Is This Time Different?
The Slowdown in Healthcare Spending

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Has health care cost growth really moderated? We first question whether the remarkable decline in expenditures during 2007-2013 is different; a similar downturn occurred in the early 1990s before roaring back in the late 1990s, and even as of 2013, there is little evidence of health sector employment slowing. Second, we find little evidence that the Great Recession alone was the cause (income effects in health care are small) or that the 2010 Affordable Care Act could take credit (it still hasn’t phased in yet). Third, Medicare, Medicaid, and private insurance exhibited very different dynamics during this period, with private insurance prices escalating and utilization slowing as consumers faced higher deductibles, and Medicare, an entitlement program, untethered from the economic downturn. Fourth, the primary determinant of long-term growth is the continued development of new and expensive technology, and there is little evidence of slowdowns in the technology pipeline; proton beam accelerators are on target to double between 2010 and 2014, and stock prices in the health sector remain exceptionally strong. Finally, while we recognize the possibility of newly developed accountable care organizations (ACOs) and emboldened insurance companies to restrain the growth of health care spending, we predict that health care costs will grow at GDP plus 1.2 percent for the next few decades; lower than previous estimates but still on track to cause serious fiscal pain for the U.S. government and employees who bear the cost of higher premiums in the form of lower wages.

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I. Introduction

The US has led the world in both the level and growth rate of spending on health care, with nearly 18 percent of US GDP produced by the health sector. Between 1980 and 2008, US health care spending grew by 7 percentage points of GDP, compared to just 2.6 percentage points for other OECD countries. Yet recent time-series evidence suggests that healthcare cost growth is moderating. Cutler and Sahni (2013) estimate a 1% unexplained drop in health care spending growth, and continued moderation for the next decade, while Nyu et al (2013) find a substantial drop in private insurance spending growth in the last several years. Some see a fundamental sea-change in spending moderation, a change that will only be strengthened as the Affordable Care Act of 2010 is phased in.

Others are less sanguine. Joseph Antos (2013) recently testified that “[t]he biggest single factor driving the recent slowdown is the economy” which means that health care spending will pick up once the economy recovers (Kaiser, 2013). Similarly, Charles Roehrig building on the work of Gene Steuerle (Steuerle,2013) observed that health care expenditure growth has represented a remarkably stable 30 percent of GDP growth, implying convergence towards a steady-state in which nearly one-third of GDP is devoted to health care (Roehrig, 2013b). Still others suggest that we’re wasting our time trying to distinguish between these two hypotheses; one cannot predict long-term trends based on a few years of data (Fuchs, 2013).

In this paper, we ask the question of whether this time the slowdown is really different?\(^1\) We first study trends in a variety of measures of U.S. health care, including personal health expenditures, total health spending, health care prices and quantities, and factor inputs such as employment in the health care sector. While the measurement issues tell somewhat different stories about inflection points, nearly all of them point to a recent decline in health care spending, with the exception of one: the Current Employment Statistics (CES) shows no slowdown in health care employment growth.

Previous studies used time-series regressions to test whether current or lagged GDP growth affects current health care spending. On theoretical grounds, we question whether

\(^1\) With apologies to Reinhart and Rogoff (2011).
GDP growth itself should have a large impact on health care spending – short-run income effects for health care spending are notoriously small (McClellan and Skinner, 2006), and it’s not clear why Medicaid or retired Medicare enrollees should seek more (or less) health care when markets are in free-fall. For this reason, we first hypothesize that the recent changes in health care spending are the consequences of factors that we know affect health care spending, of which only some are associated with the recession. Candidate factors include a rise in prices facing patients (including a larger fraction of uninsured), declining reimbursement rates to health care providers, cuts in Medicaid, a drop in innovation and the slow diffusion of new technologies, stagnant wages for health care workers, and, and the anticipation of health care reforms.

Based on both empirical analysis and evidence from the literature, we find support for this more complicated model of health care spending. Some factors affecting health care growth were the consequence of the recession, for example the sharp cut in Medicaid spending generated by ailing state budgets. But other fundamental changes, such as the rise of high-deductible health plans, evolved prior to the recession, only picking up speed as companies under financial pressure struggled to meet rising health costs. As an entitlement program, utilization in Medicare is not subject to either budgetary cutbacks (as in Medicaid or in OECD countries), nor to rising out-of-pocket costs (as in private insurance), but instead appears to evolve in a separate universe (Goldsmith, 2012), rising and falling with the diffusion of new technologies such as hip and knee replacements, and deflected only partially by CMS administrators reducing reimbursement rates and tweaking coverage rules.

Third, we hypothesize that at least some of the changes causing the slowdown in health care spending are the consequence of policy changes with one-time effects on levels of spending, but without necessarily affecting the long-term determinants of health care cost growth. For example, if healthcare costs have declined because of increasing cost-sharing, then cost growth would be predicted to revert back to more robust steady-state growth patterns once the high-deductible fad has burned out.

But what is the steady state growth rate? Newhouse (1993) concluded that the long-term growth rate of health care spending is the consequence of technology growth – the
innovation of new treatments and procedures, and the diffusion of existing ones. To predict long-term prospects for health care cost growth, we look forward into the technology pipeline. And here, we are both optimistic with regard to potential benefits – for example, the development of renal denervation and minimally invasive heart valve replacements – but pessimistic with regard to the diffusion of new and very expensive technology with uncertain health benefits. For example, proton beam accelerators that cost hundreds of millions of dollars to install, and which require thousands of prostate cancer patients to pay off the mortgage, are expected to more than double in number between 2010 and 2014.

We acknowledge the larger unknowns that make predictions challenging. First, the implementation of President Obama’s Affordable Care Act (ACA) will have an unknown impact on growth rates in health care spending over the next few decades: on the one hand, increased Medicaid enrollment will lead to greater health care spending, but on the other, the impact of scaled back Medicare reimbursement rates will reduce Medicare spending growth. The rapid propagation of Accountable care organizations (ACOs), may reduce growth rates, although the magnitude of these effects is unclear.² There is certainly great enthusiasm for these efforts; Nichols (2013) explains:

...a good metaphor for the US health care system today is the opening sweeping panorama [in The Sound of Music] followed by the crescendo of Julie Andrews’ voice singing “The Hills are Alive” with the sound of care process redesigns and incentive changes designed to make better outcomes sustainable at lower total cost.”

If ACOs eschew building proton beam accelerators (or patients face a higher copay for such services), a “static” health policy reform could have important effects on long-run growth by slowing the innovation cycle (Finkelstein, 2007). In sum, we predict a middle ground; short of a fundamental change in how we pay for new cost-ineffective technologies, health care costs will bounce back to something closer to a growth rate of GDP plus 1% or more; perhaps not the “The Hills are Alive”, nor the cult horror film “The Hills Have Eyes.”

² See Colla et al. (2012) and Chernew et al (2013) for evidence on ACO (or ACO prototype) cost savings, and Clemens and Gottlieb (2013) for an estimate of the supply elasticity of physician services with regard to Medicare reimbursement rates. Congress may also pass additional reforms, whether premium support for Medicare, or legislated price transparency for private health insurance bills.
II. Facts about the Slowdown

What is the evidence on the slowdown in health spending? We begin with the macroeconomic evidence, taken from Fuchs (2013), and shown in Figure 1. The graph shows inflation-adjusted growth rates in health care spending using a five-year average to smooth out short-term fluctuations. Fuchs (2013) also includes smoothed GDP growth rates, shifted up by 2.4% (the average excess of health care spending growth over GDP growth during this period).

The graph demonstrates the sharp decline in growth rates of spending since roughly 2005, with a particularly dramatic drop in the 2010s to the lowest growth rate since the 1950s. The decline is not quite so dramatic, however, in comparison to GDP growth; until the most recent few years, health care spending growth tracked the downward spiral in GDP growth, and indeed, the share of health care spending to GDP has not budged (yet) below about 18%, still the highest in the world by far. Note that despite the considerable commentary about the recent slowdown in healthcare spending growth, as evidenced by the debates in our introductory paragraph, since 2005 healthcare-spending growth still exceeds GDP growth by 2%.

To illustrate the tremendous pitfalls associated with making forecasts about slowing spending (Fuchs, 2013), note that Figure 1 shows similar slowdown occurred in the early 1990s, when health care cost growth slowed and even temporarily lagged behind GDP growth, leading to a decline in the percentage of GDP spent on health care from 13.7% in 1993 to 13.6% in 1994. The decline at the time was seen as a welcome correction (or even “revolution”) arising from greater competition in response to the growth of health maintenance organizations (HMOs) and the anticipation of the Clinton health care reforms. Robert G. Dederick, an economist, noted that "The medical sector is not immune to what goes on in the economy...It's not as out of touch as many people seem to think." (Hershey, 1993) Similarly, a Merrill Lynch vice president noted that "[p]hysicians are anticipating change and really beginning to change their practices” (Freudenheim, 1993). Despite this enthusiasm, it is sobering to note that the drop-off was short-lived, and by the late 1990s
growth in health care expenditures had exceeded the long-term average of GDP plus 2.4%, and in 2000 annual real per-capita growth was 7 percent.

Health care expenditures relative to even potential GDP makes the most pronounced gains during recessions, as shown in the two panels of Figure 2, with levels in Panel A and growth rates in Panel B. In both panels we use two measure of healthcare spending—total spending (which was used earlier in Figure 1) and personal health consumption expenditures, which is national health expenditures less medical sector purchases of structures and equipment and expenditures for noncommercial medical research. In many respects, this is a better representation of actual health care consumption flows. Table 1 provides a breakdown of average annual growth rates for the different series: total and personal healthcare expenditures exhibit very similar growth rates, but with the exception that total healthcare spending declined more during the most recent recession than personal healthcare spending.

The slowdown in health care spending is not unique to the United States. Figure 3, adapted from an OECD report, shows aggregate health care spending skidding from just below 5% real growth in 2008 to 0.5% in 2010 and 2011. We hypothesize that this more dramatic drop in health care expenditures than in the United States reflects both the larger share of publicly financed non-entitlement spending in other OECD countries, and a sharper drop in GDP for many countries such as Greece and Ireland – a question to which we return in Section III.

Finally, we consider an alternative measure of growth in the health care sector: health care sector employment growth. Since 57 percent of overall health care expenditures are labor costs (Turner and Hughes-Cromwick, 2013), it seems unlikely that we would expect to see a permanent bending of the cost curve without a commensurate shift in employment rates.

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4 http://www.oecd.org/els/health-systems/health-spending-continues-to-stagnate-says-oecd.htm
Figure 4 shows annual (smoothed) 12-month growth rates in the health care sector using two data surveys. The Current Population Survey (CPS) shows a strong pattern of growth in health care employment through the recent recession (2007-2009), followed by a drop in 2010-11, a jump back up in 2012, but followed by a drop in the early part of 2013. This latter fall-off has prompted some to declare that health care costs are indeed tamed (Kliff, 2013), but the CPS patterns of employment growth appear to be highly volatile, with the August 2013 early estimates showing a sharp bounce back.

By contrast, health care sector employment as measured by the Current Employment Statistics (CES) data is far more stable, and shows a remarkably constant growth rate in the health care sector since 1991 that has fluctuated around 2 percent per annum, through business cycle contraction and expansion (Figure 4). Why might the two measures of employment for the health-care sector be so different? First, it should be noted that the two series are very similar in how they depict the total employment growth (see Appendix Figure A.1). Second, there are some differences between the surveys in their treatment of multiple jobs held by the same worker, and the CPS coverage of the self-employed, which are not picked up in the CES (Bowler and Morisi, 2006). Third, the largest difference is between the sample sizes of the two surveys; the CPS is derived from a sample of about 60,000 workers, compared to roughly 160,000 firms that cover 400,000 workplaces in the CES (Bowler and Morisi, 2006). This creates greater sampling variability in the CPS even for aggregate measures of employment, with considerably greater variability for sectoral-specific growth measures. Taken together, these employment data suggest some caution in predicting a permanent bending of the health care cost curve.

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5 Nor is employment growth in health care solely the consequence of new information technology specialists and billing clerks; indeed clerical workers have been declining. During this period of time, hospital admissions have been declining, yet as Goldsmith (2012) noted, between mid-2009 and mid-2011, “[h]ospitals employed 18,000 more physicians, as well as more nurses (117,000), technicians and technologists (almost 35,000) and therapists (12,000) — all on declining core volume.”

6 Bowler and Morisi (2006) illustrate this point by noting that “...from 1994 through 2004, there were 23 months when household survey employment changed by about 500,000 over the month.... The establishment survey, by contrast, showed a change of that magnitude only once in those 10 years..., and that was due to an unusual weather event: a major blizzard that affected much of the Northeast.” (p. 27)
III. What are the Factors that Might Have Reduced Health Care Cost Growth?

Here we enumerate a list of suspects who may be implicated, or credited, for the decline in health care cost growth.

1. *The Affordable Care Act of 2010.* One explanation for the decline in health care spending growth, popular among Democrats, is the implementation (or anticipation of the implementation) of the Affordable Care Act (ACA) of 2010 (Unger, 2013). The problem with this explanation is thus far, cost-saving effects of the ACA have been mixed; the extension of insurance coverage to dependents up to age 26 will tend to increase costs, while an early accountable care organization (ACO) pilot exhibited very modest cost saving (Colla et al., 2012), although a more recent study of an ACO-like partial-capitation “Alternative Quality Contract” in Massachusetts suggested somewhat larger effects (McWilliams, et al., 2013). Most importantly, the downturn in health care cost growth began in 2006, back when Barack Obama was still a relatively unknown senator from Illinois.

2. *The Great Recession.* Others (primarily Republicans) have attributed the downturn instead to the recession. Cutler and Sahni (2013) considered the role of the recession in explaining the downturn in health care expenditures, and estimated an elasticity of about one with respect to 5-year average GDP. While their model predicts a rebound of health care spending as GDP picks up – particularly given the influence of 4 or 5-year lags in the time-series regressions (Roehrig et al, 2013), there is still a roughly one percentage point drop in health care cost growth that cannot be explained by GDP growth per se. We find that the time-series association between growth in GDP and growth in health care expenditures depends critically on the specified lag structure. For example, we also estimated regression models using aggregate data on health care expenditures and GDP from 1970-2011. Like Cutler and Sahni (2013), we also found a coefficient of about one using a 5-year geometric average, but a 3-year geometric average yielded an estimate of just 0.21, and a 7-year geometric average

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implied an estimate of 1.58. (Appendix Table A.1). Given the sensitivity of our results to relatively innocuous changes in the lag-structure, we are reluctant to make much of the time-series evidence between GDP growth and healthcare spending.

A deeper question is: Why should we expect GDP growth to drive health care spending growth? The income elasticity of health care spending is estimated to be very low (e.g., McClellan and Skinner, 2006), and there is debate as to whether recessions lead to better or worse health behaviors. Levine and Buntin (2013) used micro-level data to test the hypothesis that financial or economic distress increased Medicare utilization, and found no evidence for these explanations. A larger income elasticity of health care utilization of 0.7 comes from Finkelstein et al. (2012) who use oil-price shocks to isolate the income elasticity of demand. Their estimate encompasses a general-equilibrium transformation of health care facilities on the supply side as well as the demand side response to higher income. Even with an income elasticity of 0.7, there is almost a 1.5 percentage point decline in the growth rate of healthcare spending that is not explained by income shocks.

There are several possible explanations for the sensitivity of our results to the lag structure. One is that during economic upswings, there is more money available for new investments in either infrastructure or innovations, but that the lag time to market is 5 years or more, so that only the longer lag structures captures this innovation effect. Another and more plausible explanation—that we propose in this paper—is that the aggregate regression model is misspecified because different components of U.S. health care spending respond quite differently to policy levers and other changes in the economy, some of which are likely correlated with GDP growth. For this reason, we expand our inquiries to beyond just GDP growth to consider other policy changes that might have caused the downturn in health care cost growth.

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8 A different approach to estimating the effect of GDP is to test directly whether health care expenditure growth is more rapid in fast-growing states. That is, we want to test whether there are local income effects, for example in Finkelstein et al (2012)'s study of oil price shocks and hospital expansion. We ran a regression for the growth in total health care spending at the state level, while including year-level dummy variables to control for aggregate shocks. We find a coefficient of 0.2, holding constant year effects (Appendix Table A.2). That this coefficient is modest relative to the aggregate regression analysis is again consistent with investments in health care innovation being driven by aggregate GDP growth.

9 For example, as Levine and Buntin (2013) showed, the number of U.S. medical device patents applied for nearly doubled between 1998 and 2007, but declined during 2008 and 2009.
3. Patient Cost-Sharing. Changes in patient cost-sharing in Medicare were very small and unlikely to have affected overall cost declines (Levine and Buntin, 2013), and Medicaid patients rarely pay out-of-pocket. With regard to private insurance, largely for people under age 65, perhaps the most important policy change was the rise in high-deductible health insurance plans (including health savings accounts) involving substantially larger copayments or with more restrictive coverage, for example higher copayments for brand-name drugs compared to generics (Thomas, 2013). According to the Kaiser/HRET survey of employer sponsored health benefits, the fraction of employers offering a high-deductible plan grew from 4 percent in 2005 to 31 percent in 2011.

Figure 5 shows the deductible facing the average employee with employer-provided health insurance since 2006, from the same 2013 Kaiser study. The dollar amounts reported on the vertical axis are the amounts employees are liable for prior to the health plan kicking in, and are not the amount the employees actually paid (which will reflect individual decisions made with regard to health). The arc-elasticity of this increase between 2006 and 2013 is 0.58; using an elasticity of about 0.2 from the Rand Health Insurance Study predicts a cumulative decline of 11.6 percent in utilization (or an annual reduction in growth of 1.7 percent per year). In a study focused explicitly on these types of private insurance policies with deductibles, Aron-Dine et al. (2012) find even larger price elasticities of 0.4 to 0.6, leading to much larger drops in quantities consumed for private insurance enrollees.\(^\text{10}\)

These estimates come from the increase in deductibles, but they could overstate the true increase in the price actually facing consumers. An alternative measure comes from Nyu et al. (2013) using data from self-insured large private insurance plans. They report the annual growth in out-of-pocket expenditures for specific components of health care spending, ranging from an arc-elasticity of about 61 percent for emergency room charges between 2007 and 2011, 39 percent for brand-name drugs, 36 percent for hospital admissions, to 23 percent for outpatient visits. While Nyu et al. (2013), using their own estimated elasticities, arrived at

\(^{10}\) The RAND elasticites assume ‘complete myopia’ in that patients only respond to the spot price of healthcare. In Aron-Dine et.al (2012) consumers are allowed to respond to the ‘future price’ of healthcare, meaning that they realize that todays spending should be affected by end-of-year prices.
more modest demand effects, these price increases combined with the Rand elasticity of 0.2 implies an annual decline in utilization of 2 percentage points.

An additional factor leading to higher prices for working-age adults is the rising number of people who lacked insurance during this period. The percentage of the population age 19-64 who were uninsured rose from 18 percent in 2005 to 20 percent in 2010 before dropping somewhat to 19 percent in 2012, owing to the legislated coverage of dependents up to age 26 under the ACA. For adults age 26-49, un-insurance rates continued to rise from 22 percent in 2010 to 24 percent in 2012 (Collins et al., 2013).

4. Prices versus Quantities. Spending growth is the consequence of increasing prices or quantities or both. The distinction between prices and quantities is central to our explanation of the downturn, because Medicare, Medicaid, and commercial insurers manage prices and quantities so differently. Medicare performs little utilization review and its only cost-control tool is to reduce reimbursement rates or in a few cases, to restrict coverage. Medicaid manages reimbursements even more vigorously, for example by cutting reimbursements rates so much that enrollees essentially lack access to specialty care and newer technologies (Sack, 2010).

Commercial payers, on the other hand, are much smaller than government payers and are far more likely to be affected by rising provider market power. Rather than paying less to hospitals and physicians, as Medicare and Medicaid do, instead they attempt to slow health care cost growth on the demand side, by increasing deductibles and copayments, and by putting enrollees in tiered-networks (where patient pay higher copayments to access high-cost hospitals).

So is the slowing growth of healthcare spending a consequence of falling prices or utilization? This simple question is surprisingly complex to answer. Anderson et al. (2003) have argued the high level of US healthcare spending reflects higher prices, but it is not known whether their story (for levels) applies to the growth of spending. Second, in the short-

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11 Commercial payers in turn price discriminate by charging profitable firms more than less profitable firms (Dafny et al., 2012).
run, price increases are likely to reflect the growth of unmeasured quantities; if hospitals charge more to insert a stent, does it mean that the price of a stent went up, or might it mean that hospitals are now using drug-eluting stents when in the past they used bare-metal stents? Third, a price index is quite difficult to measure in health care, since these do not capture improved survival and quality of life resulting from technology gains in health (Cutler et al., 1998). Fourth, the well-known problems of Laspeyres price-indices—that they utilized base-period weights and ignore substitution effects—is particularly pronounced in healthcare where new therapies and new conditions can dramatically alter the distribution of spending across categories.

Of course, recognizing that there are serious problems with measurement does not mean that nothing can be learnt. The problem of quantity and quality changes masquerading as price changes can be ameliorated by comparing relative price differences across payers—Medicare, Medicaid, and Commercial. There were considerable changes since 2006 in how much physicians and hospitals were paid. These effects are unlikely to have been observed in private insurance markets; if anything, what hospitals actually charged private insurance was increasing far more rapidly than the inflation rate during 2009-11 (HCCI, 2012). During this period, however, Medicare reimbursements to providers lagged the general inflation rate. In a comprehensive study of factors causing the slowdown in Medicare fee-for-service spending, Levine and Buntin (2013) suggested a small decline of 0.3 percent in reimbursement rates for Medicare relative to the earlier high-growth periods; even with the large price elasticity for providers found by Clemens and Gottlieb (2012), it still seems unlikely that declines in fee-for-service expenditures could accounted for much of the decline in Medicare expenditures.12

A more likely source of declines in Medicare expenditures, however, is the growth in managed care contracts – that is, a capitated rather than fee-for-service payment for what is now one-quarter of all Medicare enrollees. While it is difficult to know utilization trends in managed care (since these are not generally reported), Baicker et al. (2013) estimated a pronounced spillover effect; health systems treating more managed care patients also treat

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12 Levine and Buntin (2013) also consider other factors such as a small rise in Part-A-only enrollees, but again these factors seem unlikely to have explained the decline entirely.
their fee-for-service patients conservatively (also see Glied and Zivin, 2002). In sum, provider price changes in Medicare are clearly important in affecting utilization, but the magnitude of such changes since 2006 are not large.

Another explanation for a downturn in Medicare spending could arise as well from managed care; not so much through a reduction in utilization but because of a decline in the price per enrollee. Cutler and Sahni (2013) used internal data from CMS to estimate that during 2009-11, reimbursement rates declined by 1.8 percent annually (largely because of managed care reimbursement cuts), meaning that actual utilization would not have fallen by as much as indicated.13

Finally, there is substantial evidence from across states that during this period, Medicaid continued to cut provider fees and either implicitly or explicitly limit access to high-cost services such as specialists (Sack, 2010). Medicaid has always paid marginal cost or below, but during the recession, provider reimbursements have fallen further; the Medicaid-to-Medicare fee ratios for physicians declined from 72% to 66% between 2008 and 2011 (Zuckerman and Goin, 2012).

In sum, we would anticipate that – given the severity of budgetary pressures on Medicaid, that per-enrollee Medicaid would be expected to have declined the most, with private health insurance spending the next most serious decline, and with – thus far – more modest effects on Medicare. Whether overall Medicaid spending per capita should rise or fall depends more on the magnitude of the expansion of enrollees during the recession.

5. Technology growth and diffusion. Another factor that is likely to have affected growth rates in health care spending since 2006 is the pace of technology diffusion. A substantial percentage of the growth in health care costs since the 1980s has been the diffusion of new and expensive technologies; cardiac catheterization laboratories, hip and knee replacements, advanced ICU facilities, and new pharmaceutical approaches to treating cancer and other diseases. One potential cause for the decline in health care growth could be a slowdown in

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13 Furthermore, limiting attention to just aggregate Part A and B spending ignores the dramatic growth in Part C (managed care) spending.
the diffusion of these technologies. Indeed, drug spending actually declined in 2012, both because of the rising share of generics because of higher copays for brand drugs, but also because of a distinct lack of new blockbuster drugs (Thomas, 2013).

In our earlier work, we found it useful to consider a typology of healthcare technologies to understand cost-growth in healthcare and we invoke the same classification here (Chandra and Skinner, 2012). Category I treatments which have high average productivity and are responsible for most of the increase in longevity. Category I treatments are either very low cost, or high-cost but highly cost-effective, such as anti-retrovirals for HIV and AIDS. “Category II” treatments have heterogeneous benefits across patients – with many receiving little incremental value, and “Category III” treatments—such as ICU use and proton-beam therapy are both expensive and with unknown incremental benefits.

Figure 6 shows per-enrollee Medicare fee-for-service rates of utilization between 1994 to 2010 for a variety of treatments, with rates normalized to 1.0 in 1994. Not surprisingly, Category II and III treatments are the ones that are responsible for healthcare spending. In the case of cardiac stenting and bypass surgery, there was a dramatic run-up in their use during the 1990s for heart attacks and other heart disease, and with a particularly rapid rise in the use of stents (wire cylindrical devices used to maintain blood flow in the heart’s arteries). During the mid-2000s, however, several randomized trials suggested very modest benefits arising from the use of stents for the most common types of heart disease, leading to a downturn in the use of these procedures.

As illustrated in the figure, there was a marked rise in the per-enrollee use of coronary artery bypass graft (CABG, or bypass surgery) and angioplasty (or stents) through 2004, but then the continued decline in CABG use was amplified by the retreat of stenting during this same period, which could explain at least some of the overall drop in health care spending, both in Medicare, and (to the extent a similar fall is observed in the under-65 population) in the private insurance markets as well. This change was not unique to cardiovascular

\[14\] In the 1990s, angioplasty, or a balloon that was threaded into the artery by use of a catheter, and then expanded at the location of the blockage, was most commonly used. Later, cardiologists used stents to prop open the narrowed arteries, so that currently nearly every angioplasty involves the placement of a stent (and sometimes multiple stents).
procedures; as can be seen, the slow decline was observed for all inpatient surgical procedures as well including hip and knee replacements.

In part, some of the decline in cardiac inpatient procedures (which we measure here) could have been the consequence of a gradual shift during this period from inpatient to outpatient procedures – in other words, the operation is performed in an outpatient surgical center. Levine and Buntin (2013) correctly note that these types of technological innovations might be expected to reduce costs, at least while the shift is taking place. But the problem with this explanation is that other treatments continued to diffuse during the period, at least in the Medicare population.

Figure 6 shows the continued growth in back surgery through 2010 (a “Category II” treatment), as well as the growth in ICU days for the last six months of life (a “Category III” treatment). Despite an increasing use of hospice care, Medicare spending per decedent in the last six month of life grew by 10% in real terms between 2007 and 2010.

In sum, we would anticipate a small decline in growth rates for health care expenditures since 2006 because of a slowdown in the diffusion of current technology, particularly in prescription drug spending. We would expect a larger impact for Medicare and private insurance, if only because the incentives for technology diffusion in Medicaid are weaker.

6. Portmanteau Factors. There are a variety of other factors that are not likely to have influenced health care cost growth substantially. Levine and Buntin (2013) find a small influence of younger and healthier Medicare enrollees (the leading edge of Baby Boomers) on expenditure growth, but these effects are small. Wages and compensation for health care employees could have fallen, but we do not find evidence for this using the wage data in the CPS (Appendix Figure A.2), and as noted above, overall employment has continued to climb in the face of declining hospital admissions and physician visits, making it unlikely that health care providers could pass along savings through lower prices. The major drivers of the health care slowdown are changes in relative prices to consumers and providers, and technological growth – each of which will affect private, Medicare, and Medicaid patients differently.
IV. The Envelope, Please

As noted above, we are only able to formulate fairly aggregated predictions based on economic evidence. Our predictions suggest that Medicare has to this point been largely unrestricted by cost-saving measures, and thus utilization (net of reimbursement rates) should have been growing the most rapidly, followed by private insurance spending (with prices up, but utilization slowed because of patient cost-sharing), followed in turn by Medicaid per enrollee (with the greatest provider reimbursement cuts). Actual per capita Medicaid spending should be somewhere in-between, as the Great Recession added to those newly eligible for Medicaid.

Figure 7 shows rates of per enrollee utilization for each of these different components of health care expenditures. Despite the recent downturn in Medicare expenditures, it has risen the most rapidly even during the downturn; it appears to be most insulated from the recession, although it did rise by only 0.4% per capita in real terms from 2011-12. While the overall contribution of private insurance expenditures to health care cost growth has been moderating since the early 2000s because of a decline in the share of the population covered, average premiums per enrollee have continued to rise, with most of the increase because of increased prices—utilization has not grown much. For example, inpatient spending grew 4.9 percent between 2010 and 2011, while spending on outpatient services grew 7.2 percent and spending on prescription drugs grew 1 percent. The utilization changes were -0.6 percent for inpatient care, 2.1 percent for outpatient care and 0.2 percent for prescription drugs, with unit prices being the key driver of total spending (HCCI, 2012).

Another test of the hypothesis is whether there are differential growth rates for given technologies in Medicare versus private insurance where, as noted above, copayments and high-deductibles are appearing to catch hold. As Lee and Levy (2011) have demonstrated, for both Medicare and private health insurance, the growth in the use of MRIs and CT scans was very rapid during the early 2000s. However, from 2006 forward, there has been a sharp drop in the growth of imaging generally, but it appears that rates in private insurance are essentially zero, while at least for CT scans, rates in the Medicare population continued to rise
5 percent annually after 2006. Of course, at the same time imaging rates in the Medicare program were being affected by the Deficit Reduction Act in 2007, leading to a sharp drop in rates of use for MRIs (for example) performed in imaging centers and offices (Lee and Levy, 2011).

The data presented above is limited to quite recent trends. What about earlier empirical patterns? To address this question, we turn again to the aggregate time-series regressions, only this time we consider each component of health care spending separately (Appendix Table A.1). Using a five-year lag, we demonstrate that Medicare expenditure growth appears untethered to GDP growth, with a coefficient of -0.82, which is statistically insignificant. By contrast, private health insurance is very strongly associated with GDP growth, suggesting that firms are more willing to insure their workers, and pay higher premiums, during economic upturns (the coefficient is 3.0). Medicaid is somewhere in-between, suggesting that the pro-cyclical impact of GDP on state fiscal budgets and perhaps also the willingness of the federal government to expand eligibility (a point that we return to in the next section), leads to greater expansion of Medicaid spending when the economy is healthy; certainly the recent evidence (Figure 7) suggests no growth in per-enrollee Medicaid expenditures, whether during expansions or contractions.

V. Will Health Care Cost Growth Revert Back to Long-Run Trends?
Two decades ago, Joe Newhouse addressed the question of why health care continued to rise so much faster than GDP growth (Newhouse, 1992). After ruling out a number of alternative explanations, he arrived at the root cause: technological innovations. Other factors such as changes in insurance generosity and coverage had increased utilization, but these were one-time shifts rather than a movement in the long-term growth rate. Thus our next task is to attempt to disentangle what might be the short-run effects that might be expected to moderate or disappear, and what is the underlying long-run growth rate in health care expenditures, with a special focus on technology growth and diffusion, for the next (say) two

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15 Others find a negative association; see Levine and Buntin (2013), and McInerney and Mellor, 2012.
decades? We recognize the risks of prognostication; as John Kenneth Galbraith noted, “There are two types of forecasters; those who don’t know and those who don’t know they don’t know.” Thus these predictions come with very wide confidence intervals.

We consider three approaches to assessing the prospect for long-term growth. Our first approach is to use the estimates from Table 2 to develop our best-estimate of the long-run trends separate of the short-run or transitory effects. The second approach peers into the technology pipeline to see whether it really has slowed, or whether industry observers are optimistic with regard to future growth in devices and surgical procedures. The final approach considers relative movements in health sector stock prices.

### Table 2: Annual Growth Rates of Prices, Utilization and Enrollments by Payer (2008-2012)

<table>
<thead>
<tr>
<th>Payer</th>
<th>Price Growth (Real)</th>
<th>Utilization Growth</th>
<th>Enrollment Growth</th>
<th>Share of Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicare</td>
<td>0%</td>
<td>2.5%</td>
<td>2.4%</td>
<td>30%</td>
</tr>
<tr>
<td>Medicaid</td>
<td>-0.1%</td>
<td>1%</td>
<td>4.7%</td>
<td>20%</td>
</tr>
<tr>
<td>Private</td>
<td>3.6%</td>
<td>-1.3%</td>
<td>-1.3%</td>
<td>50%</td>
</tr>
<tr>
<td>Total (weighted)</td>
<td>1.9%</td>
<td>1.5%</td>
<td>1.0%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Notes: GDP Deflator growth was 2.4% over this period and is subtracted from column 1. Private price growth and private utilization growth come from HCCI (2012) and combines price growth for inpatient care, outpatient care and prescription drugs. Medicare utilization growth is extrapolated from Levine and Buntin (2013) whose analysis covered 2008-2010.

1. **Estimating long-term trends.** We begin with Table 2, which provides estimates of price and quantity changes between 2008 and 2012 for the three largest payers: Medicare, Medicaid, and private health insurance, which collectively account for 70 percent of all healthcare spending. Ignoring other categories of spending, these categories account for 30, 22, and 48 percent of payments that these payers are responsible for. There is another 31 percent of health care spending that is not accounted for by these three categories. They include investment in facilities and innovation, and government spending for a variety of other programs, many of which supplement the primary Medicaid and Medicare programs (for example programs to help pay for Medicare deductibles among Medicaid-eligible enrollees) or which support health care for the military, such as Veterans Affairs (VA). We assume that these follow the trends of the main three programs.
long-run evolution of prices? Consider first the private insurance market. As noted earlier, there are well-known biases in the measurement of health care prices, with roughly one percent annually attributed to “price” that actually reflects new modes of treatment (Aizcorbe et al., 2011). Additionally, prices may continue to rise faster than inflation as they have since the mid-2000s, but we usually think of prices rising because of hospital consolidation (as in Gaynor and Town, 2012) to be a transitory factor that will, at some point, have to moderate.\(^{18,19}\) In other words, while prices grew 3.6% in real-terms, and likely reflect provider consolidation we are skeptical that this trend will continue indefinitely, especially because of growing FTC interventions and a number of other demand-side innovations such as superior quality measurement, transparency, narrow-networks, and tier-networks will continue to nudge patients towards cheaper providers. So while real price growth in private plans has averaged 3.6 percent over the past four years because of consolidation, we think that it will fall as a result of these new strategies to 2 percent annual growth.

Predicting the future course of Medicaid and Medicare reimbursement rates are more difficult, since cutting such rates are, up to a point, the most politically simple approach to cutting costs in health care. Certainly based on past performance, we expect Medicare reimbursements to grow at the rate of inflation, and Medicaid to grow at below the rate of inflation. But given that many states and the ACA are raising Medicaid rates in order to ensure that providers participate in it, we do not believe that the long-term growth rate of Medicaid prices will lag inflation. Combining Medicare, Medicaid and Private price growth in proportion to their relative shares (3:2:5), we see a rate of growth of real prices to be 1.85% between 2008-2012 that we believe will fall to 1% in real terms because of our anticipated decline in private price growth from 3.6 percent to 2 percent.\(^20\)

\(^{18}\) And stop once all hospitals are owned by a single corporation.

\(^{19}\) One could also appeal to a “Baumol’s disease” explanation; that productivity gains in health care will be limited and so the relative price of health care will continue to rise. However, if anything the potential for productivity gains in health care delivery is particularly promising.

\(^{20}\) That is, we do not assign specific sectoral prices to sectoral growth, but create a “price”, “quantity”, and “aging” component of health care costs and add them.
What then will happen to real quantity increases in health care? Based on Table 2, real Medicare utilization per enrollee is predicted to rise at 2.5 percent annually based on 2008-2012 growth patterns.\textsuperscript{21} We take the real growth in private health insurance utilization, and assume that it continues on its current path at 1 percent growth per year (this assumes that there is a steady stream of demand side cost-management levers such as defined-contribution plans, limited networks, value-based-insurance design and transparency tools that will continue to be added). Finally, Medicaid utilization is assumed to grow at 1 percent annually.

Finally, what about enrollment growth? The ACA will increase the fraction of uninsured who qualify for Medicaid, but the best estimates of how that will affect spending is roughly $1000 per individual (Finkelstein, et al., 2012), so even if 3% of the population becomes eligible for Medicaid, this will still only boost per capita health care expenditures by $30. Of course, aging baby boomers will tend to increase enrollment in the Medicare program (which grew at 2.4 percent between 2008 and 2012), but we account for such changes by applying a general aging index, which actuaries have estimated to be roughly 0.4 percent annually using recent data (Yamamoto, 2013).

Calculating these together (1 percent for price growth +1.5 percent for utilization growth and 0.4 for aging) yields an annual real growth in health care spending of 2.9 percent. Longer-term real GDP growth projections based on the Congressional Budget Office and the U.S. Census Bureau suggests real GDP per capita growth of 1.7 percent from 2012 through 2032.\textsuperscript{22} In sum, we end up at 1.2 percent plus GDP; certainly below the historical record of GDP plus 2.4 percent, but still absolutely consistent with a long-term growth rate in the health sector from 17.9 percent currently to roughly 23 percent in 2032 and 28 percent by 2050.

\textsuperscript{21} While more recent (2009-12) Medicare growth is lower, this in turn is partially the consequence of transitory factors such as increased fraud enforcement (per capita spending in Miami, Florida actually fell by about $2000 per enrollee) and a transition to generic drugs; these are unlikely to persist for the next few decades.

\textsuperscript{22} This calculation was based on 2012-2023 data in The Budget and Economic Outlook (CBO, February 2013), projected forward using their 2.2 percent growth rate for the last three years of their projection, and deflated by U.S. Census population projections.
2. *The Technology Pipeline.* We consider here a qualitative assessment of new developments in health care technology. We first note, as has Cutler and Sahni (2013), a distinct lack of new blockbuster drugs; combined with a rising share of generic drug sales, the pharmaceutical industry has exhibited slow growth in recent years. Yet drugs are roughly one-tenth of total health care spending.

The story is different, however, for devices and new surgical procedures, particularly in cardiovascular care. There has been rapid diffusion in left ventricular assistance devices (LVAD); these are essentially artificial hearts originally used to keep potential heart transplant patients alive, but now are being used increasingly for long-term therapy. While the market now is relatively modest (and includes former Vice-President Richard Cheney), they are very expensive, on the order of a quarter of a million dollars or more, and their growth is projected to be 10 to 15% annually.\(^\text{23}\) More worrisome with regard to costs is the interest among clinicians in expanding the use of LVADs to older patients over age 70, as well as less seriously ill (but far more plentiful) patients, such as those with Class III heart failure (Stewart and Stevenson, 2011).

Another procedure being developed is the new transaortic valve replacements (TAVR). While many elderly people have valve disorders, for most the risk of an open surgery is not worth the benefit of replacing the valve. These TAVR procedures using stents to install the valve, thus widening potential use to thousands of frail elderly people suffering from poor circulation. Additional new technology includes left atrial appendage closure (for atrial fibrillation patients, of which there are many), and renal denervation, a catheter-based procedure designed to interrupt the neural connection to the kidneys. One industry summary of this latter new technology alone projected one billion dollars annually.

There are other many developments in the treatment of cancers. One that has been gaining considerable attention from both policy-makers and investors is the increased use of proton beam therapy for prostate cancer patients. While there is no evidence that outcomes

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arising from this treatment is better than alternative treatments such as radiation therapy or prostatectomy (the removal of the prostate), it does cost roughly double – $50,000 per course of treatment, instead of $25,000 or even less. This is an example of a “Category III” treatment, expensive but with no proven value, and given the willingness of Medicare (and hence private insurance) to pay at least average total cost, it creates a strong incentive to invest in the large fix costs of the facility (costing hundreds of millions of dollars) and an equally strong incentive to run through as many prostate cancer patients as possible to pay off the bonds.

Figure 8 shows the number of actual and expected proton beam facilities in the United States. After a slow start in the 1990s, there has been a rapid acceleration in the planning of these facilities, often with two hospitals in the same region each planning their own facility (Gold, 2013). The total number of proton beam accelerators (planned and built) is expected to double between 2010 and 2014 alone, suggesting that a major driver of costs—Category III technologies are still being discovered.

Why is the United States particularly vulnerable to this kind of technology growth that shows virtually no health benefit, but promises only higher costs? One reason may be that Medicare is legislated to pay for any treatments that won’t actually cause harm. Until recently, private insurance companies find it difficult to refuse payment for treatments already approved by Medicare, so the U.S. is a particularly fertile environment for such growth (Chandra and Skinner, 2012). By contrast, Germany, Italy, Spain, the U.K., and France combined have about the same population as the U.S., but as of 2013 have 10 accelerators (and an average of 1.2 per year coming online in the future) compared to 15 accelerator in the U.S. (and an average of 3 per year coming online).

3. Financial Markets. Here we consider our third approach to projecting long-term growth in the health care sector. By examining the response of financial markets to both the overall slowdown in health care expenditures, and more specifically to the introduction of the ACA,

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24 These are from the Particle Therapy Co-Operative Group, which provides information on both proton beam therapy facilities in operation (http://ptcog.web.psi.ch/ptcentres.html) and those being built or planned (http://ptcog.web.psi.ch/newptcentres.html).
we can test the hypothesis that the private, publicly traded health care sector responded with concern to the developments of the past several years.

Al-Ississ and Miller (2013) used Republican Scott Brown’s election to the senate in Massachusetts as an instrument to measure the impact of a decline in the probably of the ACA’s passage. Based on the 2.1 percent abnormal returns to the stock market in response to the fall in the probability of passage, they concluded that the ACA was viewed as supporting cost-containment – although the expansion of Medicaid was anticipated to have a beneficial impact on hospital stocks.

But what about the health care cost growth slowdown more generally – can we detect a general downturn in health sector stocks since the mid-2000s? The comparison is complicated by the stock market collapse during the recession, but it is still instructive to compare the long-term relative trends in equity returns for the health sector, for both the New York Stock Exchange (Figure 9) and the Standard & Poor index (Figure 10). The evidence in each figure is inconsistent with the hypothesis that new efforts to contain costs (whether through the ACA, employers, or insurance companies) have at last put a brake on the development and diffusion of profitable Category II and Category III treatments. In sum, all three approaches lead to a similar story that is not supportive of the view that long-term growth in health care technology has been fundamentally altered. Coupled with the remarkably stable growth in the health care workforce, the evidence appears supportive of continued long-term health care cost growth in excess of GDP.

VI. Discussion and Conclusion

There has been considerable media and government attention to the question of whether health care costs have moderated. In this paper, we reconsider the existing evidence on this slowdown by considering a more disaggregated view of the health care

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25 The Massachusetts senate seat, filled upon the death of Democrat Edward Kennedy, was a “swing vote” in the sense that it had allowed Democrats to override Republican objections to the ACA legislation.

26 These series have not been adjusted for differences in risk that would lead to higher or lower expected returns in the health care sector.
sector. We first note that while all measures of health care spending and utilization point towards a recent slowdown, that this was not the first; that health care costs as a fraction of GDP had actually declined in the early 1990s, before resuming its strong upward trend in the latter 1990s. And certainly the remarkable stability in one measure of health care employment growth (Altarum Institute, 2013) reinforces Victor Fuch’s (2013) caution against inferring too much about the next two decades from just a few years of data.

Second, we present evidence that it is risky indeed to assume that aggregate health care spending should exhibit a stable association with GDP. Unlike other types of consumption, health care in the United States is an aggregate of very different systems – private, Medicare, and Medicaid – whose dynamic paths of quantity and costs do not move in lock-step with one another, particularly during a recession or business cycle. For this reason, we argue that researchers should consider a more disaggregated model of health care, complete with a specification of the factors such as reimbursement rates, prices, and technological developments for public and private services.

Third, in explaining the downturn in health care spending, we have placed a greater emphasis than previous researchers on the rise in cost-sharing in the private insurance market. While we consider these changes in a static framework – one can’t continue to raise co-payment rates forever – there may also be dynamic effects arising from these changes (Finkelstein, 2007; Clemens, 2011). In this view, the rise of high-deductible health insurance will deliver both a short-run reduction in quantity demanded of services, but (like Finkelstein’s analysis of Medicare in reverse) may exert a longer-term impacts on new innovation, as providers change their entire practice style as more of their patients are in high-deductible health-plans. That said, we do not see evidence of such a long-term impact on innovation, at least based on the relative growth of health sector stock prices.

Fourth, we predict continued long-term growth in real per-capita health care spending; our best guess is GDP plus 1.2 percent, which puts us somewhere in the middle of the pack, but where our confidence intervals are wide indeed. Even this modest estimate is not a cause for celebration; Roehrig (2012) has called attention to the “Triangle of Painful Choices”, which outlines the set of very unpleasant options facing the U.S. even in the face of
our “moderate” GDP plus 1 percent growth rates in health care. The pain includes some combination of dramatic increases in tax rates or drastic cuts in non-health spending; and he doesn’t even consider a further stagnation in median take-home wage growth (Auerbach and Kellermann, 2011).

Finally, and more optimistically, we also recognize that the structure and balance of power among providers and insurers may be undergoing fundamental changes. For example, private insurers emboldened by an increase in market share, from getting more patients from exchanges and the Medicare Advantage program, may begin to push back against the coverage of Category III treatments. Nascent signs of this are apparent in the isolated decisions by some private insurers to no longer cover for proton-beam therapy. Similarly, accountable care organizations in Medicare and the move towards bundled payments could encourage providers to switch from expensive and unproven therapies to cheaper ones. Many of these initiatives involve private partnerships with leading integrated delivery systems (for example Geisinger’s creation of xG and Intermountain Healthcare’s collaboration with GE). Yet ultimately, we still must be concerned about the long-term technology pipeline that could continue to deliver new and expensive technology with very modest medical benefits, but very poor value for the dollar.

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27 Howard Dean disagrees; in December 2009, just a few months before the ACA passed, he said ‘This is the insurance company’s dream, this bill.’ See Khan and Karl (2009).

28 The recent decision by Memorial Sloan Kettering Cancer Center to eschew Zaltrap for colon-cancer (at $11,000 per month) in favor of Avastin, costing half the price, captures the potential for real cost saving without sacrificing quality of care (Bach, Saltz, Wittes, 2012).
References


Table 1: Growth Rates of Health Spending Over Time

<table>
<thead>
<tr>
<th></th>
<th>Average Yearly Growth</th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Real Health Spending</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total National Health Expenditures</td>
<td>4.6%</td>
<td>4.8%</td>
<td>2.9%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Personal Health Care</td>
<td>4.6%</td>
<td>4.5%</td>
<td>3.6%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Total National Health Expenditures as a Share of Potential GDP</td>
<td>1.4%</td>
<td>2.0%</td>
<td>0.6%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Personal Health Care as a Share of Potential GDP</td>
<td>1.4%</td>
<td>1.7%</td>
<td>1.3%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Per Capita Total National Health Expenditures</td>
<td>3.5%</td>
<td>3.8%</td>
<td>2.1%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Per Capita Personal Health Care</td>
<td>3.5%</td>
<td>3.5%</td>
<td>2.8%</td>
<td>1.7%</td>
</tr>
<tr>
<td><strong>Real Per-Enrollee Spending</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per Enrollee Medicare National Health Expenditures*</td>
<td>4.0%</td>
<td>5.3%</td>
<td>3.4%</td>
<td>1.2%</td>
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<td>Per Enrollee Medicaid National Health Expenditures*</td>
<td>3.8%</td>
<td>0.2%</td>
<td>0.5%</td>
<td>-1.4%</td>
</tr>
<tr>
<td>Private Premium**</td>
<td>8.2%</td>
<td>6.2%</td>
<td>2.4%</td>
<td>3.5%</td>
</tr>
<tr>
<td>*Series only goes to 2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Series starts in 1999</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SOURCES: Total national, total personal, per enrollee medicare and per enrollee medicaid health expenditures are from the CMS National Health Expenditures Accounts from 2011-2011, with 2012 estimates for national and personal expenditures provided by the Altarum Institute. Real values are deflated by the GDP deflator published by the Bureau of Economic Analysis. Potential GDP was calculated by the Congressional Budget Office. Private Premiums are estimated by the Kaiser Family Foundation.
Figure 1: Total Health Expenditures and GDP Growth + 2.4 Percent: United States, 1970 - 2012

SOURCES: The National Health Expenditure Data from the Centers for Medicare and Medicaid Services and the Bureau of Economic Analysis. GDP and total costs are smoothed using a 5-year moving average, and deflated using the GDP deflator. Graph is inspired by Fuchs(2013).
Figure 2: Total Healthcare Spending and Personal Health Expenditures as a Fraction of Potential GDP, 1970-2012

(a) Levels

(b) Growth Rates

SOURCES: Total National and Personal Health Expenditures are from the CMS National Health Expenditures Accounts from 2011-2011, with 2012 estimates provided by the Altarum Institute. Nominal Potential GDP is taken from the Congressional Budget Office, and yearly values reported here are the average of quarterly estimates.
Figure 3: Total and Public Health Spending in the US and in other OECD Countries, 2001-2011

SOURCES: US Total and Personal Spending Per Capita are from the CMS National Health Expenditures Accounts from 2011-2011, and are deflated by the GDP deflator from the Bureau of Economic Analysis. Other OECD Spending use data from the Organisation for Economic Co-operation and Development. Spending growth for other OECD countries is calculated as a weighted average of real per capita PPP health spending.
Figure 4: Monthly Growth in Health Employment (Relative to Last Year) for the Current Population Survey (CPS) and Current Employment Statistics (CES), 2001-2013

SOURCES: Current Employment Statistics and author calculations based on the Current Population Survey Merged Outgoing Rotation Groups. The health industry is defined according to NAICS codes 621, 622, and 623 from the 2002 version of the North American Industry Classification System. Estimates of the number of employed in the CPS are smoothed using a 13 month window.
Figure 5: Average Health Insurance Deductible across All Plan Types among Covered Workers, by Year.

SOURCE: Kaiser HRET Survey of Employer-Sponsored Health Benefits, 2013, inflation adjusted using the GDP deflator (through Q2 2013). Family plans have higher deductibles but similar growth patterns.
Figure 6: Rates of Utilization of Selected Procedures in the Medicare Fee-for-Service Population Over Age 65 (1994 = 1)

SOURCE: Dartmouth Atlas of Health Care, various years.
Figure 7: Real Per Enrollee and Per Capita Spending, By Payer (2001 = 100).

SOURCE: Total health health spending per capita and per enrollee expenditures are from the CMS National Health Expenditures Accounts from 2011-2011, with 2012 estimates for national expenditures provided by the Altarum Institute. Private Premiums are estimated by the Kaiser Family Foundation. Real values are deflated by the GDP deflator published by the Bureau of Economic Analysis.
Figure 8: The Number of Proton Beam Accelerator Facilities Operating, Planned, or Under Construction in the United States, 1990-2016

SOURCE: Particle Therapy Co-Operative Group
Figure 9: New York Stock Exchange Cumulative Returns, Health Sector and NYSE Composite Index (January, 2003 = 100)

SOURCE: New York Stock Exchange Index Services. The NYSE includes currently includes 109 companies listed on the New York Stock Exchange that are classified in the health care sector according to the Industry Classification Benchmark, which is proprietary to FTSE International Limited and Dow Jones & Company, Inc. The most common company types in the index are pharmaceutical companies, health care providers, and medical equipment companies.
Figure 10: Cumulative Returns, S&P 500 Health Sector and S&P 500 Composite Index (September 2008 = 100)

SOURCE: S&P Dow Jones Indices. The S&P 500 Health Index includes the companies in the S&P 500 which are classified in the Health Sector according to the Global Industry Classification System, developed by MSCI. Currently, this is a set of 54 companies.
Appendix A

Appendix Figure A.1: Monthly Growth in Employment (Relative to Last Year) for the Current Population Survey (CPS) and Current Employment Statistics (CES), 2001-2013

Appendix Figure A.2 - Real Wages (Health Sector) vs. Real Wages (Non-Health Sector), CPS. (Figure to come.)
Appendix Table A.1: Real, Per Capita Sending Growth By Payer vs. Gdp Growth Rate (Main Years)

<table>
<thead>
<tr>
<th>Dependent Variable: Growth in Real, Per Capita Costs Paid By:</th>
<th>Total</th>
<th>Personal</th>
<th>Medicare</th>
<th>Medicaid</th>
<th>Private Insurance</th>
<th>Out of Pocket Spending</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: No Lags</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real, Per Capita GDP Growth (Current Period)</td>
<td>0.165</td>
<td>0.0626</td>
<td>-0.217</td>
<td>-0.370</td>
<td>0.512*</td>
<td>0.508**</td>
</tr>
<tr>
<td></td>
<td>(0.105)</td>
<td>(0.0939)</td>
<td>(0.256)</td>
<td>(0.433)</td>
<td>(0.233)</td>
<td>(0.168)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0385***</td>
<td>0.0404***</td>
<td>0.0626***</td>
<td>0.0714***</td>
<td>0.0458***</td>
<td>0.00611</td>
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<tr>
<td></td>
<td>(0.00320)</td>
<td>(0.00292)</td>
<td>(0.00674)</td>
<td>(0.0133)</td>
<td>(0.00595)</td>
<td>(0.00475)</td>
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<tr>
<td>R2</td>
<td>0.044</td>
<td>0.007</td>
<td>0.017</td>
<td>0.022</td>
<td>0.089</td>
<td>0.16</td>
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<tr>
<td><strong>Panel B: With 3 Lags</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of Curr and Lag Coefs</td>
<td>0.553*</td>
<td>0.544**</td>
<td>-0.463</td>
<td>0.313</td>
<td>0.980</td>
<td>0.962*</td>
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<tr>
<td>Wald F Statistic</td>
<td>6.768</td>
<td>8.803</td>
<td>0.999</td>
<td>0.323</td>
<td>3.700</td>
<td>7.325</td>
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<td>P-Value</td>
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<td>0.005</td>
<td>0.324</td>
<td>0.573</td>
<td>0.062</td>
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<td>R2</td>
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<td>0.170</td>
<td>0.025</td>
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<td><strong>Panel C: With 5 Lags</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sum of Curr and Lag Coefs</td>
<td>1.398***</td>
<td>1.188***</td>
<td>-0.821</td>
<td>2.179*</td>
<td>3.076***</td>
<td>1.590***</td>
</tr>
<tr>
<td>Wald F Statistic</td>
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<td>41.40</td>
<td>1.057</td>
<td>6.345</td>
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First Year: 1970
Last Year: 2012
N: 43

Standard errors in parentheses
Results are from OLS regressions with robust standard errors.
* p < 0.05, ** p < 0.01, *** p < 0.001

SOURCES: Total national health expenditures are from the CMS National Health Expenditures Accounts from 2011-2011, with 2012 estimates for total and personal spending provided by the Altarum Institute. The gross domestic product and GDP deflator are published by the Bureau of Economic Analysis.
### Appendix Table A.2: Health Spending Growth vs. GDP Growth Rate

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
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<th>(5)</th>
<th>(6)</th>
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<td><strong>Dependent Variable:</strong> Growth in Real, Per Capita Total National Health Expenditures</td>
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<tr>
<td>Real Per Capita GDP Growth</td>
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<td>0.428*</td>
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<td>1.328***</td>
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<td>Real Per Capita GDP 8-Year Geometric Growth</td>
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<td>1.488***</td>
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<td>(0.249)</td>
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<tr>
<td><strong>Constant</strong></td>
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<td>0.0385***</td>
<td>0.0381***</td>
<td>0.0337***</td>
<td>0.0240***</td>
<td>0.0161***</td>
<td>0.0125**</td>
<td>0.0116*</td>
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<td>(0.00392)</td>
<td>(0.00359)</td>
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Standard errors in parentheses.

Results are from OLS regressions with robust standard errors.

* p < 0.05, ** p < 0.01, *** p < 0.001

**SOURCES:** Total national health expenditures are from the CMS National Health Expenditures Accounts from 2011-2011, with 2012 estimates provided by the Altarum Institute. The gross domestic product and GDP deflator are published by the Bureau of Economic Analysis.