caveats and limitations inherent in the data.

The lack of long time series data and the number of gaps and discontinuities has sometimes forced health economists to use local or provincial data to estimate the effects of health policies. Two conceptual errors may plague such analyses. The first is the use of cross-sectional results to make inferences across time. While it is certainly true that 2001 will become 2002, and in turn become 2003 and so on, Spain will never become Sweden, nor will Mississippi become Massachusetts. Health and policy change over time, not place. The second is a failure to appreciate the econometric implications of accounting identities and how a fixed budget implies errors that are not independent, but are forced to sum *exactly* to 0. Whatever deviations are made in one area or category *must* be offset by deviations in the opposite direction in other areas or categories. In practice, most budgets are slightly porous so that the sums are not exact: borrowing, saving, deficits and "creative accounting" can ease the rigidity of financial constraints – but only for a while, and usually with increasing difficulty as gaps become wider. Similarly, definitions of households or of categories such as health, housing, food and transportation may have blurred boundaries that creates inconsistencies leading to double- or under-counting. It is the work of NIPA and the system of health accounts (SHA) to reduce or eliminate such inconsistencies, yet "discrepancy" amounts of varying magnitudes are always used to make the calculations balance (OECD, 2000; WHO 2011). A series of research attempts to reconcile national health expenditure estimates constructed by US Office of the Actuary with those found during large scale patient surveys (namely, the Medical Expenditure Panel Survey, which surveys of families, individuals, providers, and employers across the US) show disparities of 5 percent to 30 percent between the two estimates (Sing *et. al.*, 2006).

Policy Implications. Using excess growth in health care (i.e., percentage increase in share) as the core measure of health expenditures is not just a technical decision, it forces attention on the central cost problem: health expenditures rising faster than the ability to pay for them. Focusing instead on the raw amounts or even real adjusted growth rates would divert attention toward prices, utilization, illness categories, and other intermediates or peripheral issues, rather than the gap between expenditures and ability to pay. The core issue, however, is the gap. Only by earning more or spending less can a country bring finances back into balance. Losing weight, shortening the length of hospital stays, limiting price increases or closing clinics will not accomplish this end (although all such remedies have been tried, often repeatedly). Control comes from staying within a budget. Apparently, "technical" concerns regarding the matching of temporal and spatial units actually reflect major policy concerns: since any change in an inertial health care system will only be revealed slowly, monthly and annual observations are too short, and observations on precincts, cities, provinces, regions and other sub-national units are too small. Only by observing the changing health share of GDP over many years can the effects of national policies on medical professions and health financing be seen. The external cross-currents and random noise that obscure the dynamics of health spending growth must be smoothed over or filtered out. The fact that spending is usually lower on Sundays or in the middle of winter may be true but not very meaningful. Much more important are the developments in medical science and technology occurring over decades or centuries.

Observations of households or local firms providing health insurance do not change fact that aggregates and per capita average payments are mostly determined by workforce regulations, standards of care, regulations, tax policies and subsidies that are national in scope. Some trends may even be influenced by forces that are trans-national or global. Awareness of problems in aggregation and the temporal and spatial units of observation suggest that short-, medium- and long-run forecasts of health spending may require different methods, as does the study of per personal spending by individuals or groups (see Section V below).

III. Lags, Business Cycles, and Growth Trends

Year-to-year variation in health spending is most strongly affected by a delayed response to business cycles, the vagaries of rising and falling incomes, and inflation. Observed variation over any span shorter than a year is plagued by seasonal fluctuations, timing and measurement errors, arbitrary allocations (e.g., how much less depreciation for February since it has only 28 days, how much more for a month with 3 bi-weekly pay-periods rather than two?) and so on, so that such fluctuations have to be treated primarily as noise. This noise, and even the business cycle fluctuations, tend to average out over longer spans of observation so that the underlying growth trends are revealed. From this broader perspective it appears that, although growth in health costs has seemed inexorable since 1960, it was actually rather flat or only modestly rising during the decades and centuries prior. Closer analysis indicates that after surging during the 1960s and 1970s, excess cost growth in the health sector began to fall, and is now just 1 percent above the rate of GDP growth or less in many countries.

The techniques developed to measure economic growth with the system of national accounts can be extended to analyze the growth in the health sector. Health expenditure in Canada US grew from $2 billion in 1960 to $135 billion in 2005, an average growth rate of 9.7 percent per year. Table 2 presents the total health expenditure increase from 1960 to 2005 for several OECD countries decomposed as population growth, price growth, real per capita GDP growth, and excess growth (the percentage increase in health share of GDP).[3]

TABLE 2: Growth Components, OECD Countries 1960 – 2005

Growth accounting decompositions similar to the one above can be made for most countries, revealing broad similarities (such as growing populations, rising per-capita incomes, substantial inflation) but also significant differences for sub-periods and within particular countries (for example, rapid population growth with little income growth in much of Africa, deflation and population shrinkage in Japan since 1990, global inflation spiking during the 1970s, recession and recovery cycles, or growth spurts in Spain and Ireland). One purpose such component analyses is to separate out general macroeconomic trends so as to more clearly reveal the growth pattern for a specific sector, such as health, where rising costs are of particular concern to policymakers.

The sources and patterns of variation in measured growth differ according to the frequency of observation. High frequency measurement (minutes, hours, days) captures mostly transitory noise that is irrelevant in the long run. The ordinary mid-range troughs and peaks of the business cycle are best seen in observations of quarters or years. In order to reveal long-run growth trends and to see what caused health expenditures to take ever larger shares of GDP, patterns of growth across decades or centuries must be examined.

Table 3: Focal Point by Frequency ***(temporal spans of observation)***

Health is inertial. Like other major categories of pooled public spending (education, defense, pensions), it responds more slowly to change than finance, housing, commodities and other sectors of the economy. Hence, it is not surprising that hourly, daily or monthly observations are dominated by noise. Even the quarterly observations exploited to define the beginning and end of recessions are of little use. It will be necessary to extend the span of observation to encompass more than five decades to understand the causes of spending that has raised the health share of GDP from less than 4 percent to more than 10 percent in many developed countries.

Business Cycles and Variable Lags

Because health care is inertial, the rates of growth in health spending in 1995 may carry more information about 1994, 1993, 1992, 1991 or even prior to 1990 than it does about current conditions. Figure 5b has the same data as Figure 5a in Section II above, showing GDP growth and annual health spending for Finland 1980 – 2000. In 5b, the data is presented in a scatterplot (rather than a time series as in 5a). Without temporal ordering, there appears to be almost no correlation between contemporaneous GDP and health spending. A data transformation using a lagged 3-year moving average of GDP as in Figure 5c reveals some of the correlation. The dynamics of the process and the strength of the income-expenditure relationship over time are much more fully revealed by regular time series, as originally presented in 5a. In other words, timing matters. A researcher looking only at contemporaneous correlations, or just one or two lags, could seriously underestimate the strength of the relationship between spending and the business cycle, or even conclude that there was no relationship. The lag transformation smoothes the GDP curve and shifts it in time to show more of the relationship.

In Finland, the lag between the 1994 recession and the corresponding decline in health expenditure growth was about 3 years. The structure of lags seems to vary between countries and by the particular type of spending (e.g., hospital construction, diagnostic testing, drugs). Analysis of data for the US shows relatively long average lags, with peak response to shifts in GDP coming after 4 years. Regressions for total national health expenditures (NHE) and various categories of spending are shown in Table 4.

Table 4 _Regression:_ Growth in Real Health Expenditures (%) U.S. 1960 – 2009

ARIMA (autoregressive integrated moving average) analysis confirms most of these results, but even 50 years is an insufficient number of observations to provide much certainty about the standard error of the coefficients. Aggregation provides data with an "average lag" that is a composite of many different processes of varying lengths. Most of the residual, however, is white noise, so that smoothed long-run graphs (i.e., observation frequencies of 6 to 10 years or more with repeated observations) yield a good representation of the underlying trends. Most of the random annual errors and business cycle effects can be filtered out by comparing health expenditures to a "smoothed" version of real per capita income (6-year moving average (MA) for GDP, 3-year MA for deflator) as shown in **Figures 6a and 6b.**

Fig 6a Growth in U.S. NHE and smoothed GDP (regression scatterplot 1960 -2012)

Fig 6b Growth in U.S. NHE and GDP (smoothed): time series graph 1960 -2012

Source: OACT (2014) National Health Expenditures and author calculations (Getzen 2014)

Once fluctuations due to business cycles and random errors have been filtered out and spending is smoothed with a 10- or 20-year moving average, the underlying "excess growth" trend that has been raising the health sector's share of GDP becomes more clearly visible. The annual percentage growth rate of per capita income in the US, although variable (sd = 2.1%), appears to be stationary and integrated of order 1.[4] Indeed, despite two world wars and a great depression, real per capita growth in each 20-year period throughout the entire 20th century stayed close to 2 percent. Most other countries in the OECD since 1960 show similar stationarity. However, national health spending is not integrated to the same degree but trends downward, and thus would appear to require further differencing in order to become stationary. This poses a number of econometric problems. Is it appropriate to measure variability relative to a simple mean, (4.5 percent), or should it be relative to a trendline stretching down from 7 percent to 2 percent? How many times should the health series be differenced in order to become stationary for an ARIMA analysis? Can the two series be treated as co-integrated? Decomposition clarifies and resolves a number of these problems. It indicates that excess growth has slowed dramatically from 1970 to 1990. However, that slowing itself poses additional questions, questions that cannot be answered until the span of observation is expanded beyond 50 years.

Long-Run Trends and Growth Surges

Estimates of health expenditures prior to 1960 become increasingly irregular the farther back one goes. Edouard Ducpetiax, William Playfair and others carried out small surveys of household consumption in Europe during the 19th century (Stigler, 1954). In the US, Carroll Wright carried out massive surveys of household spending among thousands of industrial workers in Massachusetts, and subsequently in several other states, between 1880 and 1910. These and the reports published by the International Labour Organization (ILO) on France, Germany, Norway, Sweden and the UK yield results indicative of health spending in the range of 2 percent to 5 percent of total household consumption. The frequently cited estimates of the Committee on the Costs of Medical Care (CCMC) of 3.7 percent of GDP in 1929 fall within this range, as does an earlier estimate by Louis Dublin, an insurance executive who wrote and lectured extensively about health economics during the 1920s (see note 1).

Alternate estimates for growth of the health sector can be obtained from the production side, measuring health labor relative to total employment. Data from the decennial census in the US indicates that health occupations accounted for 11 percent of total labor in 2010 compared to the 18 percent of GDP accounted for by health spending **(Table 5)**. The ratio of spending share to labor share is greater than one (1.7:1) because the earnings of health workers are above average. This ratio was similar in 1960. Since the ratio has been relatively stable, between 1.7:1 and 2.0:1 during each of the last six decennial census years, extrapolation back to early census years may not be unreasonable. In 1930, health labor was 1.8 percent of GDP and expenditures 3.5 percent. In 1900, health labor was of the 1.2 percent of GDP, and in 1850, it was 0.9 percent. There were about 12 ancillary workers for every physician in 2010, compared to only 7 in 1960 and less than 1 prior to 1900. Since ancillaries earn less than physicians, the relative shares of expenditure:labor used for extrapolations to the 19th century should be higher, perhaps 2 or 3:1. In 1850, there were about 18 physicians for every 10,000 population, a physician:population ratio that stayed almost constant before falling to just 13 in 1930, although these physician were more educated and by then assisted by more than three nurses and other ancillary workers apiece. The physician:population ratio did not begin to rise significantly until 1970, but then grew rapidly, almost doubling over the next 30 years. Although extrapolating from sparse occupational data to estimate national health expenditures is a stretch, it is not unreasonable to consider that, since the health share of employment did not increase between 1850 and 1890, the health share of GDP probably also grew very little during that period. There clearly was growth from 1900 to 1929 (when the first verifiable estimate of 3.5 percent of GDP was made) since, even though physician supply grew slightly less than population, the number of ancillaries per physicians increased from just 1 to more than 3.

Table 5: Decennial Employment and Expenditures, 1850 - 2010

In what may have been the first modern study of the national health expenditure trends, J.R. Seale, a physician and travelling fellow from Oxford studying at Harvard, examined US government and private data for the period 1929-1956. In _The Lancet_, he observed that ***"the proportion of the gross national product devoted to medical care tends to remain constant"*** (emphasis in the original). He went on to add that it "rises during national economic depressions and it falls during wars. A persistent rise in real per capita gross national product will tend to result in a very gradual increase in the proportion (Seale, 1959)." Like Malthus, Seale had the misfortune of making a generalization just before a major change that reshaped economic behavior occurred: 20 years later, rising costs were being deemed a "crisis" and "unsustainable" in most OECD countries (Hanes and Prescott, 2002; Getzen 2013).

Figure 7 SEALE: US Health Expenditure Relative to GDP 1929-1956

Estimates for the years before 1960 are spotty and less consistent, yet they allow two empirical generalizations to be stated with some confidence: health expenditures were lower before 1950 than afterward, and were rising much more slowly. Spending relative to per capita income rose slowly if at all in most countries during many of ten prior decades (Getzen, 2014).

The Surge in Health Spending: 1960 to 2006

In 1960, the average expenditure share of GDP among developed countries was near 4 percent. Those at the higher end (the US at 5.1 percent, Germany at 5.2 percent, and Canada at 5.4 percent) were not very far out of line, nor were those at the lower end (Norway at 2.9 percent, Iceland & Japan at 3.0 percent, and Belgium at 3.4 percent), except for Spain (at 1.5 percent), which was arguably still emerging as a modern economy. Health shares more than doubled for almost all of these countries before the end of the century, implying excess growth rates on the order of GDP+2 percent or more. Something had changed to radically accelerate spending by 1960.

In 1850, the share of household consumption among early industrial workers devoted to health was more than 2 percent. A century later it had grown, but still accounted for only about 4 percent of earnings. Since the share had not yet doubled during this span of one hundred years, the average rate of excess growth was less than 1 percent annually, and was probably more on the order of 0.25 percent to 0.5 percent. Rapidly rising per capita incomes pushed medical spending to rise rapidly as well, but not nearly as rapidly as they did in the decades after 1960.

Since the global recession began in 2007, the health share of GDP has risen very little in most countries, and clearly fell during 2010 (Morgan and Astolfi, 2014). Whether or not the recent slowdown marks the end of a 50-year surge in spending is still unclear. What is clear from the data is that most countries experience a period of rapid expansion in the health sector once economic development passes a certain point, and that the rate of excess growth, after surging to GDP+3 percent or GDP+5 percent, begins to moderate in the following decades, falling to GDP+1 percent or lower.

Figure 8: OECD Health Expenditure Growth Rates 2000 – 2010
(source: OECD Health Data 2014 and author calculations)

The path of growth in Spain provides an illuminating example, albeit somewhat extreme. Starting from a low base in 1960, the health share more than doubled within the next 10 years. Although still below the OECD average, it continued to grow more rapidly, doubling again over the next 30 years. By 2010, the differential between Spain and the OECD average was less than 1 percent of GDP (9.6% for Spain vs. 10.5% OECD average). Although the path of health expenditures in Spain and among the other developed countries over the next 30 years is still unclear, projections of future excess growth of GDP+0 to 1 percent are not unreasonable.

Policy Implications. Stepping back from this dense and detailed discussion of historical data, several implications for policymakers become clear. First, economic growth is the main driver of health spending. Second, change occurs only slowly and within the heavily regulated and professionally ossified health sector, so that any shock or sudden shift in GDP or inflation is passed through only slowly. Third, in order to see the effects of prior policies or workforce disruptions, these lagging macroeconomic effects must be filtered out. Otherwise, each year's fluctuation will be over-interpreted as the result of some policy or external cause rather than more appropriately seen as reflecting the turbulent flow and eddies of the macroeconomy. Finally, it should be noted that, however challenging the rise in health care costs since 1960 has been, it clearly has begun to moderate sometime during the past 25 years. The recent, sharp drop in response to the great recession may not mean that expenditures will no longer rise faster than GDP, yet it is likely to be counted as part of a period of very restrained growth.

IV. Forecasting National and Global Health Expenditure Trends

Forecasts of what medical expenditures will be over the next year or two must take account of hundreds or thousands of factors: emerging diseases; new drug launches and patent expirations; insurance regulations; out-out-of-pocket payments; aging, childbirth and other changes in demographic group composition; advances in diagnostic imaging; physician workforce; hospital construction, and so on. There are many commercial and government forecasters in each country diligently striving to make such forecasts using the best available information. A consensus average of the available reports is usually able to predict medical cost growth to within one or two percent for the next one or two years. However, many of these factors will average out over the next 10 years and are unknown or impossible to predict much farther into the future. Long-run forecasts fruitfully ignore most of the detail that occupies short-run forecasters, concentrating on a few key elements, with the underlying trend in excess health expenditure growth being foremost among them.

Short-, medium- and long-run forecasts use different methods and have different purposes (Getzen, 2000b). Annual budgets and health insurance premiums are set using short-run forecasts, so these estimates are best expressed in nominal currency amounts, as these are the terms in which budgets are cast. Medium-range forecasts of 3 to 10 years are better stated as real inflation-adjusted per capita expenditures to allow for comparisons over time and place, and to indicate the change in resources required to meet expected cost increases. Annual fluctuations over the next 5 or more years are dominated by the business cycles and the delayed adjustment of the health care system to macroeconomic shocks. Most of these cyclical disturbances will pass within a decade and hence can be ignored for forecasts extending beyond that span. Long-run forecasts of 20 to 75 years are mostly used for projecting government obligations and retiree health liabilities. Nominal dollar statements are almost useless. (What would it mean to say that Germany will spend 34,27 trillion deutschmarks in 2050? How much inflation will there be before a child born today will retire?) Such forecasts are much better expressed as a share of GDP or as a percentage of wages.

Expressing long-run projections as percentage growth in share, or equivalently as *excess growth* of GDP + *x* %, focuses attention specifically on *health spending* rather than general inflation or wage increases. Statements regarding amounts spent, even real per capita amounts, confound the health forecast with the GDP forecast. They give little insight into whether the burden of payment for care will be larger or smaller relative to the ability to pay, and it is this fiscal gap that is the major concern of policy makers—not the nominal amount or per capita insurance premiums. It is growth in the health share that should be the target of health forecasters—not inflation or per capita income, which are better left to macroeconomic forecasters.

The literature on long-run health forecasts is fairly thin, especially when compared to the voluminous literature assessing macroeconomic forecasts. The only regular sources of forecasts are national statistical agencies, the OECD, the World Bank and WHO. Even these sources tend to make their forecasts available at irregular intervals and use different boundaries, definitions and methodologies so that results are hard to compare over time, and almost never go back after the fact to assess the accuracy of forecasts made in prior years. Evaluating a single forecast made by an independent researcher at one point in time and never followed up is even more difficult and less valuable. For the most part, healthcare forecasting models have only been evaluated with respect to old data already recorded before the forecast was made. Such backcasting exercises are of limited use in assessing future results.

Accuracy

Any single forecast can happen to be almost correct, or not, by chance. Assessment of accuracy requires a series of forecasts that are published in advance and then compared to sequent outcomes. Macroeconomic forecasts start with a basic standard: the "naïve" forecast that the level (or growth) this period will be the same as it was last period. The results of the forecast made by the model are then compared, after the fact, to a naïve forecast. Other common standards for comparison are a moving average over the past *Y* years, an exponential smooth, or an average of published forecasts. It is surprisingly hard for experts to consistently improve on a naïve forecast. The number of professionals outmatching common formulas that can be programmed into a spreadsheet is, of course, even smaller. Expert judgment rarely beats a technical forecast made carefully by fitting a very simple model onto prior data.

One of the few studies comparing prospective forecasts to actual spending data was done by the US Office of the Actuary to examine the predictive performance of their projections for 1997 to 2009. They found that they tended to over-estimate the rate of spending growth, with an accuracy of about ±1 percent each year. However, it is possible that positive and negative errors might offset each other. To assess long-run trend accuracy, it is necessary to measure the cumulative growth over a longer time span and compare forecast to actual. Getzen later examined all of the Medicare Office of Actuary (OACT) projections from 1986 to 2002 at 1-, 2-, 5- and 10-year spans, finding that cumulative annualized errors were about 1 percent (e.g., 10.46 percent over ten years) (Getzen, 2015).

The shorter-term ups and downs of employment, inflation and stock indexes are often of greater interest to market analysts than the long-run trend, making mean absolute percentage error (MAPE) a preferred measure of accuracy in most market applications. However, the issues are rather different in national health expenditure forecasting. Actuaries making 10- or 20-year budget projections are more concerned with getting the long-run trend right than with the ups and downs of monthly or yearly fluctuations, making cumulative error a more relevant measure of accuracy.

Once cyclical macroeconomic fluctuations are filtered out by using moving averages to smooth inflation and real GDP growth, there is very little additional information that can be added to improve a forecast of the excess health spending growth trend over time. Although we know that there will be technological advances, we do not know exactly what they will be, how long it will take to implement them, or how much they will influence spending. In effect, there are just part of the trend. The same limitations apply to future changes in obesity, infectious disease incidence, disability, mortality or a host of other factors. What is required for long-run national health expenditure forecasts are data series long enough to show how the rate of share growth has surged and subsided over time, such as that provided in **Figure 9** below for the US. Excess growth was around 1 percent above GDP for several decades before 1955, probably back into the 19th century. Sometime after 1955, excess growth accelerated, surging above +4 percent during the late 1960's. Recessions and a variety of administrative efforts slowly reduced excess growth down toward GDP+0 percent, eventually holding health spending steady at 13.5 percent of GDP from 1993-2000. Renewed growth took the health share above 17 percent by 2010, when the great recession and new administrative control again restrained growth. Projections by the OACT, Congressional Budget Office and the Society of Actuaries are consistent, forecasting long-run future excess growth of 0.5 percent - 1.5 percent for the US. The OECD health data and current projections for many nations look similar but with smaller surges consistent with their current health shares, closer to 10 percent. Additional cliometric effort is needed to extend the data series for most countries back into the decades prior to 1960.

Figure: 9 Excess Medical Cost Growth rate in the U.S. 1930 – 2020 (smoothed)
source: OACT 2014, Historical Statistics of the US 2006, and author calculations

Focusing on the excess growth rate that pushes the health share upward, and removing monthly and annual fluctuations, makes the task of forecasting vastly easier, effectively narrowing it to a single parameter. *Health expenditures are projected to increase at a rate of GDP +**X**%, and the share of the economy consumed in the health sector will rise from its current level by **X**% a year.* The task is made computationally simple, yet still subject to residual uncertainty. Forecasting research indicates that this level of uncertainty could be the limit for accuracy with current data and methods. Plus or minus 1 percent is the most that can be said. The range may be narrowed as methods and data improve, yet the persistence of uncertainty in macroeconomic forecasts of monetary supply, exchange rates, inflation, trade, GDP, unemployment and other variables, after decades of diligent efforts by the leading statistical agencies of the world, suggest that further improvements in accuracy may not come easily or quickly.

Policy Implications. The starting point for policymakers is understanding that data on spending must be collected, refined and analyzed to reduce the welter of detail and complexity. Having done so, legislators today must accept that an unsustainable burden of excess cost growth accumulated in prior decades. Rather like overweight patients who continue carbohydrate loading after outgrowing youthful sports, national health systems must now control consumption and work off some organizational fat so that excess is not accumulated again. The task of health policymakers is as simple, and as difficult, as that.

V. Aging, Health Expenditures and Fiscal Burdens

The difference in phenomena observed at different organizational (micro and macro) and temporal (short and long) scales is well illustrated by comparing individual and population aging. The observation that medical spending increases with a person's age is well known. Yet, just because each individual's medical expenses are increasing does not mean that the average expense per person for the national health system as a whole must increase. Doctors and their patients, who tend to age together, must ignore or re-frame their daily experiences in order to see a bigger picture. From a macro perspective, as in **Figure 10a**, it becomes apparent that there was only a weak correlation between each nation's spending per capita and population age across the OECD in 1975. **Figure 10b** shows that the rate of increase in the percentage of population above age 65 over the ensuing 25 years was not at all correlated with increases in the health share of GDP. Using "share of GDP" normalizes the data to adjust for exchange rates and the unitary elasticity of incomes and wages, removing several sources of spurious correlation that tend to plague multivariate regressions, especially those that include variables already strongly correlated with income such as education and longevity. The weak correlation at a point in time is mostly secondary rather than causal. More developed countries have more wealth and more old people, and also spend more on medical care. These countries also have higher rates of urbanization, literacy, automobile ownership and financial services; and lower rates of fertility, infant mortality, civil unrest and transactions costs.

Figures 10 a & b: Population Aging Correlation with Health Spending Growth

(source: OECD Health Data 2014 and author calculations)

One reason for the persistence of the idea that aging has caused the rapid rise of health care costs may have been that it was so obviously true at the individual level that "common sense" generalizes that it should also hold for the national average. The atomistic fallacy that what is true for the individual must be true for the group was reinforced by the simultaneous incidence of increasing longevity and increasing costs. They rise together because both are being pushed upward by the same underlying factor (economic development), yet one does not cause the other, or vice-versa, in any simplistic way. The mounting stack of empirical studies showing that most medical cost growth was caused by factors other than population aging, and the lack of cross-national time-varying correlation between national health costs and the age of national populations confirms the hypothesis that they are co-determined rather than causally related. However, even though aging *per se* is not a major cause of the rise in average medical costs, longevity *is* financially burdensome for both households and governments, with increasing medical costs being a major element.

Spending on the Elderly is Not Constant

Medical expenditures on elderly patients have increased rapidly during the 20th century, primarily because spending on patients of all ages has increased rapidly. Even the relative spending on old persons relative to the young is not a constant, but shifting over time, as shown in **Table 6.**

Table 6: U.S. Spending per person by Age Category

A different pattern might have emerged in these data from the US without the creation of universal health insurance for those over age 65 and the poor (but not working people), in 1965. The constraints that kept spending below 200 percent of the mean in the 1950s were already eroding in the early 1960s. After the passage of Medicare and Medicaid, spending on the old quickly soared to 500 percent of that for the young. Since 1990, the exuberant generosity toward the medical care of the old has dissipated. In 2013, Medicare spending actually declined in both real and nominal dollars, despite the movement of an increasing number of baby boomers into coverage. While unlikely to ever again dip to the miserly levels of the 1950s, the ratio of spending for medical care among those over age 65 is likely to hover closer to 3 times that of the young rather than the 1987 peak of 5.4 times. Other OECD countries usually have ratios in the range of 2.5 - 4.5, but much work still remains to trace how the path of the old:young spending ratio has evolved over time in each country.

Policy Implications. Any forecast of future health spending for the elderly depends heavily on two distributional parameters: (1) what share of total economic resources should be spent on health (*health share of GDP*) and (2) how much more should be spent on the care for the elderly relative to the young (old:young spending ratio). Both are determined primarily by politics and social choice rather than demographics or biology. The most important conclusion from the empirical studies reviewed above is that spending on medical care for the elderly is not driven by illness, but by policies, even if many of those policies are embedded in administrative decisions and not publicly articulated, since coming out in favor of cutting benefits to the old, or the young, is generally viewed as self-destructive behavior by politicians – however, having physicians and health services managers make decisions that stay within a fixed budget is not. A corollary is that innovation in medical technology is a result of increased spending, as well as a cause of increased spending. There is reflexive feedback between health policy and expenditures: a rise (or fall) in spending will create pressure for a change in health policy, and any significant change in health policy will tend to force expenditure growth up (or down). Health policy and health spending must always be considered interdependent and endogenous to a greater or lesser degree.

Population aging gathered a great deal of attention during the 1960s and 1970s and was often blamed for the sudden rise in national health spending. At the time, life expectancy and medical costs were both growing rapidly, and it seemed natural to assume that the relationship was causal. "Demographic" models were constructed that projected future health expenditures using a linear matrix that mimicked the format used for projections of future pension payouts (the "*c*" are "age-sex" categories" or "age-sex-disease/disability" categories if more detail is desired).

$$\text{Total Cost} = \sum cost_c \times pop_c \times (\text{Total Population Growth} \times \text{Other Cost Growth})$$

Projections made with such demographic/disease models worked very well in forecasting medical costs for a particular group of insured persons for the next year or two, but failed when extended to aggregate national cost trends over 5, 10 or 50 years. Among the first analyses of total cost trends and population aging was that carried out by Barer and Evans for British Columbia in the late 1980s (Barer et al., 1989). They found that demographic/disease changes for persons age 65+ accounted for only a small fraction of overall aggregate health spending increases, and were overwhelmed by underlying medical costs increases (increases in price and utilization driven by income and policy, not attributable to increased illness or disability). The finding that most medical cost increases were driven by factors other than aging was confirmed repeatedly in many subsequent studies (Getzen, 1992; Gerdtham *et al.,* 1992; Zweifel *et al.*, 2004; Steinman *et al.,* 2007). Why then was the erroneous perception that aging caused cost increases so persistent? Because it made sense based on the immediate experience of both patients and physicians, and because the two trends came to prominence at the same time. The temporal association was not coincidental, as both increased longevity and increased medical costs were being driven by the same force: the rapid modern development of post-industrial economies after World War II. This coincidence, while not in itself indicative of causality, does point to the underlying cause.

VI. Global Health Spending Patterns 1850-1955 and 1960-2075

The discussion in this final section centers on how and why health spending rose so rapidly after 1950, after having been steady or only slowly rising for many previous decades, and what the pattern of growth is likely to be from now until 2075. Prior to 1850, medical care was not very scientific or useful. The most common therapeutic intervention in western medicine during the 19th century was the use of a lancet to open a vein, even though it soon became common knowledge among physicians that bleeding did little to cure diseases. Medical care was often limited to sage advice, the laying on of hands, and attempts at prognosis. Healing usually occurred because most people naturally got better as they were fed and rested. Expenditures rose as per capita incomes rose, but there was little excess growth because there was little extra benefit.

The leading centers of medical science and pharmaceutical innovation were in Europe. Rapid advances were made in the fields of bacteriology, pathology and diagnostic testing. Germany excelled in the production of chemicals and drugs, and in 1883 had created the first broad national health insurance program. Collective financing elsewhere was mostly limited to charity, guilds and friendly societies. The practice of medicine took time to catch up to the new scientific advances, and was little changed in the first decades of the new century. Medical nihilism was still prevalent among practitioners and there was little reason for patients to choose and pay for a university-educated physician over an herbalist, homeopath, mystic or Christian Science reader.

By the 1920s, the practice, organization and financing of medicine had begun to undergo a virtual revolution, incorporating science into a number of new and effective treatments. By 1960, research was carried out in huge academic medical centers and pharmaceutical companies on a scale that just 50 years earlier had been unknown, and indeed unthinkable. The developments over this span are ably reviewed in Robert Fogel's *The escape from hunger and premature death, 1700-2100*, Roy Porter's *The Greatest Benefit to Mankind,* and the edited volume on *The Therapeutic Revolution* by Morris Vogel and Charles Rosenberg.

In 1960, the year the OECD health data set begins, expenditures across the developed countries averaged about 4 percent of GDP, little different from the estimated level of medical spending relative to incomes of industrial workers or the urban middle and upper classes in 1850 or 1920 (although rural farmers still relied mostly on home remedies and spent little on professional care back then). Antibiotics and advanced surgical techniques had brought about a medical revolution, but costs had not yet exploded. The US became the world's largest economy, and medical leadership had followed riches to reside in Boston, Baltimore, Chicago, New York and San Francisco. However, it was the European countries that first established truly national health financing systems that paid for health care for all (or almost all) citizens. The surge in spending that started around 1960 was led by the US, and spending grew most rapidly in that country for the next 50 years, eventually exceeding 15 percent of GDP and still headed higher. Expenditures also rose in almost every wealthy developed country, sometimes later and more slowly, but most approached 10 percent by 2015.

Amongst this wealth of detail and statistics, a common pattern can be discerned. Medicine underwent a transformation akin to the demographic transition and industrial revolution. Massive population growth began during the 18th century for many of the OECD countries, while urbanization and the industrial revolution came afterward and significant growth in per capita incomes for the masses usually only arrived in the late 19th century. It is not yet clear why it took a century more for the transformation of health care. Perhaps sudden premature mortality had to fall and incomes rise to make-to-make ameliorating disease and lengthening lifespan worthwhile, or the congregation of people into larger cities sufficient to generate knowledge, or enough wealth accumulated to fund research that took decades to yield practical results. Whatever the cause, it is clear that developmental transformation of the health sector came after many decades after the advances in population, agriculture and trade.

Some trends for the next hundred years are already evident. The rise in population due to demographic transition has already ended in many developed countries, and appears be slowing across the globe. The health sector has already climbed above 4 percent in South Korea, Brazil, Eastern Europe and Turkey as middle class consumption swells. Europe was the dominant medical market in the 19th century, and the US in the 20th century, but by the end of the 21st century, both India and China will each have health expenditures larger than Europe or the US.

Development, not disease, drives spending on health. Yet while the trends in longevity may be fairly clear, and some aspects of disability tentatively projected, the scope and magnitude of development over the next century and any possible future transitions (or stagnations or reversals) is cloudy. Will advances in technology lengthen lifespan and rectangularize morbidity and mortality to such an extent that curative medicine is cheap or irrelevant? Will industrial technology advance to yield nearly infinite clean energy so that cost is no longer a concern to policymakers and possessions no longer accepted as measures of development? More prosaically, will the surge in costs that followed the medical revolution eventually subside like the population surge of the demographic transition, bringing an end to excess health cost growth?

Two major economic uncertainties – income distribution and productivity growth – may have significant influence over the future path of income growth. Broad national financing of medicine has pulled the spending of all citizens within each country up toward the levels of a favored urban and industrial minority and hence raised the level of expenditure as a share of GDP. It may not be coincidental that the "middle classing" of an economy has often coincided with the transformation of medical practice and financing. Political support for broadly equal health financing is placed under strain as poor or median households, who gain from distributive equity, fall farther and farther behind the income groups at the top 10 percent or 1 percent. Less developed countries often have great disparities, with a few at the top obtaining world-class medical care while the masses crowd into under-staffed clinics. In the US, the Medicaid program for the poor often uses restricted provider networks that serve relatively few middle-class or wealthy patients. Even in Norway, eminently wealthy and egalitarian, top earners tend to buy preferential access. Increasing inequalities of income and wealth since 1980 have already put stress on the financing systems for health care in almost every developed country. Extreme inequality could fragment a health system into disparate tiers, with those at the bottom having only limited access to the most modern medicine.

Conflict over income inequality will be exacerbated if the long-run trend of per capita income growth starts to slow or stagnate. The ability of modern economies to maintain 2 percent to 3 percent annual productivity increases as they did in the 20th century has recently come into question (Gordon, 2014). Catch-up growth will keep emerging economies well above that rate, but may do little for the citizens of developed countries that may already be entering a more mature and slower stage of growth. Furthermore, barring catastrophic interruption of current trends, almost every country in the world is likely to have achieved development by the end of the 21st century.

Since, historically, the rate of excess health cost growth among developed nations usually surged to GDP+3 percent or more before decelerating to +1 percent or less over the next 20 to 50 years, it is likely that the emerging economies will follow this pattern, but do so more rapidly. Eventually, all countries will reach a higher plateau with a constant health share (sustainable growth near GDP+0 percent or less). Whether that will take a few decades or a few centuries is an open question (i.e., it could reach that plateau after the health share grows to 20 percent, or not until it approaches 50 percent of GDP). Some factors suggesting higher growth are the increasing value of life and health relative to other goods and services as per capita incomes surpass 10 times or 100 times subsistence levels. With a lifespan of 120 years, even middle-aged workers have many years to save for retirement and the long-term care that is the greatest financial risk toward the end of life. On the other hand, technological advances continually commodify medicine. Treatments and vaccines for tuberculosis have become cheap, and soon hepatitis, HIV-AIDs will experience similar price reductions. Patent expirations have already slowed the growth of pharmaceutical spending. Robotic surgery may do the same for that field. Since both upward and downward forces are likely, the path of expenditure growth may well depend on the relative balance.

Policy Implications. The most important insight to be gained is the ability to see the "medical transformation" and surge of health financing as a developmental stage, like the demographic transition or the industrial revolution. It was successful, wildly so, far beyond the expectations of the public or politicians. Dealing with success, and costs, of this magnitude is hard. No one in 1960 anticipated today's pension crises or the need for housing for millions of disabled elders. Other policy lessons are more prosaic. Periodic measurement of costs can help a nation maintain a sustainable level of medical costs, but analysts should not fail to adjust for lags or pay too much attention to temporary fluctuations lest they be distracted by all the noise. Medical technology will undergo major advances, yet since we do not know what they are or the magnitude of their financial effects, a long-run forecast incorporates technological growth in the underlying secular trend. The effects of legislation and organizational reforms are similarly endogenous.

Changes in trend are more apt to result from invisible shifts in administrative procedures and political will than public rhetoric or votes in Parliament. Micro-simulation models using age/sex/disease projections are necessary to estimate the presumptive budgetary impact of policy proposals but are rarely as accurate at forecasting actual growth rates as the macro models that usually ignore the particularities of legislation and technology. Despite that, it is helpful to consider the mounting evidence that all health costs, and especially costs of the elderly relative to the mean, are determined by the political process that shapes the health care system of each nation, and not by demography or disease. ##########

End Notes

1. There is an estimate of 2.5% of GDP given in a 1928 compendium of works by the insurance executive and health economists Louis I Dublin (Dublin, 1928), but it does not indicate the basis or methodology of the estimate, or the precise year and scope. Studies of health expenditures were carried out at various times by the Social Security Administration until the 1960s, but they were much more comprehensive with regard to public than private expenditures, and are not entirely consistent.

2. The classic presentation of the "permanent income" hypothesis is that in Milton Friedman's Theory of the Consumption Function (Friedman, 1957). More specific application to the estimation of national health expenditures is provided by Getzen (Getzen, 1994; Getzen, 2014).

3. The standard growth decomposition procedure is to first to calculate the rate of "excess growth" by the percentage increase in share(equivalent to the percentage rate of growth in health expenditures net of the rate of growth in nominal GDP). GDP is then similarly decomposed into the growth in population and price inflation, designating the remainder as "real growth in per capita income" and typically attributed to technology or productivity.

4. That is, the percentage growth rate does not itself trend up or down or display regular patterns of variability, more or less stable with a random walk around the mean of 2.1% per year.

5. Thomas Malthus' 1798 classic *Essay on the Principle of Population* led to the term "Malthusian" being applied to a subsistence economy where gains in productivity are soon dissipated by "more mouths to feed." Unfortunately, the industrial revolution took hold soon after, as did significant reductions in birth rates, so that increasing economic productivity greatly raised per capita income (and not just population) during the ensuing decades. For a more extended discussion, see the article by Hansen and Prescott in the American Economic Review or Chapter 15 in the Getzen (2013) text.

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Table 1: Inflation and Health Employment in Canada

CANADA	*Inflation*	Employment			Health Share
		Nurses	Total	ratio	% of GDP
1972	*5.6 %*	152,005	8,447,000	.0180	7.3
1973	*8.9 %*	159,274	8,860,000	.0180	7.0
1974	*14.4 %*	168,530	9,220,000	.0183	6.9
1975	*9.8 %*	177,182	9,364,000	.0189	7.4

Source: OECD Health Data 1990, author calculations.
Note how the financial measure of health share is distorted by delayed adjustment to the 1974 spike in inflation.

TABLE 2: Growth Components, OECD Countries 1960 – 2005

	annual % growth in Total NHE	population growth	increase in price level	real GDP per capita	Share (excess) growth	Health Share of GDP 2005
Canada	9.7%	1.3%	4.3%	2.4%	1.3%	.099
France	10.8%	0.6%	5.0%	2.6%	2.3%	.111
Germany	7.8%	0.9%	3.1%	2.0%	1.6%	.107
Japan	10.4%	0.7%	3.2%	3.8%	2.3%	.082
Netherlands	9.5%	0.8%	4.1%	2.3%	2.1%	.098
Spain	17.0%	0.8%	8.2%	3.3%	3.9%	.083
Sweden	10.0%	0.4%	5.4%	2.2%	1.6%	.092
Switzerland	7.6%	0.7%	3.3%	1.5%	1.9%	.112
UK	10.8%	0.3%	6.3%	2.2%	1.7%	.083
USA	10.0%	1.1%	4.0%	2.1%	2.5%	.154

Source: OECD Health Data 2012, author calculations.

Table 3: Focal Point by Frequency *(temporal span of observation)*

(span)	Focus on Variation due to:
Days, Months	**Transitory Noise**
Quarters, Years	**Business Cycles**
Decades, Centuries	**Long-run Growth Trends**

Table 4 *Regression:* Growth in Real Health Expenditures (%) U.S. 1960 – 2009

	Constant	real per capita GDP growth						*Deflator*		Time	R2
		year 0	year -1	year -2	year -3	year -4	year -5	year 0	year -1		
US - Total NHE	.046	**.17**	**.07**	**.04**	**.19**	**.29**	**.23**	*-.28*	*-.12*	-.0006	**.702**
Hospital	.068	**-.17**	**.06**	**.06**	**.14**	**.39**	**.24**	*-.15*	*.25*	-.0011	**.705**
Physician	.044	**.03**	**.36**	**.14**	**.13**	**.37**	**.03**	*-.52*	*-.69*	-.0006	**.312**
Dental	.009	**.36**	**.16**	**.22**	**.18**	**.22**	**.32**	*-.41*	*.07*	-.0002	**.311**
Pharmaceutical	-.071	**.73**	**.34**	**.70**	**.71**	**.09**	**.15**	*-1.04*	*-.95*	.0016	**.457**
LTC	.058	**.22**	**.65**	**.45**	**.18**	**.54**	**.35**	*-.67*	*.03*	-.0013	**.662**
Insurance Admin	.064	**.17**	**.44**	**.26**	**.34**	**.57**	**.49**	*-.57*	*.12*	-.0013	**.470**
Out of pocket	-.006	**.43**	**.26**	**.13**	**.11**	**.26**	**.00**	*-.57*	*-.53*	-.0001	**.245**

Source: Getzen (2014) based on data from www.cms.gov/nationalhealthexpenddata 22 May 2011

Table 5: Employment and Health Share, US 1850 to 2010

	Population	Employees	Health	Physicians		Ancillaries	Health %		*growth rate*	
					per million	per Physician	of Labor	GDP	*Labor share*	*GDP share*
1850	23,192	5,372	**46**	41	*176*	*1.1*	**0.8**			
1860*	31,443	8,595	**61**	55	*175*	*1.1*	**0.7**		*-1.8%*	
1870	39,818	12,925	**103**	64	*162*	*1.6*	**0.8**		*1.2%*	
1880	50,156	17,392	**114**	86	*171*	*1.3*	**0.7**		*-1.9%*	
1890	62,948	23,318	**170**	105	*166*	*1.6*	**0.7**		*1.1%*	
1900	75,995	29,073	**346**	131	*173*	*2.6*	**1.2**		*5.0%*	
1910	91,972	37,371	**486**	152	*166*	*3.2*	**1.3**		*0.9%*	
1920	105,711	42,434	**634**	151	*143*	*4.2*	**1.5**		*1.4%*	
1930*	122,775	48,830	**900**	163	*133*	*5.5*	**1.8**	3.5	*2.1%*	
1940	131,669	51,742	**1,020**	175	*133*	*5.8*	**2.0**	3.9	*0.7%*	*1.1%*
1950	150,697	59,230	**1,450**	198	*131*	*7.3*	**2.4**	4.3	*2.2%*	*0.9%*
1960	180,671	67,990	**2,064**	234	*129*	*8.8*	**3.0**	5.2	*2.2%*	*1.8%*
1970	205,052	79,802	**3,277**	297	*145*	*11.0*	**4.1**	7.2	*3.1%*	*3.4%*
1980	227,726	104,058	**5,403**	433	*190*	*12.5*	**5.2**	9.2	*2.4%*	*2.4%*
1990	250,132	123,473	**7,580**	587	*235*	*12.9*	**6.1**	12.5	*1.7%*	*3.1%*
2000	282,172	131,720	**10,103**	772	*274*	*13.1*	**7.7**	13.8	*2.3%*	*1.0%*
2010*	310,233	130,275	**13,777**	935	*301*	*14.7*	**10.6**	17.9	*3.3%*	*2.6%*

Source: U.S. Bureau of the Census, Historical Statistics of the United States: Colonial times to 970 (1975); Bureau of Labor Statistics, annual employment data tables. Employment and population stated as millions of persons. *1860 total civilian employment extrapolated.

Table 6: U.S. Spending per person by Age Category

	1953	1963	1970	1977	1987	1996	2000	2004	2010
All persons	$ 69	143	291	616	1,664	3,153	3,803	5,276	7,097
under age 65	$ 65	127	234	452	1,088	2,115	2,650	3,953	5,392
Age 65 and older	$109	299	809	1,962	5,830	10,285	11,778	14,797	18,425
*in 2009 nominal dollars									
Ratio: over age 65 / under age 65	**1.7**	**2.4**	**3.5**	**4.3**	**5.4**	**4.9**	**4.4**	**3.7**	**3.4**

Sources: Cutler and Meara (1987); Meara and Cutler (2004); Hartman (2009), Lassman 2014; Getzen (2013).

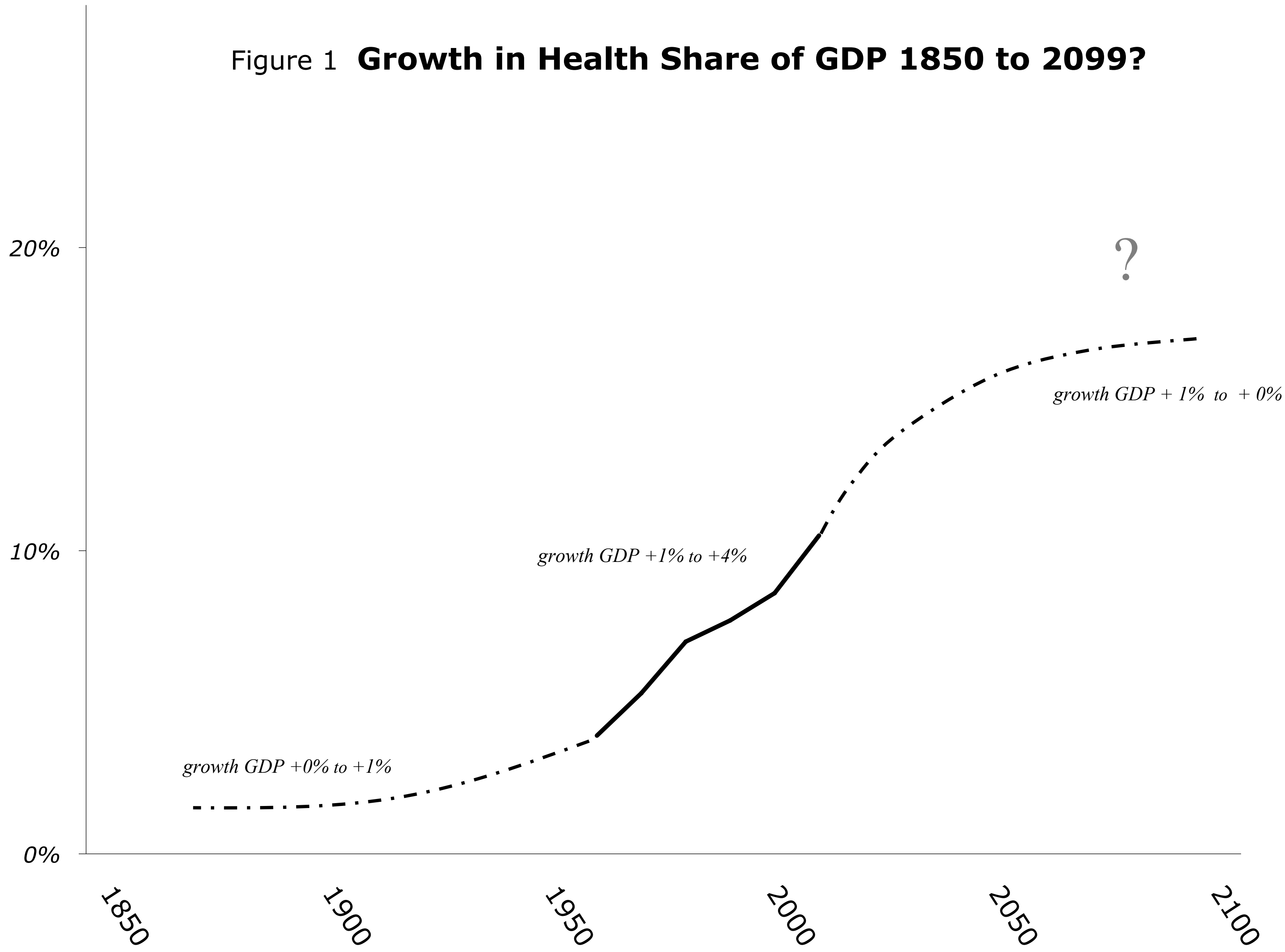


Figure 1 Growth in Health Share of GDP 1850 to 2099?
20%
10%
0%
?
growth GDP + 1% to + 0%
growth GDP +1% to +4%
growth GDP +0% to +1%
1850
1900
1950
2000
2050
2100

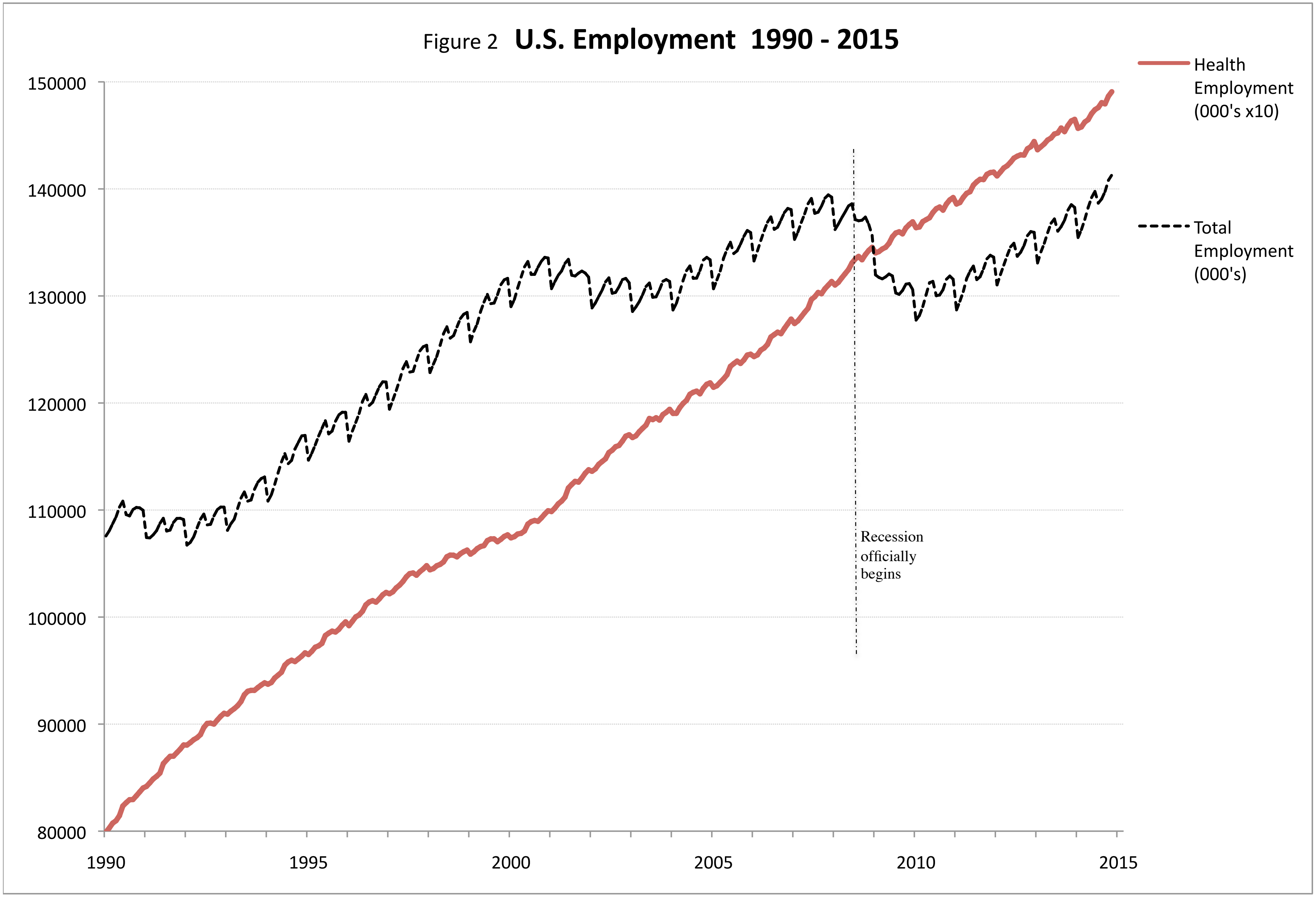


Figure 2 U.S. Employment 1990 - 2015
Health Employment (000's x10)
Total Employment (000's)
Recession officially begins
150000
140000
130000
120000
110000
100000
90000
80000
1990
1995
2000
2005
2010
2015

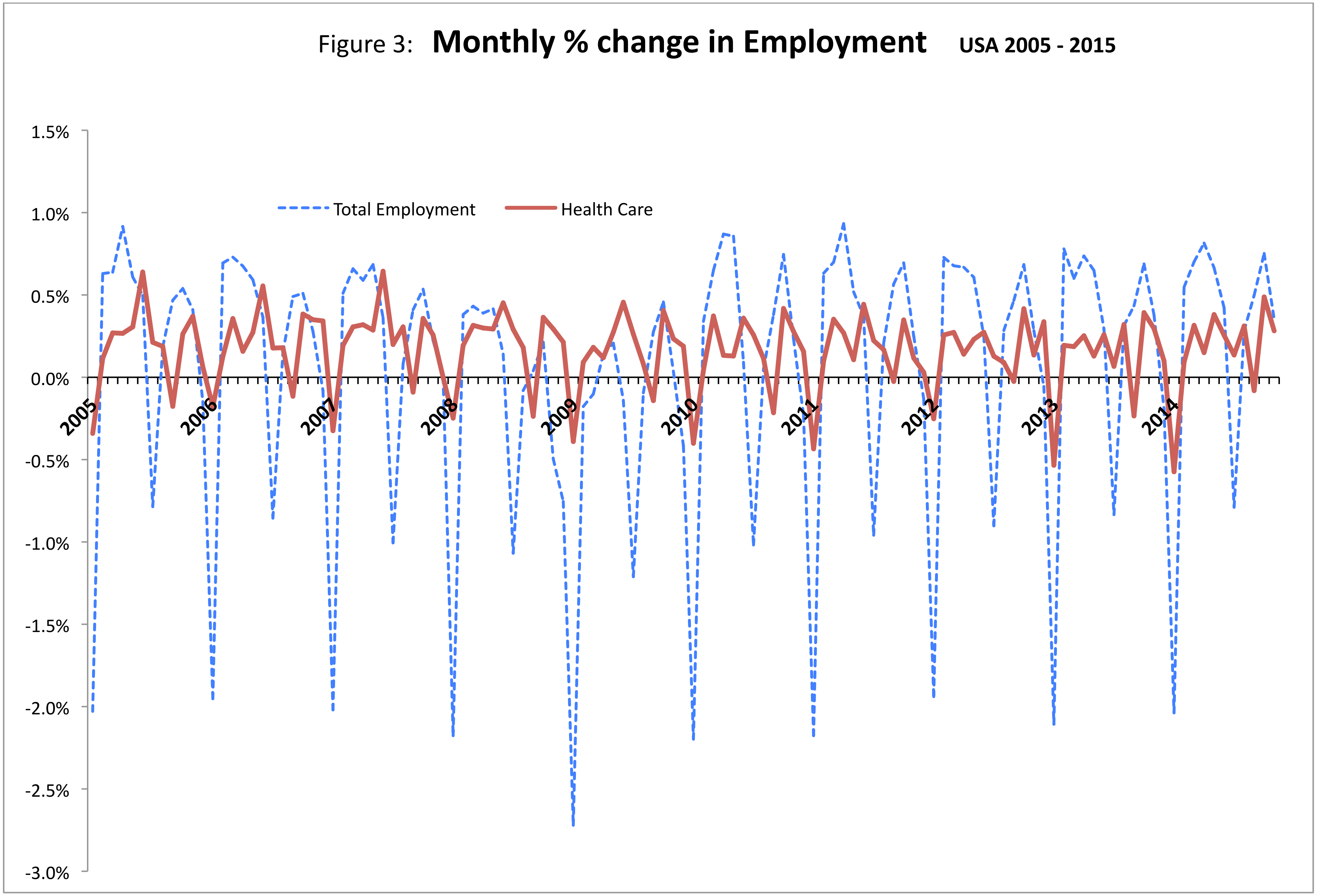


Figure 3: Monthly % change in Employment USA 2005 - 2015
Total Employment
Health Care
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
-2.0%
-2.5%
-3.0%
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

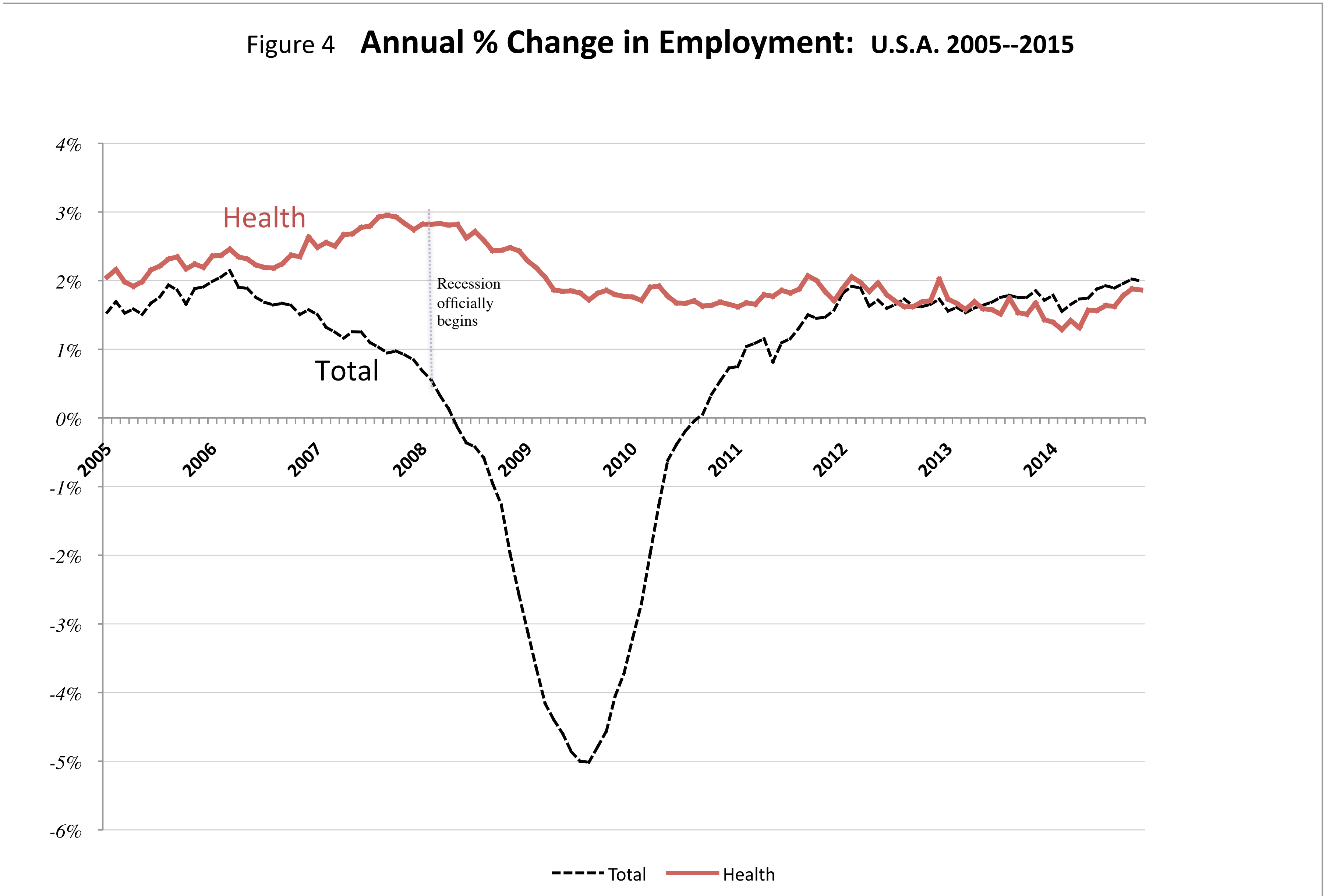


Figure 4 Annual % Change in Employment: U.S.A. 2005--2015
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
-5%
-6%
Health
Total
Recession
officially
begins
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Total
Health

Figure 5a **Finland 1980 - 2000**
annual % growth in real PCI and Health

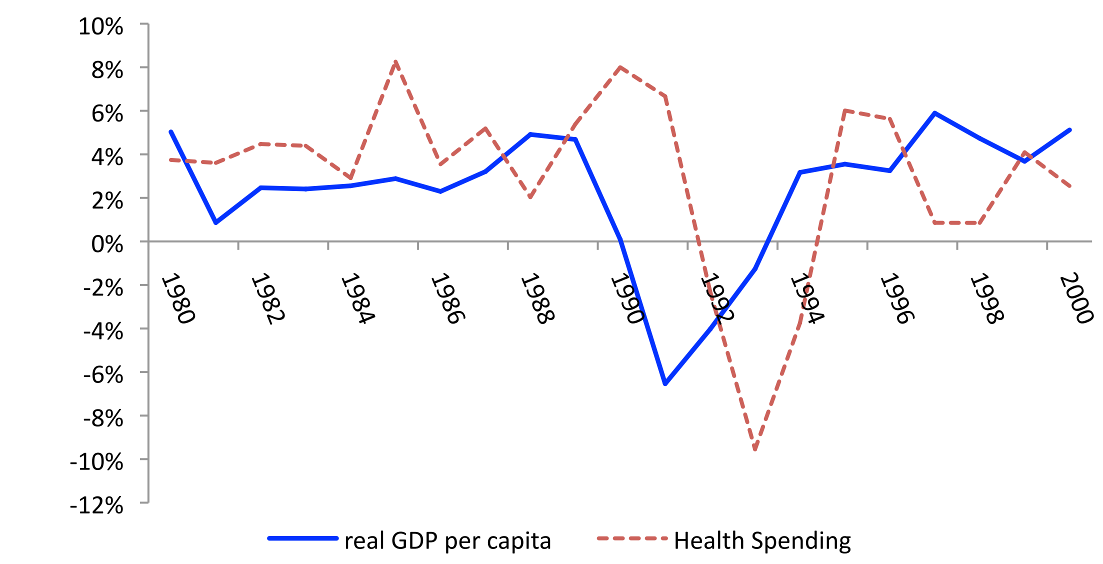
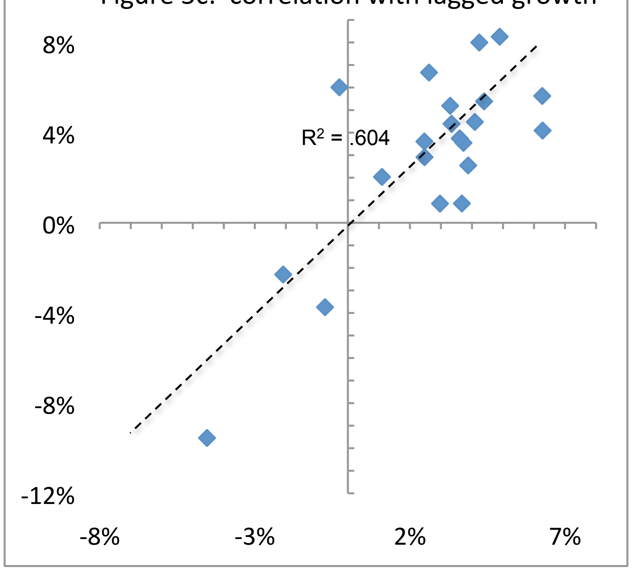
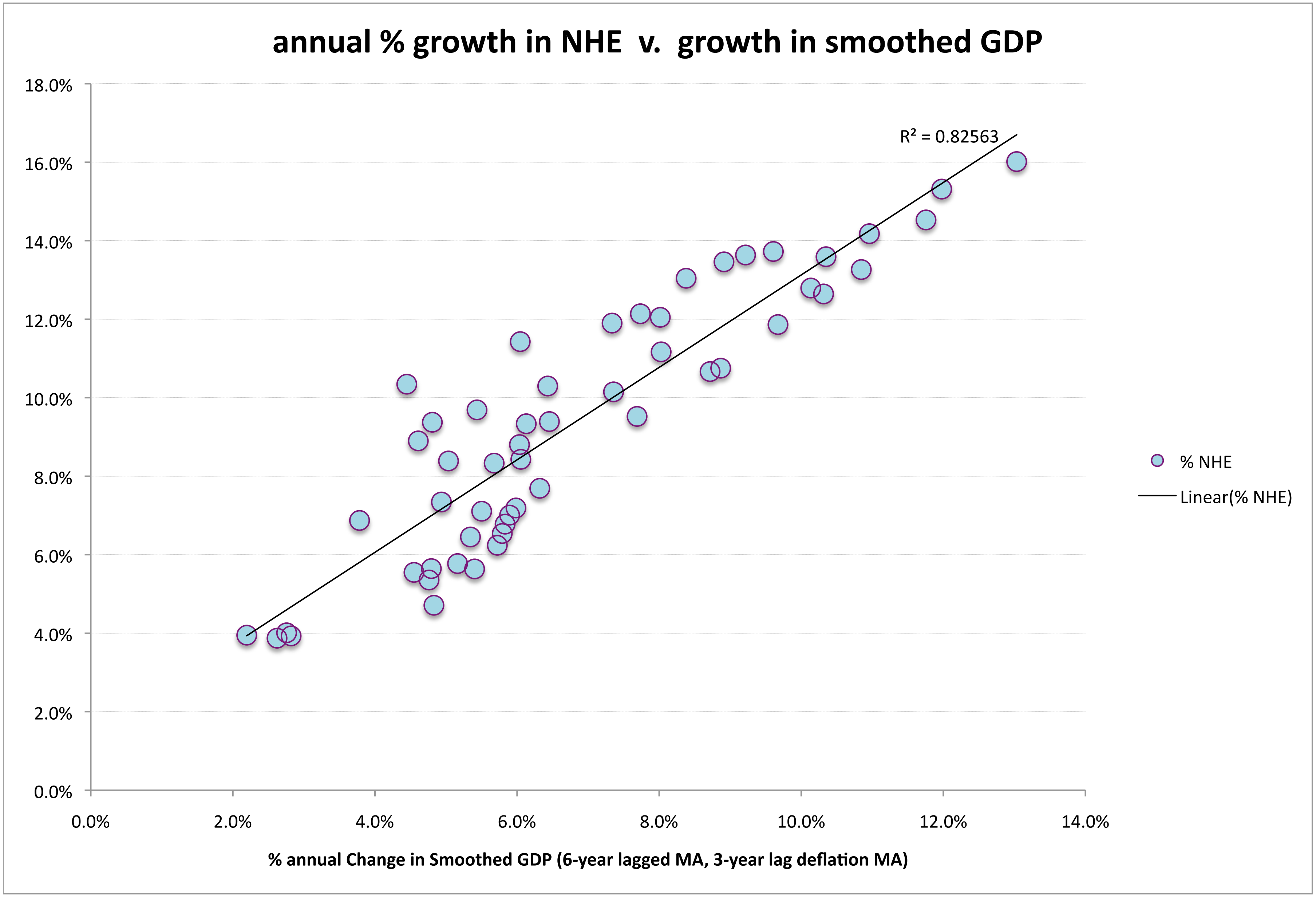
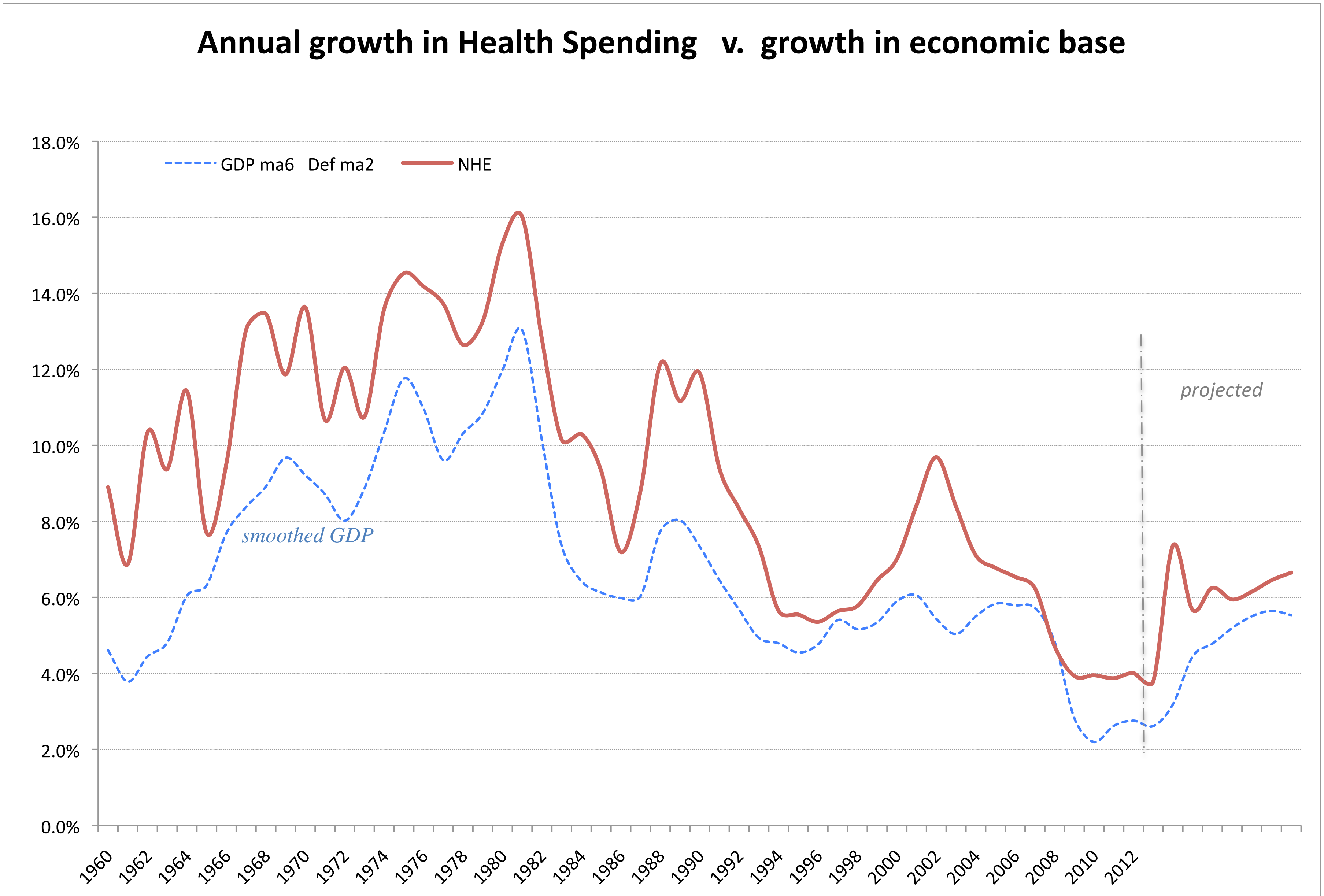


Figure 5b: Correlation with current growth

Figure 5c: correlation with lagged growth




annual % growth in NHE v. growth in smoothed GDP
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%
R² = 0.82563
% NHE
Linear(% NHE)
% annual Change in Smoothed GDP (6-year lagged MA, 3-year lag deflation MA)



Annual growth in Health Spending v. growth in economic base
18.0%
16.0%
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
GDP ma6 Def ma2
NHE
smoothed GDP
projected
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012

Figure 7: from **J.R. Seale (1959). *The Lancet* no.7, 102, page 555.**

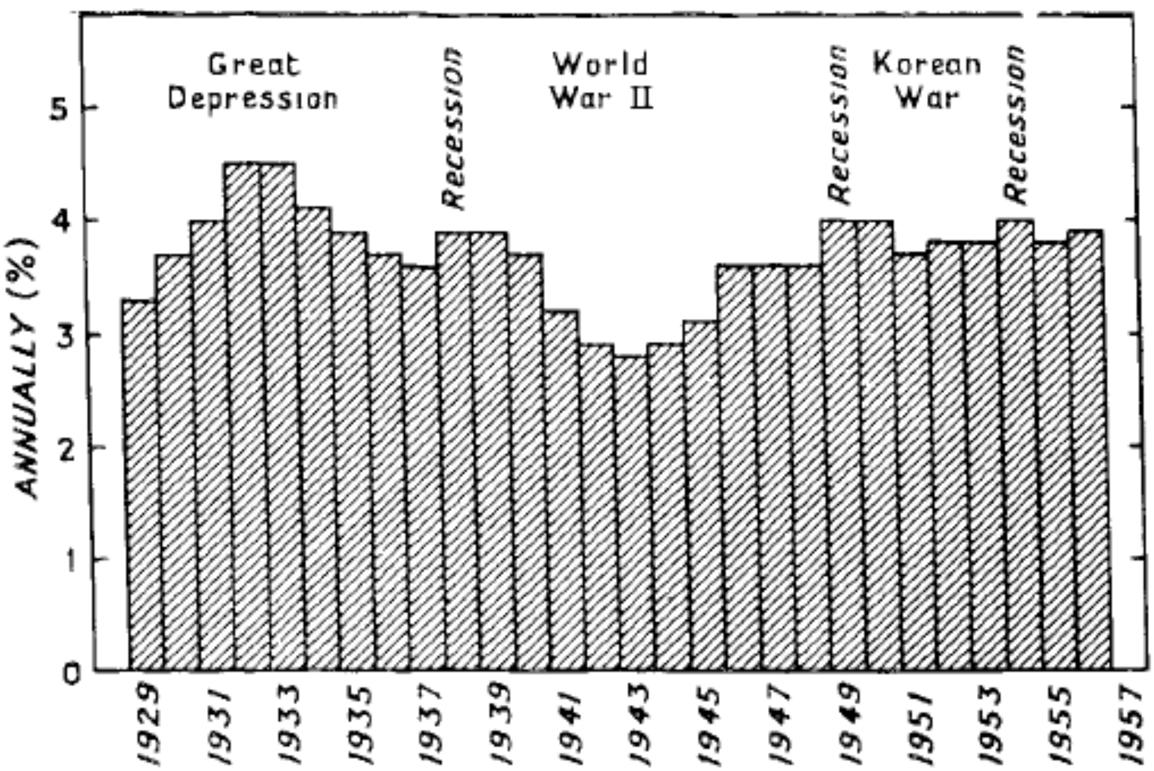


Fig. 2—National expenditure on medical care expressed as a percentage of gross national product, U.S.A., 1929–56.

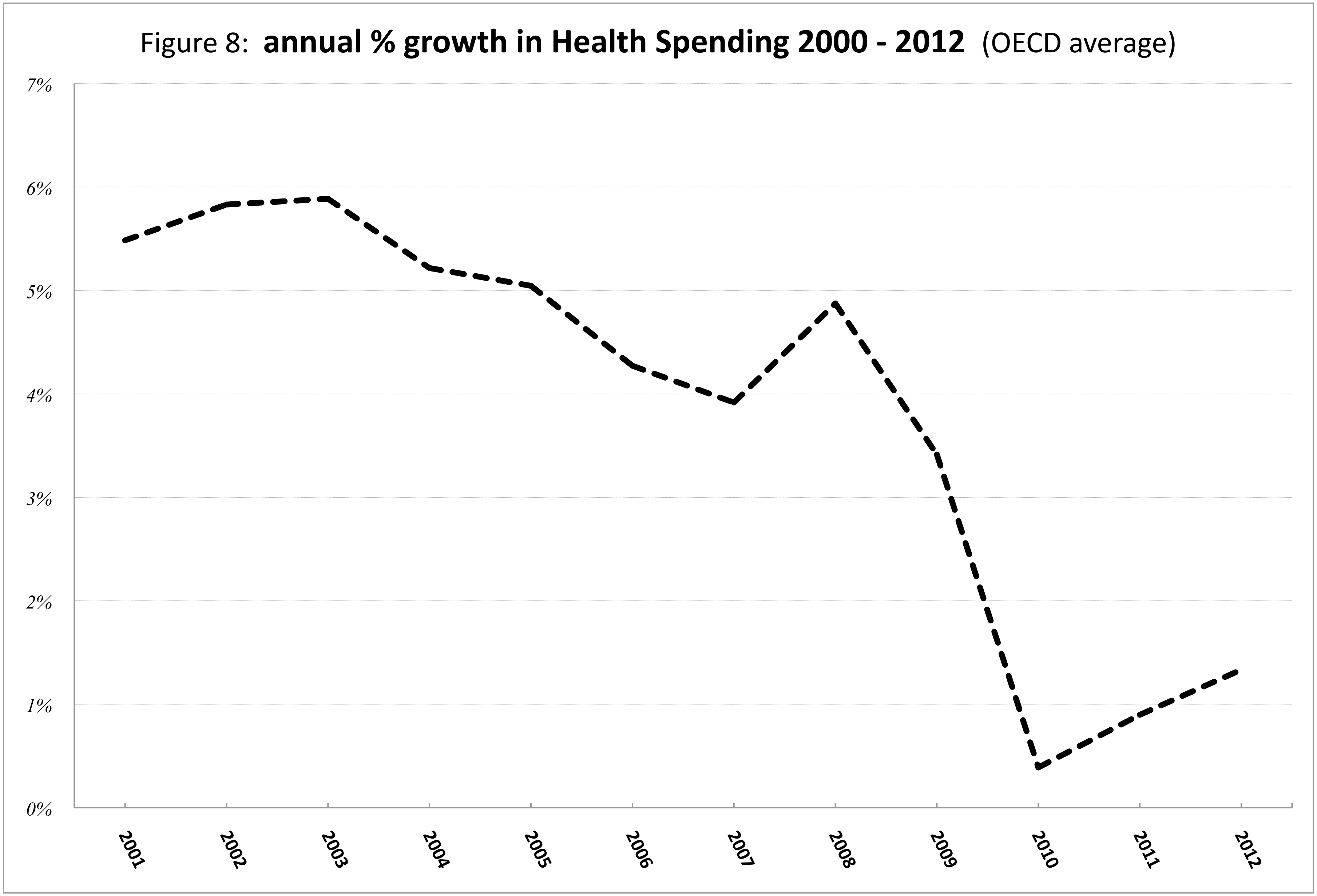


Figure 8: annual % growth in Health Spending 2000 - 2012 (OECD average)
7%
6%
5%
4%
3%
2%
1%
0%
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

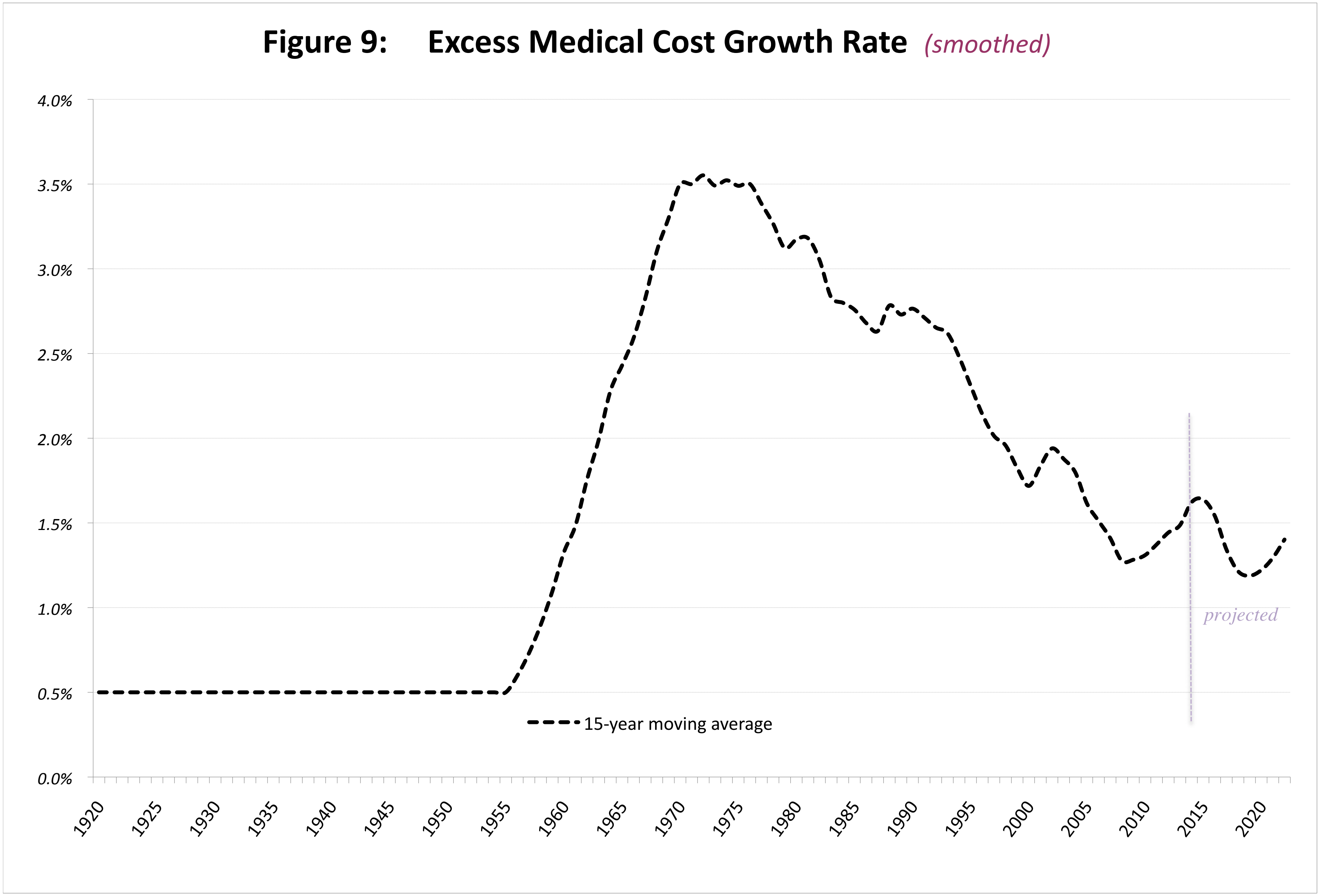


Figure 9: Excess Medical Cost Growth Rate (smoothed)
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
15-year moving average
projected
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

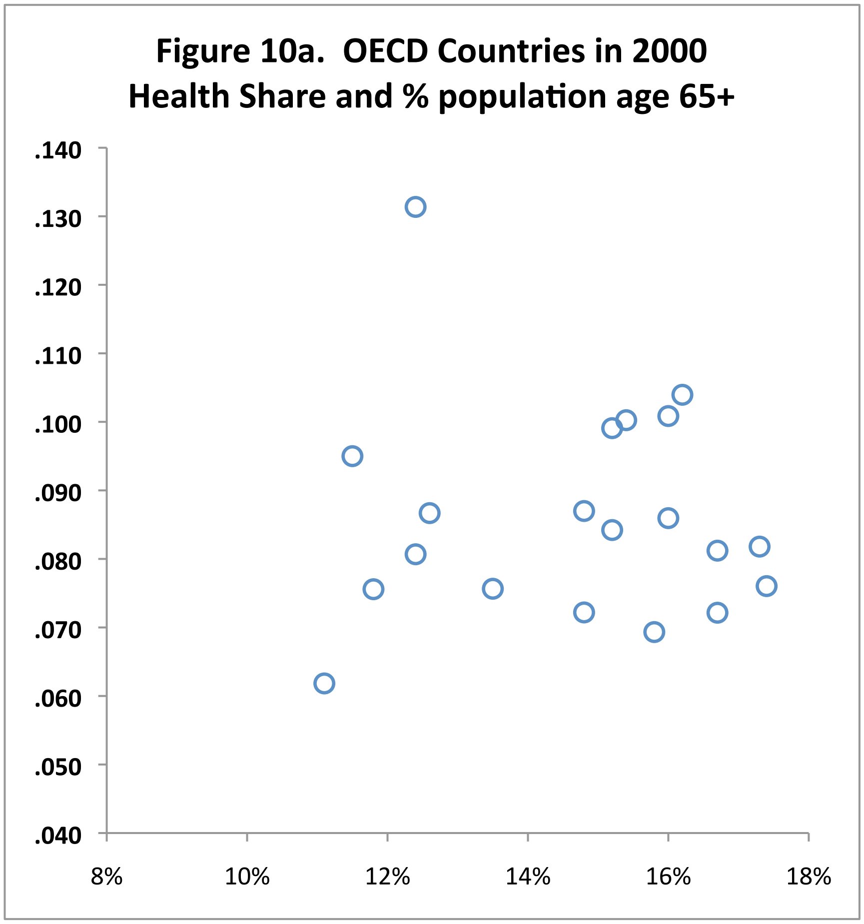


Figure 10a. OECD Countries in 2000
Health Share and % population age 65+
.140
.130
.120
.110
.100
.090
.080
.070
.060
.050
.040
8%
10%
12%
14%
16%
18%

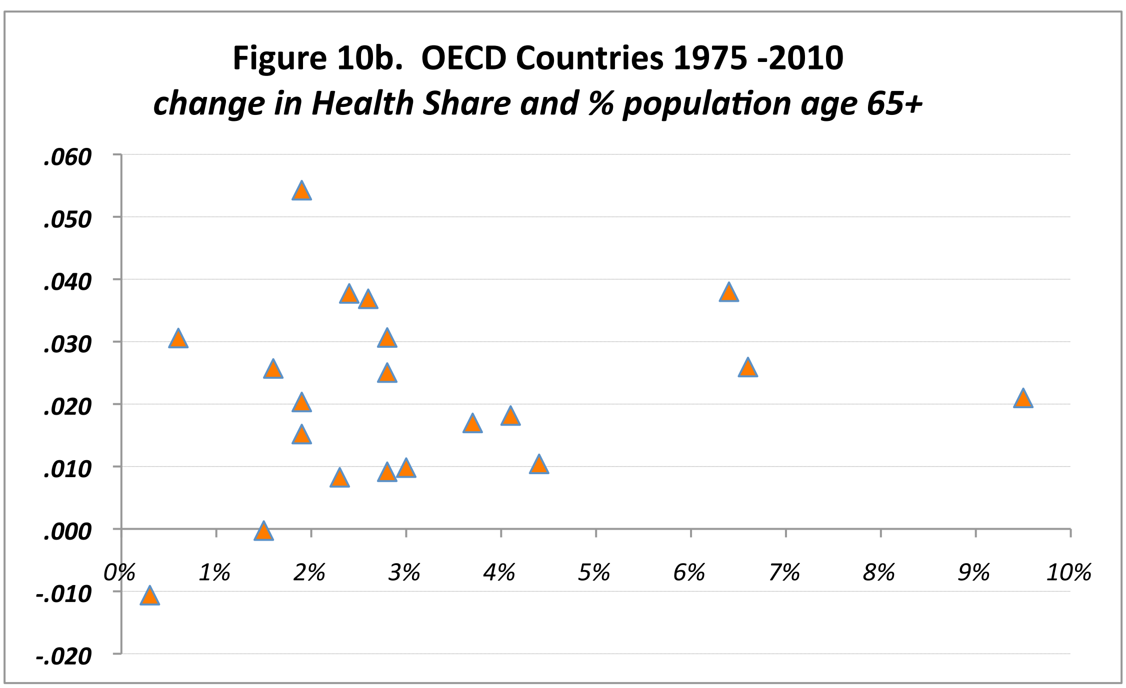


Figure 10b. OECD Countries 1975 -2010
change in Health Share and % population age 65+
.060
.050
.040
.030
.020
.010
.000
-.010
-.020
0%
1%
2%
3%
4%
5%
6%
7%
8%
9%
10%