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ABSTRACT

Why have health care costs moderated in the last decade? Some have suggested the Great Recession alone was the cause, but health expenditure growth in the depths of the recession was nearly identical to growth prior to the recession. Nor can the Affordable Care Act (ACA) can take credit, since the slowdown began prior to its implementation. Instead, we identify three primary causes of the slowdown: the rise in high-deductible insurance plans, state-level efforts to control Medicaid costs, and a general slowdown in the diffusion of new technology, particularly in the Medicare population. A more difficult question is: Will this slowdown continue? Here we are more pessimistic, and not entirely because a similar (and temporary) slowdown occurred in the early 1990s. The primary determinant of long-term growth is the continued development of expensive technology, and there is little evidence of a permanent slowdown in the technology pipeline. Proton beam accelerators are on target to double between 2010 and 2014, while the market for heart-assist devices (costing more than $300,000) is projected to grow rapidly. Accountable care organizations (ACOs) and emboldened insurance companies may yet stifle health care cost growth, but our best estimate over the next two decades is that health care costs will grow at GDP plus 1.2 percent; lower than previous estimates but still on track to cause serious fiscal pain for taxpayers and workers who bear the costs of higher premiums.

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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 (Chandra and Skinner, 2012). 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, while Nyu et al (2013) find a large downturn in private insurance spending growth in the last several years.

Others are less sanguine. Joseph Antos (2013) recently testified that "[t]he biggest single factor driving the recent slowdown is the economy," implying that health care spending will pick up once the economy recovers (Kaiser, 2013). Similarly, Charles Roehrig and Gene Steuerle have documented that health care expenditure growth has exhibited a remarkably stable pattern relative to GDP growth, implying convergence towards a steady-state in which nearly one-third of GDP is devoted to health care ((Steuerle 2013; Roehrig, 2013). Still others suggest that we're wasting our time trying to distinguish between these two hypotheses, since 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 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

[1] With apologies to Reinhart and Rogoff (2011).

exception of one: the Current Employment Statistics (CES) shows little slowdown in health care employment growth relative to the size of the sector.

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 GDP growth alone should have a large impact on health care spending – short-run income effects for health care spending are modest at best (Borger, 2008; McClellan and Skinner, 2006). Instead, we hypothesize that three factors led to the decline in health expenditure growth. The first was the rapid diffusion of high-deductible health care plans that, together with a continued decline in the fraction insured, has led to higher out-of-pocket prices for health care. In this new regime, households did scale back physician visits, particularly those in financial distress (Lusardi et al., forthcoming).

The second factor that helped to slow health care cost growth were cuts in Medicaid benefits and reimbursement rates that were necessitated by shrinking state budgets, with the end result of nearly flat per-capita real spending for the growing population of Medicaid enrollees. Like OECD countries facing similar budgetary pressure, (OECD, 2013), state Medicaid officials restricted services and cut reimbursement rates, which in turn attenuated the utilization of specialists, many of whom no longer accepted Medicaid patients (Sachs, 2010).

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). Why then has Medicare spending moderated? As Levine and Buntin (2013) showed, the Medicare slowdown growth couldn't be attributed to elderly people being in better health, or arising from financial stress among Medicare enrollees. Instead, we present evidence for a

third factor underlying the reduction in health care growth: a slowdown in the diffusion of new technologies that had accounted for much of the growth in expenditures during the previous decade. For example, angioplasty (the insertion of a balloon in a clogged cardiac artery) and later, stents (wire cylindrical devices designed to maintain blood flow) grew at double-digit rates during the 1990s and early 2000s, but their use has since stagnated. Similarly, Cutler and Sahni (2013) documented the demise in the introduction of new blockbuster drugs, and the transformation of former brand drugs to generic status.

Will the slowdown persist? Medicaid programs have been successful in cutting reimbursement rates and restricting benefits, but they cannot do so indefinitely without causing a complete collapse in access to care for their enrollees. Similarly, the transition to high-deductible plans will continue to attenuate health care cost growth until the transition is complete – a *level* versus a *growth rate* effect -- at which point growth rates will revert to their long-run path.

What then *is* the long-run growth rate? Newhouse (1992) concluded that the long-term growth rate of health care spending is the consequence of technology growth – new treatments and procedures, and the diffusion of existing ones. Looking forward, we describe a variety of new technologies, some with modest health benefits, but nearly all with large price-tags, leading to billions of dollars in potential future health spending. For example, proton beam accelerators that cost hundreds of millions of dollars to install, have no established benefits to patients over traditional treatment options, are expected to more than *double* in number between 2010 and 2014. New bioabsorable stents are viewed as energizing the otherwise moribund stent industry (Zamanian, 2013). The near doubling of medical technology funding

between 2009 and 2013 (Medmarket Diligence, 2013b), and stepped up patent activity for medical devices, coupled with strong relative health care stock performance suggests a reemergence of technology growth. Using these and other data, we predict that the real yearly growth rate of health spending will be 1.2% plus GDP growth over the next two decades. . This estimate is bracketed by the Medicare Actuary Report (1.15% plus GDP growth through 2037; Board of Trustees, 2013) and the Congressional Budget Office (CBO) (1.5% plus GDP growth).

We acknowledge our prediction comes with a wide confidence interval. The impact of President Obama's Affordable Care Act (ACA) is not yet known, particularly the potential cost-saving effects of Accountable Care Organizations (ACOs). Many knowledgeable observers already see the signs of a transformation in the U.S. health care system. As Len 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, change how patients pay for cost-ineffective technologies, and begin to slow the innovation cycle (Finkelstein, 2007), we could see the promised transformation. Alternatively, the technology pipeline could start up again, bringing continued rapid growth in health care costs (perhaps coupled with sluggish GDP growth). Our prediction of 1.2% plus GDP growth, which implies that 23 percent of U.S. GDP will be spent on health care by 2032, is somewhere in between -- not as uplifting as "The Hills are Alive", but not quite as scary as the cult horror film "The Hills Have Eyes."

II. Facts about the Slowdown

What is the evidence on the slowdown in health spending? We begin with the macroeconomic evidence, adapted from Fuchs (2013), and shown in Figure 1. The graph shows smoothed inflation-adjusted growth rates in health care spending. The graph demonstrates the sharp decline in growth rates of spending since roughly 2005, with a particularly dramatic drop in the 2010s. 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 yet dropped below 17%, still the highest in the world by far. Despite the considerable commentary about the recent slowdown in healthcare spending growth, since January 2012 healthcare-spending growth has exceeded GDP growth by 1%.

To illustrate the pitfalls associated with making forecasts about slowing spending based on just a few years of data (Fuchs, 2013), note that Figure 1 shows a similar slowdown in the early 1990s, when GDP spent on health care even declining slightly 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 potential GDP are 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 measures 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.[2] In many respects, this latter measure 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, with the exception that total healthcare spending rose by less during the most recent recession than did personal healthcare spending.

The slowdown in health care spending is not unique to the United States. Figure 3 uses aggregate health care spending from OECD data, and demonstrates a slowdown that is more abrupt in other developed economies than in the U.S.. This sudden stop in OECD countries likely reflected the necessity (and ability) of centrally financed health care insurance programs such as the National Health Service in England to hold the line on budgets by "cutting wages, reducing hospital staff and beds, and increasing co-payments for patients."[3]

[2] These definitions are from http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/dsm-11.pdf (p. 6).

[3] OECD (2013). The Figure created in the OECD report relied on aggregate spending; we calculated a weighted average of per-capita spending growth, where the weights were the populations in each country.

By contrast, Medicare is an entitlement program obligated to reimburse any bills submitted. There were a few modest attempts to scale back rates of Medicare reimbursement or restrict services covered, during the recession. State Medicaid administrators were better able to cut reimbursement rates and restrict eligibility, but their budgets were strained by the sudden inflow of newly eligible (and often jobless) Medicaid enrollees. We return to these points below 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. 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 mid 2012, but followed by a drop in the late part of 2012. The CPS monthly estimates showing much more variability than the smoothed estimates we show here.

By contrast, health care sector employment as measured by the Current Employment Statistics (CES) data 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).[4]

[4] Recent employment growth in health care is not solely the consequence of the new information technology specialists and billing clerks required by the digitization of health records; indeed clerical workers have actually been declining over this period. Instead, it is driven by increases in utilization per admission. As Goldsmith (2012) noted, between mid-2009 and mid-2011 when hospital admissions were falling, "[h]ospitals employed 18,000 more physicians, as well as more nurses (117,000), technicians and technologists (almost 35,000) and therapists (12,000)."

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 reflected in the CES (Bowler and Morisi, 2006). The third difference is the sample sizes of the 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, particularly for sectoral-specific growth measures.[5] And while even the CES has shown a recent slowdown in job growth, these employment data taken together suggest caution in predicting a permanent bending of the health care cost curve.

III. What are the Factors that Might Have Reduced Health Care Cost Growth?

Here we line up the usual suspects implicated in (or credited with) 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), with David Cutler (2013) concluding that "…the ACA is a significant part of the reason" for the downturn, and

[5] 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)

Council of Economic Advisors stating that 'the available evidence suggests that the ACA is contributing to these trends' (CEA, 2013).

The problem with this explanation is thus far, cost-saving effects of the ACA have been mixed. Some characteristics of the ACA increase costs, such as the extension of insurance coverage to dependents up to age 26. One accountable care organization (ACO) pilot reduced costs by less than 2 percent (Colla et al., 2012), although a private Massachusetts initiative was able to save substantially more (McWilliams, et al., 2013; Song et al., 2012). Most importantly, the cost-saving components of the ACA are not yet fully implemented, and thus cannot explain why health care cost growth began to moderate in 2006, when Barack Obama was still a senator from Illinois.

However, two other features of the ACA may have made a difference a few years after the start of the slowdown. The first is rule changes in Medicare that were phased-in starting in 2010, such as lower payments to Medicare Advantage plans and other providers ($17 billion over three years) as well as reduced payments to hospitals with poor quality measures ($230-$280 million per year starting in 2012). These changes may have reduced national spending growth by 0.2 percentage points in the past 3 years (CEA, 2013). Furthermore, there are spillover effects of reductions in Medicare payments rates onto commercial plans—as Medicare rates change, commercial rates change in the same direction (Clemens and Gottlieb, 2013; White, 2013). While the magnitude of these effects is still debated, payment reductions in Medicare could have been mirrored by payment reduction in private plans, with current estimates suggesting dollar-for-dollar reduction spillovers.

The second is anticipatory effects among providers and insurers who are preparing for competition through the new health exchanges and alternative payments models. While this is possible—as the private Massachusetts initiative indicates—we don't see direct and widespread evidence of cost-saving strategies being adopted by providers, nor do we see evidence from Massachusetts that private health care costs are growing more slowly there than in the rest of the country.

2. The Great Recession. Others (primarily Republicans) have attributed the downturn instead to the recession.[6] 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. In regression models using aggregate data on health care expenditures and GDP from 1970-2011, we find, like Cutler and Sahni (2013), a coefficient of about one using a 5-year geometric average. But the results were sensitive to the lag structure, with a 3-year geometric average yielding an estimate of 0.21, and a 7-year geometric average implying an estimate of 1.58. (Appendix Table A.3). Furthermore, a state-level time-series cross-section regression including year dummy variables yielded no

[6] For the former, see Antos (2013), for the latter see Rick Unger, "New Data Suggests Obamacare Is Actually Bending The Healthcare Cost Curve," http://www.forbes.com/sites/rickungar/2013/02/12/new-data-suggests-obamacare-is-actually-bending-the-healthcare-cost-curve/.

significant relationship between state-level income changes and state-level health care spending[7].

One explanation for the wide range of results is that 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 example, GDP growth generates tax revenue growth, which allows greater expansion of existing government-financed health care systems; the long-run elasticity of health care expenditures with regard to aggregate income is estimated to be roughly 1 (Getzen, 1992; see Borger et al., 2008).[8] The short-run fall in tax revenue during the Great Recession played a key role in reducing European health care spending (OECD, 2013), but as noted earlier, these were muted in the United States; Medicare was largely insulated from budgetary cuts during the recession, while Medicaid spending actually increased as enrollment surged. The fraction of workers with private health insurance continued its gradual decline, but that trend had begun a decade earlier.

Some support for these hypotheses come from aggregate time-series regressions where we consider each component of health care spending separately (Appendix Table A.2). Using a five-year lag, we demonstrate that Medicare expenditure growth appears unassociated with GDP growth, with a coefficient not significantly different from zero.[9] By contrast, private health insurance is very strongly associated with GDP growth, with a coefficient of 3.0, suggesting that

[7] Results from the state-level regression are available on request.

[8] An income elasticity of health care utilization of 0.7 was estimated by Acemoglu et al. (2013) who use oil-price shocks in areas that are oil-rich to instrument for a general-equilibrium change in health care utilization in response to a permanent increase in income. Because they include year-specific fixed effects, this estimate nets out any effects of GDP growth on innovation and technology growth.

[9] Others find a negative association; see Levine and Buntin (2013), and McInerney and Mellor, 2012.

firms are more willing to insure their workers, and pay higher premiums, during economic upturns. Medicaid is somewhere in-between, consistent with the pro-cyclical impact of GDP on state fiscal budgets moderated by the anti-cyclical effects of rising enrollment during recessions.

Another explanation for the downturn in health spending is demand; enrollees were less likely to seek care because their income had declined. Yet most estimates of the income elasticity of demand are clustered near zero, (e.g., McClellan and Skinner, 2006; Borger et al., 2008). Nor did Levine and Buntin (2013) find that Medicare enrollees with financial downturns reduce health care utilization by more than those who did not suffer such downturns. Recall however that these Medicare enrollees are largely insulated from the sting of copayments and deductibles. As we argue next, the landscape has changed dramatically in the U.S for non-Medicare patients who are exposed to much greater out-of-pocket payments, making utilization far more sensitive to financial stress (Lusardi, et al., forthcoming).

3. Patient Cost-Sharing. One fundamental change that could potentially explain the slowdown in health care costs is the rise in cost-sharing, and hence the higher prices of services facing patients. For example, in a 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 with a deductible since 2006 using data from the same Kaiser/HRET survey. The dollar amounts reported on the vertical axis are the amounts the workers are potentially liable for, and not what they actually paid (which will reflect individual decisions made with regard to health). This figure shows that, for those with a plan that has a

generalized annual deductible, the average size of the deductible more than doubled between 2005 and 2011.

As a result of higher deductibles, out of pocket costs grew for patients enrolled in private insurance. Harrera et al. (2013) found that out-of-pocket payments grew at an average annual rate of 8 percent between 2007 and 2011; during this time, insurer spending on medical expenditures grew at an annual rate of 4.9 percent.[10] Nyu et al. (2013) found similar sharp increases in out-of-pocket spending for private insurance plans between 2007-11; 61 percent for emergency room charges, 39 percent for brand-name drugs, 36 percent for hospital admissions, and 23 percent for outpatient visits. Based on the Rand Health Insurance study's estimate of price elasticity of demand for health services of -0.2, an 8% nominal per year increase in out of pocket costs (which is approximately 6.4% real) would lead to an estimated decline in utilization of about 1.3% per year among patients of private plans.[11]

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, uninsurance rates continued their climb from 22 percent in 2010 to 24 percent in 2012 (Collins et al., 2013).

[10] One important caveat to our characterization of increasing cost-sharing is the role of cost-sharing for prescription drugs. Here, there has been little rise in copayments and coinsurance for generics, but much larger copayments increases for non-preferred drug (Thomas, 2013).

[11] Aron-Dine et al. (2012) find even larger price elasticities of 0.4 to 0.6, leading to much larger drops in quantities Their estimates are higher because they allow consumers to respond to the 'future price' of healthcare, meaning that they realize that today's spending should be affected by end-of-year prices. On the other hand, the impact of shifting patients into high spending plans will be moderated by the fact that the healthiest patients are also the most likely to self-select into high-deductible plans (Einav et al., 2013).

Our discussion of the growing role of out of pocket payments may appear to contrast with Baicker and Goldman (2011) who note that out-of-pocket payments as a share of total spending has been *falling* over time. One reason for this apparent inconsistency is that there have been large increases in the use of post-acute services such as skilled nursing facilities and home health that are covered by Medicare and Medicaid with very little cost-sharing (Chandra, Dalton and Holmes, 2013). By contrast, as we have noted earlier, rates of increase in out-of-pocket spending for private health insurance, and the rise in numbers of those uninsured, have led to higher out-of-pocket prices facing households

We hypothesize that this new landscape of high deductibles and copayments resulted in an interactive effect in which greater financial exposure amplified previously modest income effects. For example, Lusardi et al. (forthcoming) conducted surveys in five countries during the depths of the Great Recession. On net, 19.5 percent of Americans responded that they reduced routine physician visits, compared to 6.6 percent (France) and 3.6 percent (Germany); both countries with modest copayments. In Canada and Great Britain, countries with few if any copayments, there was no net decline in rates of reported physician visits.[12]

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

[12] They also found a large wealth elasticity; those who experienced a greater than 50 percent drop in wealth were far more likely to respond that they have cut back on physician visits.

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.[13] Rather than paying less to hospitals and physicians, as Medicare and Medicaid do, they attempt instead to slow health care cost growth on the demand side, by increasing deductibles and copayments, and by putting enrollees in tiered-networks (where patients 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-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.

[13] Commercial payers in turn price discriminate by charging profitable firms more than less profitable firms (Dafny et al., 2012).

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. For example, prices paid by employer-sponsored health insurers for inpatient admissions grew at an annual rate of 5.2 percent between 2007 and 2011, while intensity only grew at an annual rate of 1.3 percent annually (Herrera et al., 2013). During this period, however, Medicare reimbursements to hospitals were just above inflation, and reimbursements for outpatient care lagged the general inflation rate.[14] Thus we can conclude that, even in the presence of biases in measuring price increases for inpatient services, private (commercial) prices rose considerably more rapidly than Medicare prices.

The slowdown in overall Medicare spending could have also occurred because of 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 their fee-for-service patients conservatively (also see Glied and Zivin, 2002). Managed care could have also effected a reduction 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

[14] This is based on our own unreported calculations using cohorts of heart attack patients. See also Levine and Buntin (2013).

utilization would not have fallen by as much as suggested by the decline in aggregate expenditures.[15]

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, our data suggests that price growth rates behaved very differently between private commercial plans (the most rapid rate of growth), Medicare (little change in real terms) and Medicaid (some evidence of real price reductions). We turn next to the question of how innovation and the diffusion of new technologies affected growth in the *quantity* of health care.

5. *Technology growth and diffusion.* The pace of technological growth is likely to have affected recent health care expenditure growth. 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. The diffusion of some of these technologies has indeed slowed. Drug spending actually declined in 2012, both because of the rising share of generics, but also because of a scarcity of new blockbuster drugs (Thomas, 2013). But based on the technology pipeline, we believe that there will be a bounce-back in technology growth and innovation.

[15] Furthermore, limiting attention to just aggregate Part A and B spending ignores the dramatic growth in Part C (managed care) spending.

In 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 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. But even after including high cost treatments like anti-retrovirals, Category I technologies have not been a first-order driver of cost growth, and we do not expect them to have a discernable impact on overall expenditure growth in the years to come. "Category II" treatments have heterogeneous benefits across patients – with some gaining valuable health benefits, but with others receiving little incremental value, and "Category III" treatments—such as proton-beam therapy, or the aggressive use of intensive care unit (ICU) beds, are both expensive and have unknown (or no) incremental benefits

Figure 6 shows per-enrollee Medicare fee-for-service rates of growth between 1994 and 2010 for a variety of treatments, with rates normalized to 1.0 in 1994. 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 (e.g., Boden et al., 2007), leading to a downturn in the use of these procedures. The downturn in the combined use of stents and coronary artery bypass graft (CABG, or bypass surgery) is even more marked, as shown in Figure

6. This change was not unique to cardiovascular 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 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 on a per-procedure basis, at least while the shift is taking place. Yet the new bioabsorbable stents – which are absorbed into the arterial walls after several months – have led some observers to forecast a rebound in market growth for stents (Zamanian, 2013).

Other treatments, considered in more detail in Table 2 using data from the Dartmouth Atlas of Health Care,[16] continued to grow in the later 2000s, but at a slower pace. For example, back surgery, a "Category II" treatment, grew at an annual rate of 6.5% during 1996-2001, before slowing to 2.5% growth in 2001-06 and 1.8% in 2006-10. And while a few Category III categories, such as ICU days in the last six months of life (Figure 6), continue to expand, Table 2 shows clearly that many inpatient surgical procedures had turned the corner by 2006.

Has technology slowed down differentially between Medicare and commercial insurance? Some evidence for this comes from Lee and Levy (2011), who document the slowdown in "Category II" magnetic resonance imaging (MRIs) and X-ray computed tomography (CT scans) during the mid-2000s; for their sample of privately insured patients, growth was essentially flat, while for Medicare CT scans, growth continued at about 5 percent annually (Lee and Levy, 2011). The anecdotal evidence from Lee and Levy (2010) lends support to the view

[16] See http://www.dartmouthatlas.org/tools/downloads.aspx.

that Medicare has less leverage than private insurance companies in slowing the diffusion of Category II technologies.

6. Other potential explanations. There are a variety of other factors that might have influenced health care cost growth. 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.

IV. Accounting for Recent Growth in Health Costs

The major drivers of the health care slowdown are changes in relative prices to consumers and providers (having both income and substitution effects) and technological growth – each of which will affect private, Medicare, and Medicaid patients differently. Figure 7 shows rates of per enrollee utilization for each of these different components of health care expenditures. Despite the recent downturn in Medicare spending growth, total Medicare spending has risen the most rapidly even during the downturn because of both spending and enrollment growth (although growth in real terms per beneficiary slowed to 0.4% in 2012; Kronick and Po, 2013). 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 real premiums per enrollee have continued to rise by about 2.7% per year (HCCI, 2012), with most of the increase because of increased prices—utilization has not grown by much.

Table 3 provides our best-guess benchmark 2007-11 measures of the components of growth in Medicare, Medicaid, and private insurance. These include price growth per enrollee, quantity (or intensity) growth per enrollee, and the growth in enrollment rates. While there are other components of health care spending such as public health, we focus on Medicare, Medicaid, and private commercial insurance payments, whose shares are 30, 22, and 48 percent of this subset of spending, respectively.[17]

In this table, we calculated growth in total spending and enrollment using the CMS National Health Expenditures data, supplemented by data on private premiums from the Kaiser Family Foundation. Price growth in Medicare, Medicaid and private insurance are taken from a literature review, and then we calculate utilization growth to be the residual 'real' growth rate.[18] Considering first the Medicare market, we use the Levine and Buntin (2013) estimates of

[17] 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.

[18] Because utilization is taken as the residual after subtracting price growth from total costs per enrollee, our measure of utilization changes will confound changes in utilization per enrollee and changes in the health composition of current enrollees. For Medicaid, the impact of composition changes is large because of the influx of young, non-disabled adults during the recession; we discuss this issue later in the text. For Medicare, changes in composition should be minor, since the average age of Medicare patients changed very little between 2007 and 2011 as the baby boomers started to retire. For private insurance, the composition effect is harder to estimate. Insurance rates have gone up both among healthy under-26 year olds who are now allowed to stay on their parents' plan, and also among seniors and those over 55. Note that for all of these estimates, we also do not

growth in Medicare price growth.[19] Medicaid price growth varies widely by state, but we abstract from this regional variation by taking the aggregate estimates of price growth from Zuckerman and Goin (2012). Finally, our estimates of real price growth are based on the HCCI (2012) estimates for 2007-11.[20]

We can use this table to consider several straightforward hypotheses. First, how much did the ability of state governments to hold the line on additional Medicaid expenditures contribute to the slowdown? Under the counterfactual that Medicaid prices would have risen as rapidly as private health insurance prices, the answer is 0.5% slower growth during this period, which is half of the unexplained 1 percentage point drop estimated by Cutler and Sahni (2012).

A second question is, how much have utilization controls at private providers (chiefly through increased cost-sharing) and in Medicaid (chiefly through the restriction of certain types of care like specialist visits) contributed to the slowdown? This is a more difficult question to answer because Medicaid enrollees have been becoming healthier over time. Between 2007 and 2010, enrollment in Medicaid among healthier adults rose far faster than those who were aged or disabled because of the weak economy. Based on a simple back-of-the-envelope calculation, average utilization between 2007 and 2010 would be expected to fall by about 0.8% per year simply because the average age of Medicaid patients is dropping. This means age-adjusted utilization growth in Medicaid is closer to 0.7% per year, which is similar to utilization

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attempt to control for differential selection of healthy or sick individuals at a given age out of private insurance and into Medicaid during the recession, a phenomenon which is understudied and poorly understood.

[19] Note that this measure roughly tracks the CPI-U, which is another measure of inflation. As noted above, we also find in unreported analysis Medicare reimbursement rate growth lags even the GDP deflator for Part B physician services.

[20] This aggregate number hides a substantial amount of heterogeneity across spending categories.

growth in private spending. After this correction, if we were to assume that utilization growth for both private plans and Medicaid were equal to the 1.4% utilization growth in Medicare, then overall spending growth would have been 0.4% higher.

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. 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."[21] Thus these predictions come with very wide confidence intervals.

We consider three complementary approaches to assessing the prospect for long-term growth. The first 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 second approach considers relative movements in health sector

[21] http://www.economist.com/blogs/buttonwood/2012/01/economics-and-markets

stock prices. The final approach is to use the estimates from Table 3 above to develop our best-estimate of the long-run trends separate of the short-run or transitory effects.

1. The Technology Pipeline. We consider qualitatively 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 devises originally used to keep potential heart transplant patients alive, but they are now used increasingly for long-term therapy among patients with heart failure. LVADs are very expensive, costing over $300,000 in the first year (Rogers et al., 2011). While the market now is relatively modest (and includes former Vice-President Richard Cheney), the sector's growth rate is projected to be 10 to 15% annually.[22] 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

[22] The Wall Street Transcript, March 19, 2012. http://finance.yahoo.com/news/10-15-growth-ventricular-assist-190300712.html

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 arising from this treatment is better than alternative treatments such as radiation therapy or prostatectomy (the removal of the prostate), it costs 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 fixed 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.[23] 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

[23] 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).

double between 2010 and 2014 alone, suggesting that a major driver of costs—Category III technologies are still being discovered.

Predicting aggregate trends in technology development, rather than just specific cases, is much harder. One proxy for future growth is new medical technology funding, which has nearly doubled between 2009 and 2013 (MedMarket Diligence, 2013b). Another proxy for future technology growth is the number of patents approved. The number of US patents approved for medical device manufacturing remained steady at about 9000 per year between 2000-2004, falling to about 7000 per year between 2005-2010, and then increasing to record levels of about 13,000 per year between 2011-2012.[24] As noted by Levine and Buntin (2013), the number of approved patents is partly determined by internal policies of the Patent Office, and so is not a good proxy for year-on-year investment research and development. However, what the recent surge in approved patents does suggest is that the pipeline is full for technologies that may appear on the market in the coming two decades.

Why is the United States particularly vulnerable to technology growth that is highly costly, but where benefits are often small or not measured reliably? 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 proton beam 10 accelerators (and an

[24] Patent statistics are taken from the US Patent and Tratemark office Patent Team's Monitoring Report on Medical Devices (http://www.uspto.gov/web/offices/ac/ido/oeip/taf/meddev.htm#PartA2_1).

average of 1.2 per year coming online in the future) compared to 15 accelerators in the U.S. (and an average of 3 per year coming on line).

2. Financial Markets. Another approach to projecting long-term growth in the health care sector is to examine the response of financial markets to both the overall slowdown in health care expenditures, and more specifically to the introduction of the ACA. 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.[25] 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 the New York Stock Exchange (Figure 9). The evidence 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.[26]

[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.

3. Predicting health care expenditure growth. To make our prediction, we begin with the 2007-11 growth data in Table 3, and consider how these different factors each might be expected to be transformed, given the evidence considered in the earlier sections. Consider first the private insurance market. 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), bundled payments, reference price, price transparency, or the growth in ambulatory surgical centers, to be transitory factors that will, at some point, have to moderate[27] We conjecture that real price increases in the private insurance sector will drop from 2.7 percent annually in 2007-11 to 1.5 percent over the next two decades.

In the longer-term, it is unlikely that the growth rate in Medicaid payments can continue to fall so far behind Medicare payments without providers refusing to accept Medicaid patients. Thus we assume that both Medicaid and Medicare payments will continue to rise by a rate of 0.9 percent plus inflation (the current Medicare rate of growth in reimbursement, from Table 3); substantially less than private plans because of Medicare's ability to impose administratively set prices.

What then will happen to real quantity increases in health care? As noted in Table 3, real Medicare utilization per enrollee rose at 1.4 percent annually based on 2007-2011 growth patterns, which we assume will continue.[28] This is a conservative estimate for there are

[27] 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. But others point to large potential productivity gains in the health care sector relative to other sectors of the economy (e.g., Chandra and Skinner, 2012).

[28] 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 in nominal terms) and a transition to generic drugs; these are unlikely to persist for the next few decades. This prediction takes into

reasons, as noted above, to believe that a new wave of innovations could increase Medicare spending. Private plans continue to have avenues for restricting spending, such as defined-contribution plans, limited networks, value-based-insurance design and transparency tools. But the rollout of new high-deductible plans is nearly finished, and so we expect utilization growth to bounce back to 1.4% per year. We further assume a long-term growth in per capita Medicaid utilization of 1%, which is marginally higher than the age-adjusted real growth in utilization for Medicaid during 2007-11.

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 newly 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).

Adding these three effects (1.2 percent for price growth +1.3 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

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account the imminent provisions of the Affordable Care Act, but not more speculative impacts of the cost-saving experiments (such as bundled payments) which will require additional legislation to fully implement.

2032.[29] In sum, we end up at 1.2 percent plus GDP; certainly below the historical record of GDP plus 2.4 percent (Fuchs, 2013), and not very different from *current* (2013) data (Figure 1), but still consistent with a long-term growth rate in the health sector from 17.9 percent currently to roughly 23 percent in 2032.

V. 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 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 time; 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 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 aggregate health care spending growth may not exhibit a stable association with GDP growth in the medium-term. 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 expansion. For this

[29] 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.

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. In Finkelstein (2007) and Clemens (2011), the rise of high-deductible health insurance will deliver both a short-run reduction in quantity demanded of services, and may also exert a longer-term impact on the incentive to adopt and pay for new innovations in an environment of 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 that will exceed GDP; our best guess is GDP plus 1.2 percent, which puts us in the middle of the pack between Medicare actuaries and the CBO, even if our own confidence intervals are wide. 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 "moderate" GDP plus 1 percent growth rates in health care. The pain includes some combination of increases in tax rates or drastic cuts in non-health spending, and does not capture the additional unpleasantness of private health insurance premium hikes soaking up any real wage growth for the median worker (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.[30] Nascent signs of this are apparent in the isolated decisions by some private insurers to no longer cover proton-beam therapy.[31]

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, such as Intermountain Healthcare's collaboration with General Electric. Moreover, on both sides of the political aisle there is consensus that fee-for-service creates incentives for overuse. And while the exact solutions to this problem may differ on the spectrum of market versus regulatory approaches to technology management, a Republican-led Congress would continue the move towards payment reform. Yet ultimately, all these policy solutions must be concerned about the long-term technology pipeline that will continue to deliver new technology with large price-tags but with the potential for very modest health benefits.

[30] 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).

[31] 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).

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Table 1: US Health Spending Growth During Four Periods

	Average Yearly Growth			
	1990-2001	2001-2007	2007-2009	2009-2012
Real Health Spending				
Total National Health Expenditures	4.6%	4.8%	2.9%	2.5%
Personal Health Care	4.6%	4.5%	3.6%	2.5%
Total National Health Expenditures as a Share of Potential GDP	1.4%	2.0%	0.6%	0.8%
Personal Health Care as a Share of Potential GDP	1.4%	1.7%	1.3%	0.8%
Per Capita Total National Health Expenditures	3.5%	3.8%	2.1%	1.7%
Per Capita Personal Health Care	3.5%	3.5%	2.8%	1.7%
Real Per-Enrollee Spending				
Per Enrollee Medicare National Health Expenditures*	4.0%	5.3%	3.4%	1.2%
Per Enrollee Medicaid National Health Expenditures*	3.8%	0.2%	0.5%	-1.4%
Private Premium**	8.2%	6.2%	2.4%	3.5%

*Series only goes to 2011
*Series starts in 1999

SOURCES: Health expenditures are from the CMS National Health Expenditures Accounts between 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 Analysism, and potential GDP is published by the Congressional Budget Office. Private premiums are estimated by the Kaiser Family Foundation.

Table 2: Annual rates of change in selected Surgical Procedures

	1996-2001	2001-2006	2006-2010
All Surgery	1.3%	0.0%	-3.4%
Abdominal Aortic Aneurysm Repair	1.9%	-2.1%	-3.4%
Back Surgery	6.5%	2.5%	1.8%
Coronary Angiography	3.8%	-1.8%	-7.2%
Coronary Artery Bypass Grafting (CABG)	-1.6%	-6.6%	-7.4%
Percutaneous Coronary Interventions	8.0%	2.4%	-10.9%
Carotid Endarterectomy	-1.1%	-5.6%	-6.1%
Cholecystectomy	-0.6%	-3.6%	-4.2%
Hospitalization for Hip Fracture	-0.9%	-1.6%	-2.4%
Hip Replacement	3.7%	2.4%	4.0%
Knee Replacement	2.6%	7.3%	1.6%
Mastectomy for Breast Cancer	-2.7%	-8.7%	-6.2%
Resection for Colon Cancer	-0.3%	-3.9%	-16.2%
Aortic/Mitral Valve Replacement	2.7%	0.1%	0.2%

Source: Dartmouth Atlas of Health

Table 3: Growth Rates of Prices, Utilization and Enrollments by Payer (2007-2011)

	Price Growth (Real)	Utilization Growth	Enrollment Growth	Share of Payments	Share of Enrollees
Medicare	0.9%	1.4%	2.5%	30%	16%
Medicaid	-0.4%	-0.1%	4.7%	22%	19%
Private	2.7%	0.7%	-1.3%	48%	65%
Total (Weighted)	**1.5%**	**0.7%**	**0.4%**	**100%**	**100%**

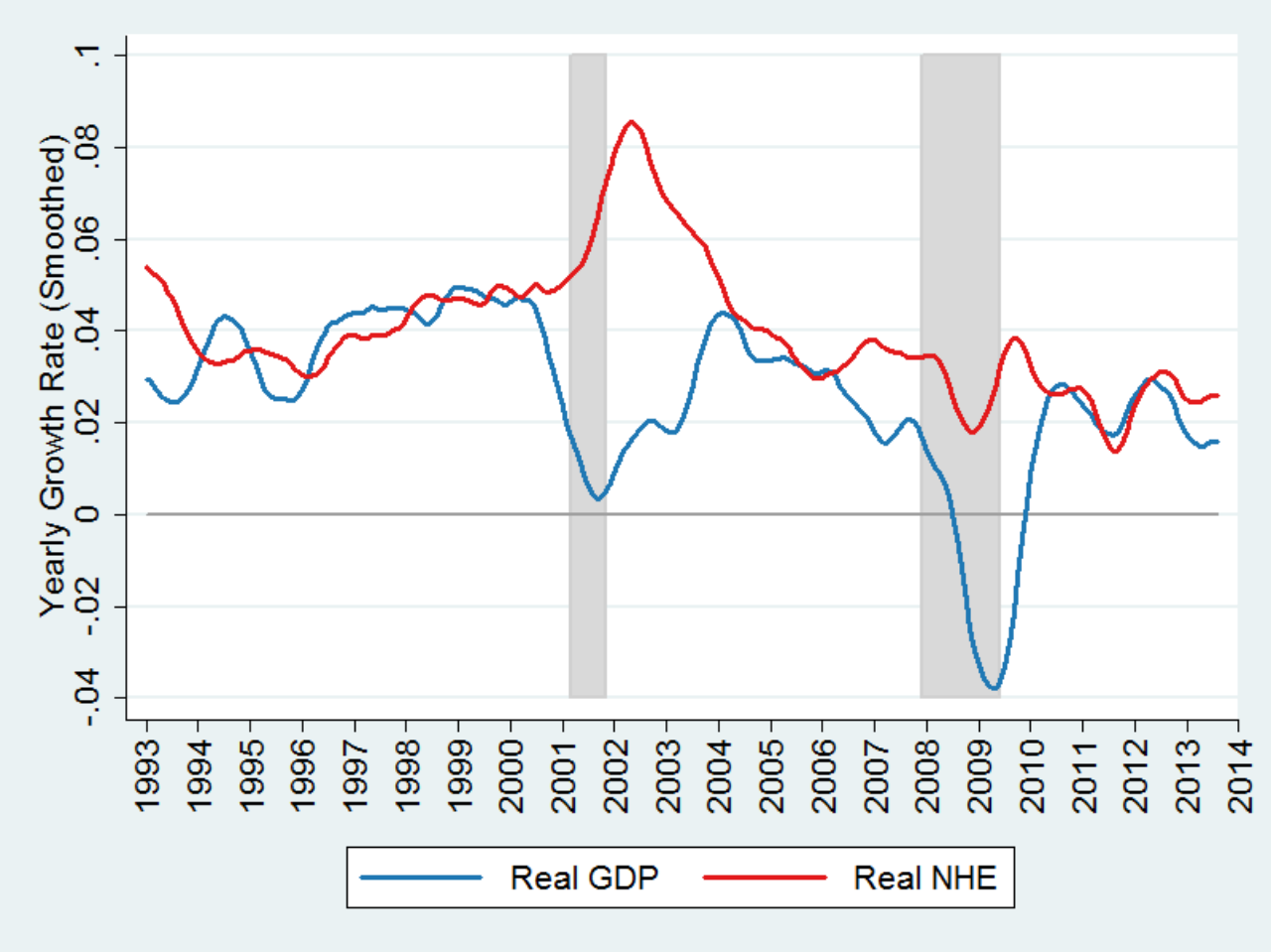
SOURCES: The GDP deflator was 1.6% and was substracted from column 1. Price growth in Medicare is based on estimates of nominal price growth of 2.5% per year between 2007 and 2010 by Levine and Buntin (2013). Medicaid price growth is taken from Zuckermand and Goin (2012), who estimate that physician fees have risen by 4.9% in Medicaid between 2008 and 2012, which is an annualized growth rate of 1.2%. Price growth for private payers is calculated based on Health Care Cost Institute calculations of price and utilization growth for inpatient, outpatient, physician, and prescription drug benefits in their 2010, 2011, and 2012 cost growth reports. To estimate aggregate price growth, we take a weighted average of component growth rates for the years 2007-2011, where the weights are total spending by component-year.

We take per enrollee spending growth, enrollment growth, share of payments and share of enrollees from the datasets listed in Figure 7. Utilization growth (g_u) is calculated from nominal spending growth (g_n) and price growth (g_p) according to the equation:

$$1 + g_u = \frac{1 + g_n}{1 + g_p}$$

Total price and utilization growth rates are weighted by the share of payments. Enrollment growth is weighted by share of enrollees.

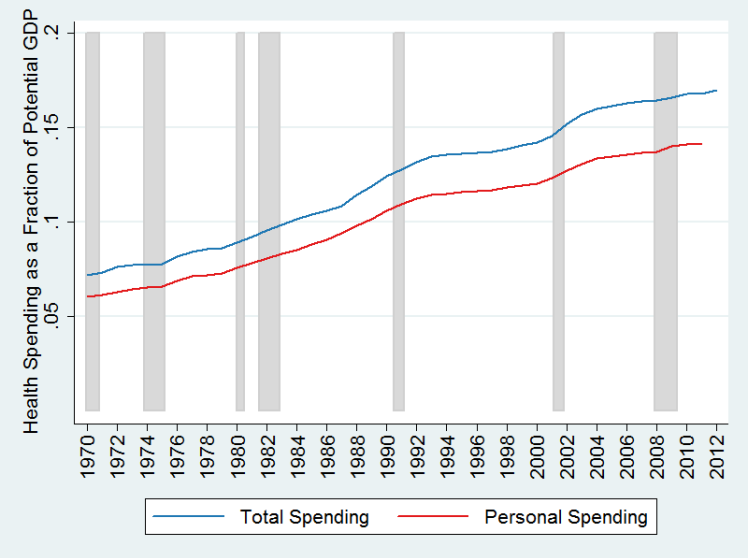
Figure 1: Total National Health Expenditures and GDP Growth, 1999 - 2013



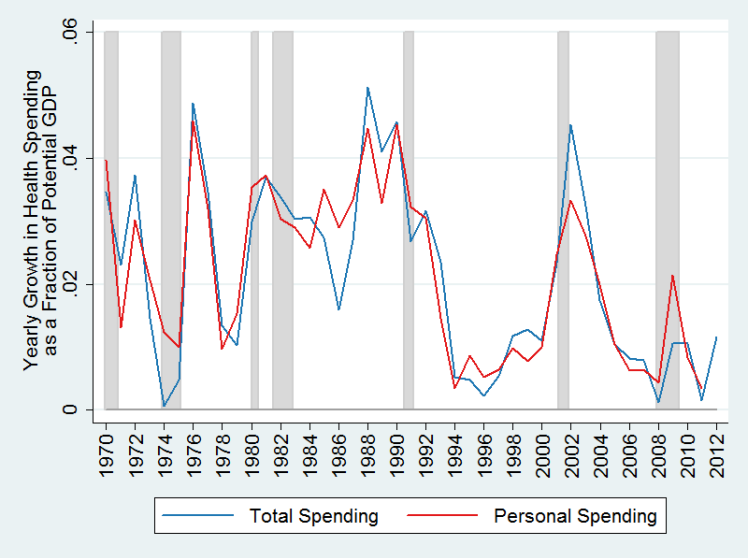
SOURCES: Monthly Health Expenditure Data are calculated by the Altarum Institute, and monthly GDP is estimated by Macroeconomic Advisors. We use the implicit GDP deflator from Macroeconomic Advisors to deflate nominal national health expenditures. Graph is smoothed using a density estimator with an epanechnikov kernel and a bandwidth of 2 months. This graph is inspired by Fuchs(2013).

Figure 2: Total National Health Spending and Personal Health Expenditures as a Fraction of Potential GDP, 1970-2012

(a) Levels

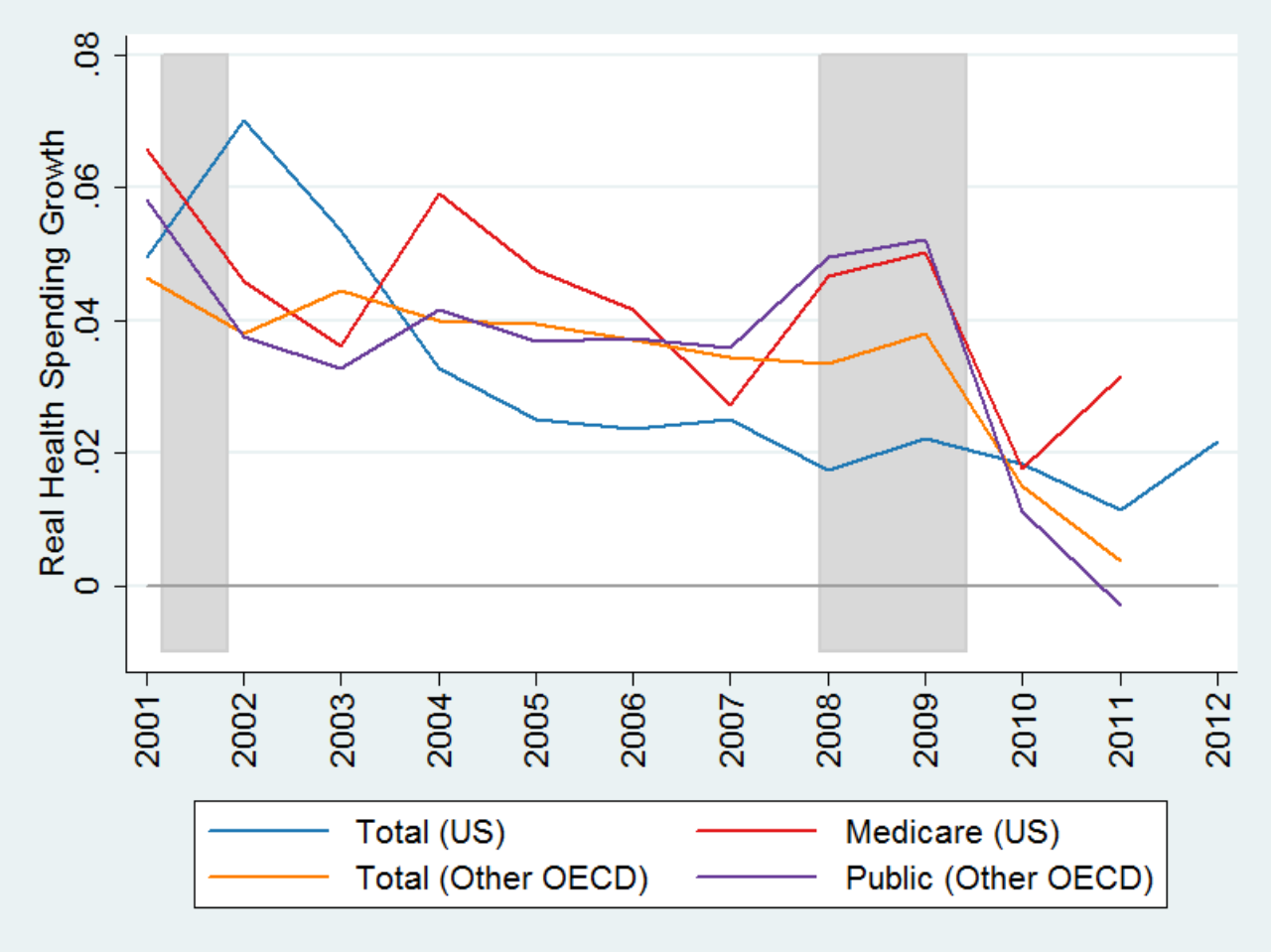


(b) Growth Rates



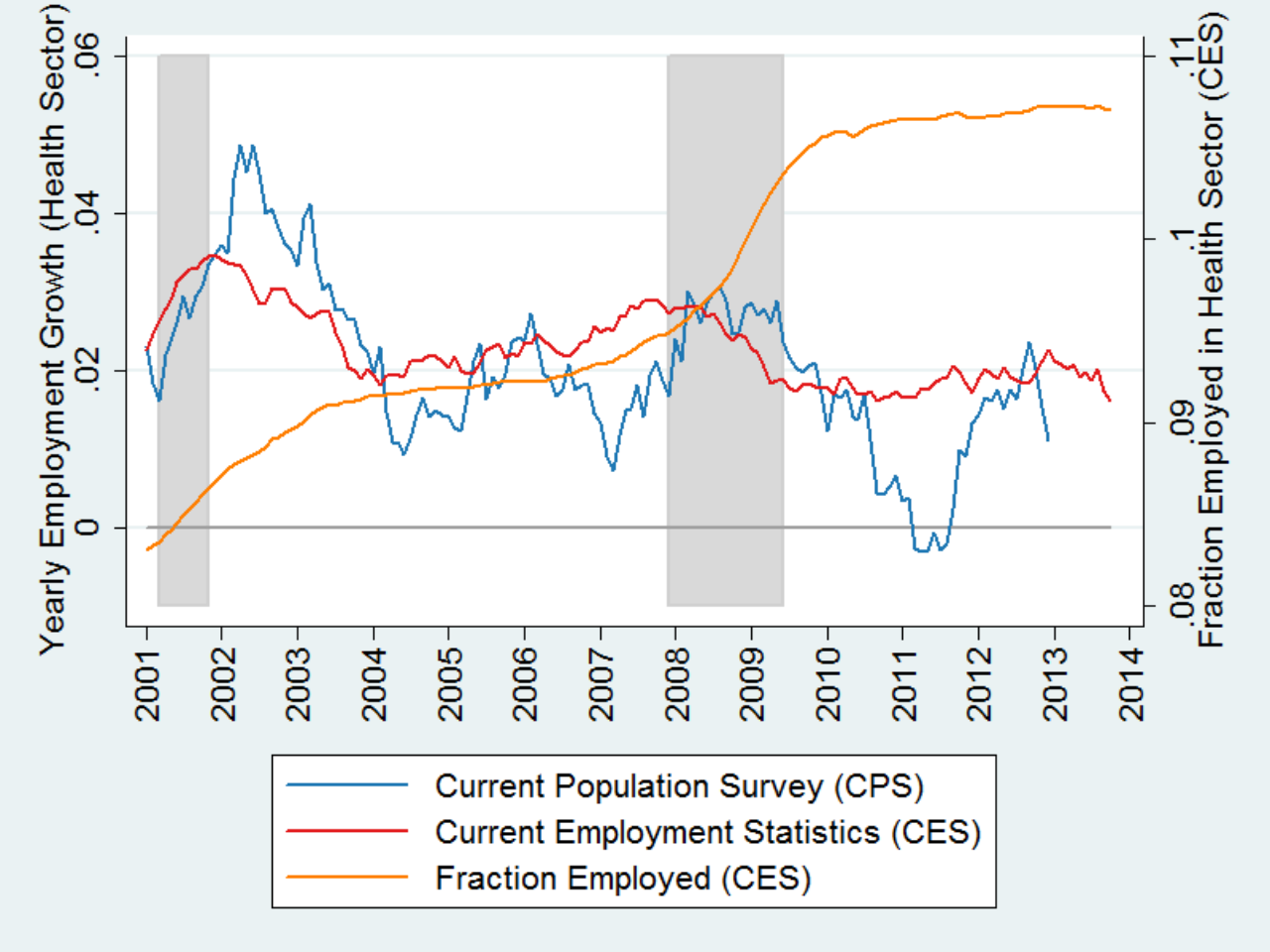
SOURCES: Total national and personal health expenditures are from the CMS National Health Expenditures Accounts from 2011-2011, with 2012 estimates provided by the Altarum Institute. Nominal Potential GDP is estimated by the Congressional Budget Office. Yearly potential GDP the average of quarterly estimates.

Figure 3: Total and Public Health Spending in the US and in other OECD Countries, 2001-2011



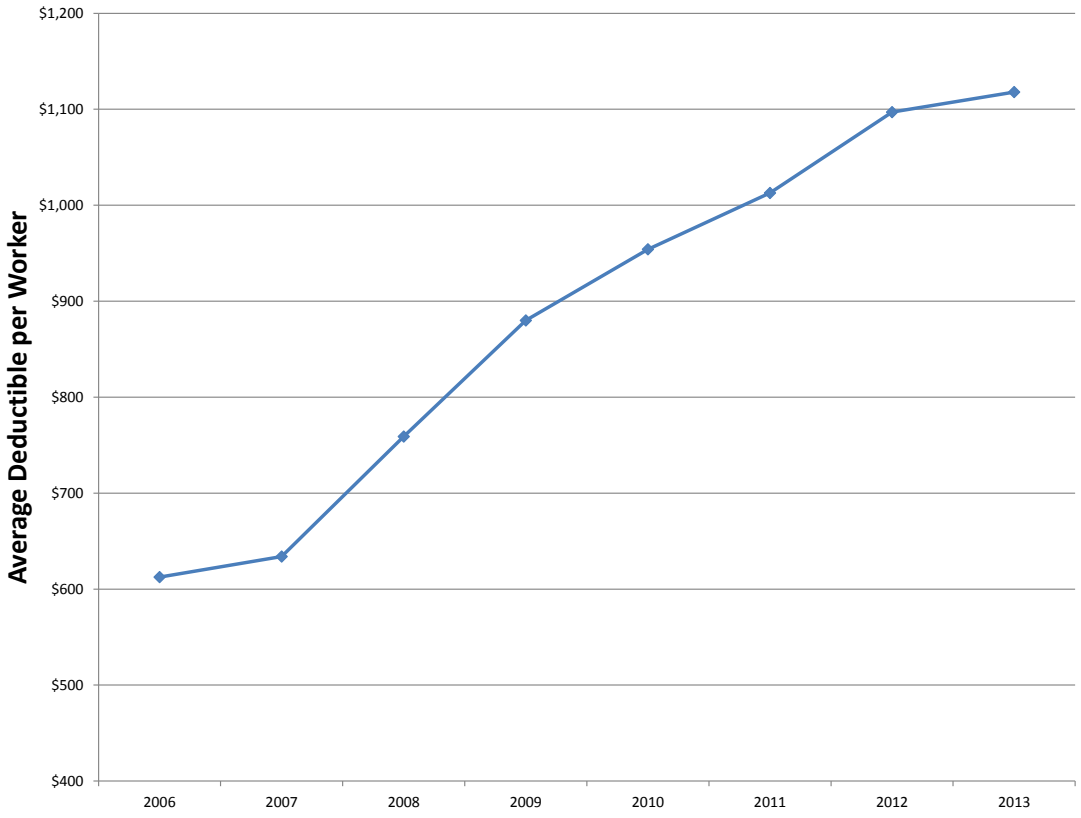
SOURCES: US total and personal spending per capita are from the CMS National Health Expenditures Accounts, and are deflated using the GDP deflator from the Bureau of Economic Analysis. Spending growth for other OECD countries is calculated as a weighted average of real per capita PPP health spending using data from the Organisation for Economic Co-operation and Development.

Figure 4: Monthly Growth in Health Employment (Relative to Last Year) for the Current Population Survey (CPS) and Current Employment Statistics (CES), 2001-2013



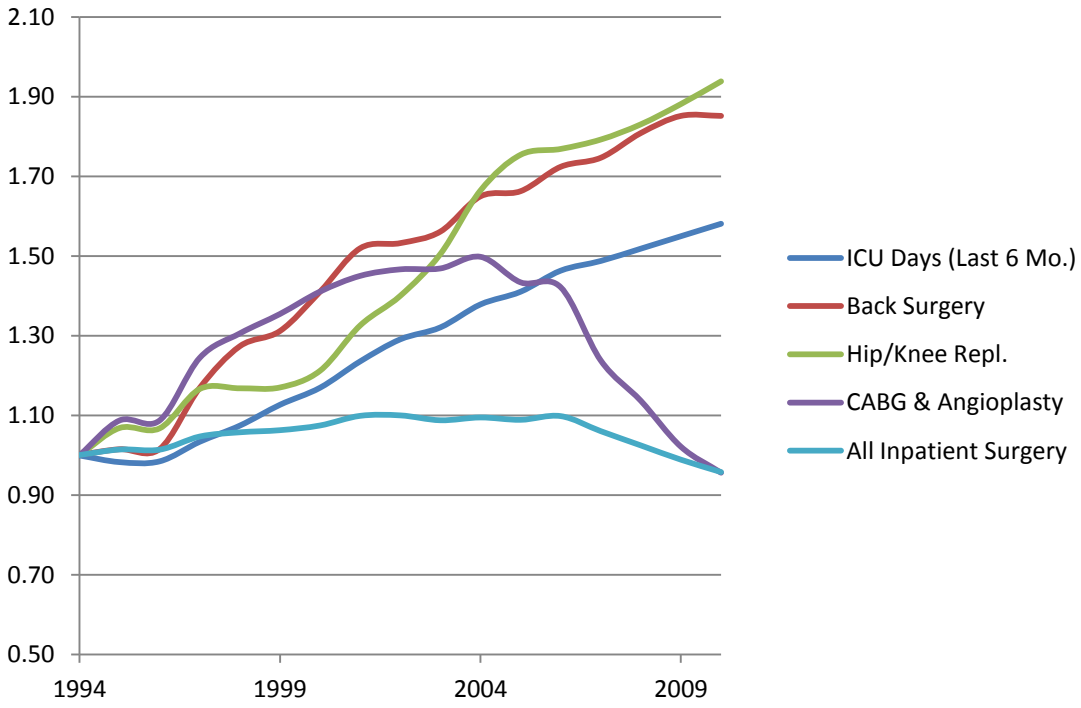
SOURCES: Current Employment Statistics and author calculations based on the Current Population Survey Merged Outgoing Rotation Groups. The health industry is defined according to NAICS codes 621, 622, and 623 from the 2002 version of the North American Industry Classification System. Current employment statistics estimates are seasonally adjusted, and estimates of the number of employed in the CPS are smoothed using a 13 month window moving average. The fraction employed in the CES are the number of health employees over the total number of nonfarm workers.

Figure 5: Average Health Insurance Deductible across All Plan Types among Covered Workers With A Deductible, 2006-2013



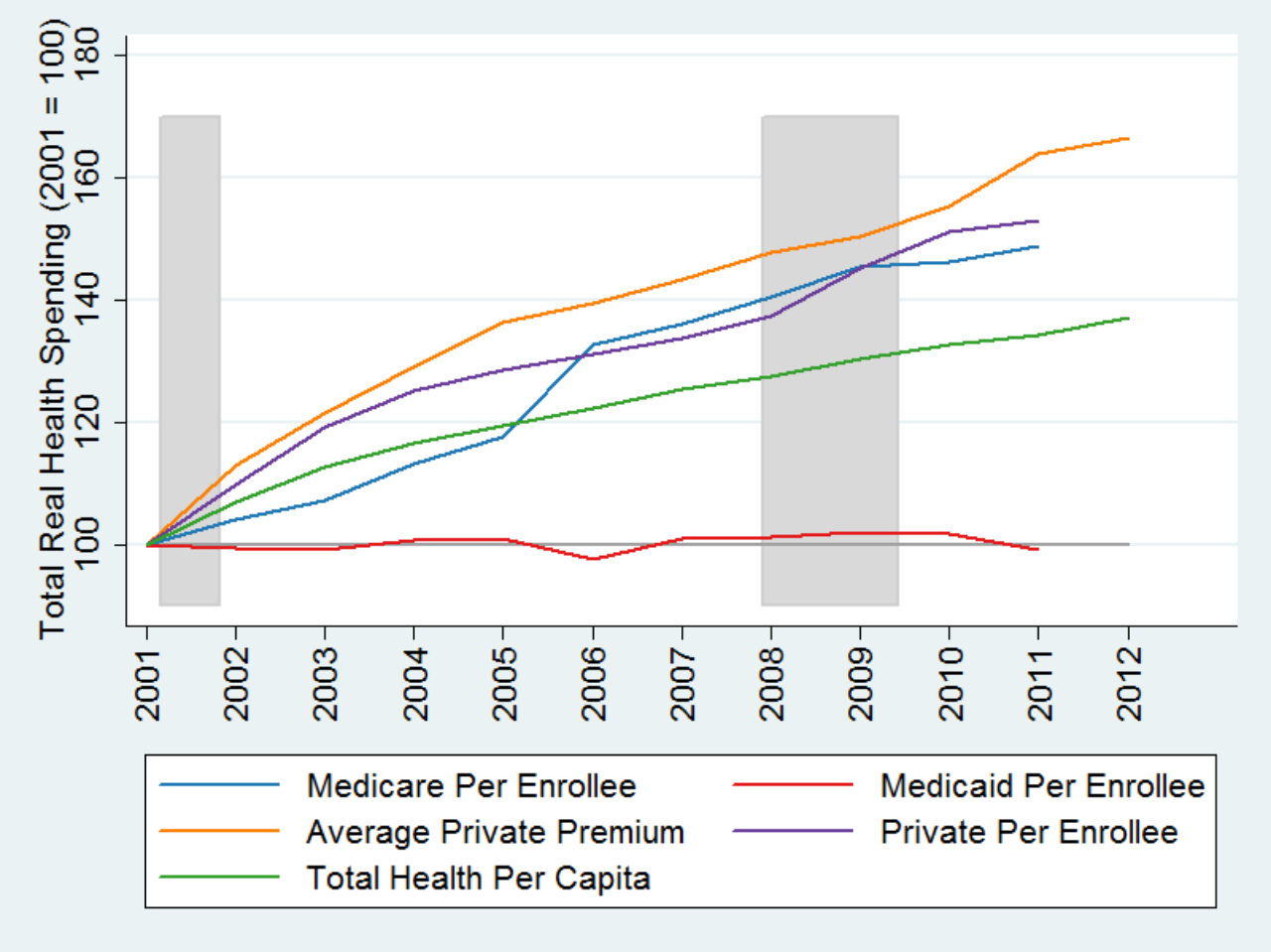
SOURCE: Kaiser HRET Survey of Employer-Sponsored Health Benefits, 2013, inflation adjusted using the GDP deflator (through Q2 2013). Family plans have higher deductibles but similar growth patterns.

Figure 6: Rates of Utilization of Selected Procedures in the Medicare Fee-for-Service Population Over Age 65 (1994 = 1)



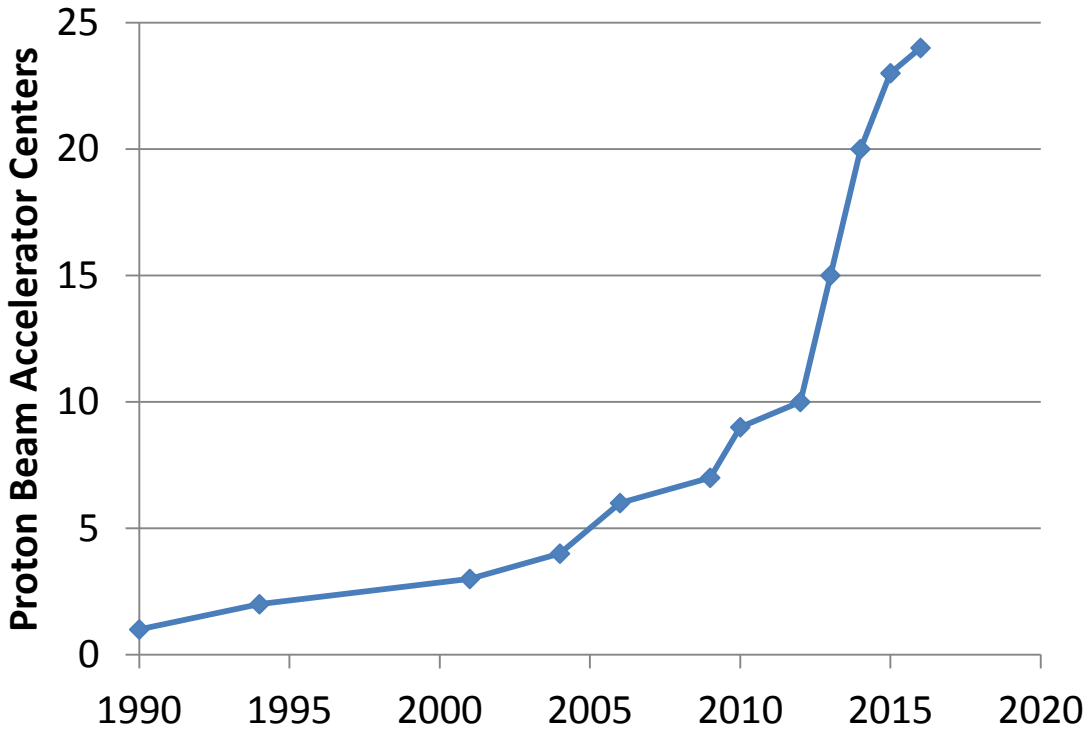
SOURCE: Dartmouth Atlas of Health Care, various years.

Figure 7: Real Per Enrollee and Per Capita Spending, By Payer (2001 = 100)



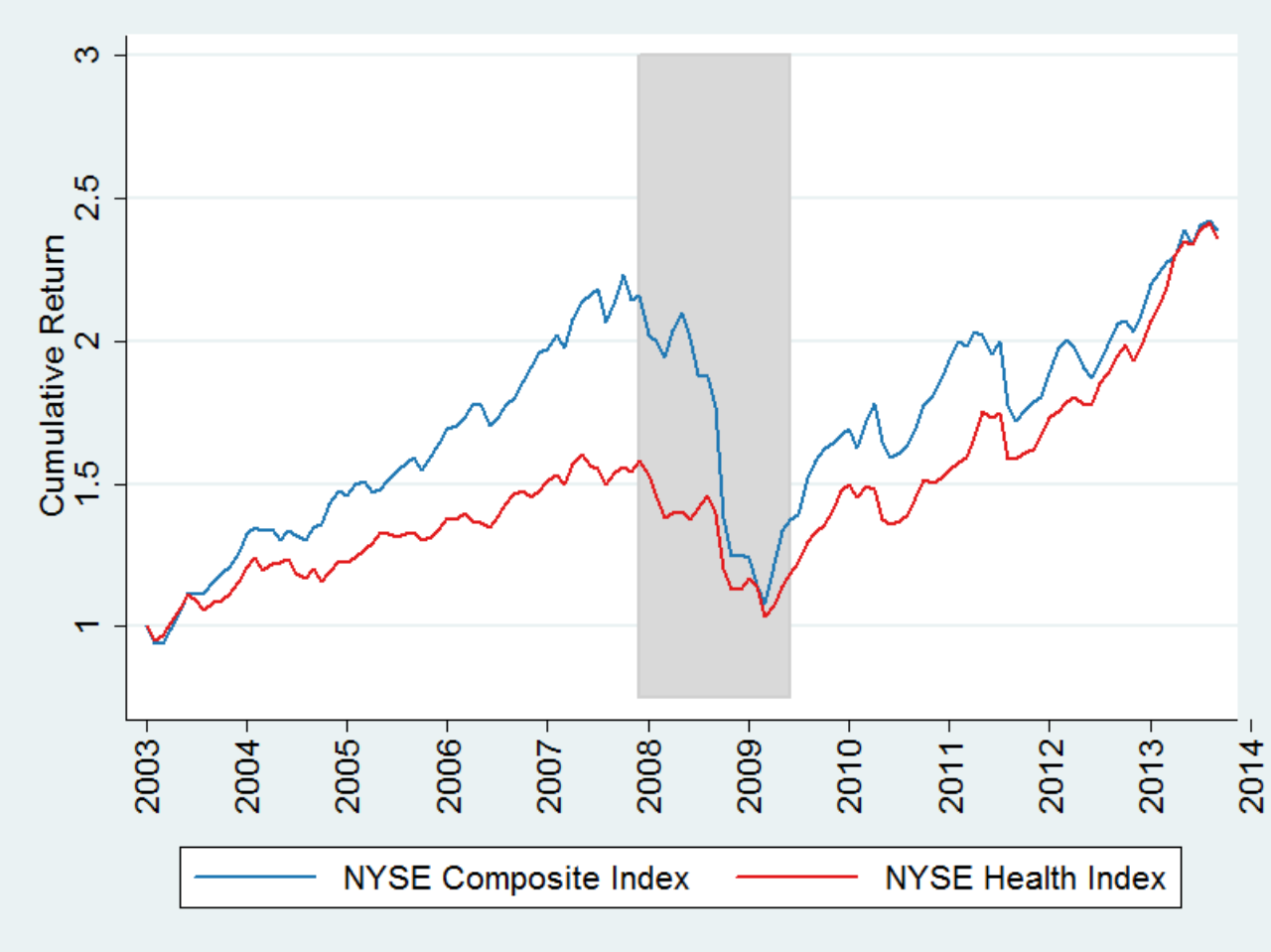
SOURCE: Total health health spending per capita and per enrollee expenditures are from the CMS National Health Expenditures Accounts from 2011-2011, with 2012 estimates for national expenditures provided by the Altarum Institute. Private premiums are for a representative individual with no dependents, and 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



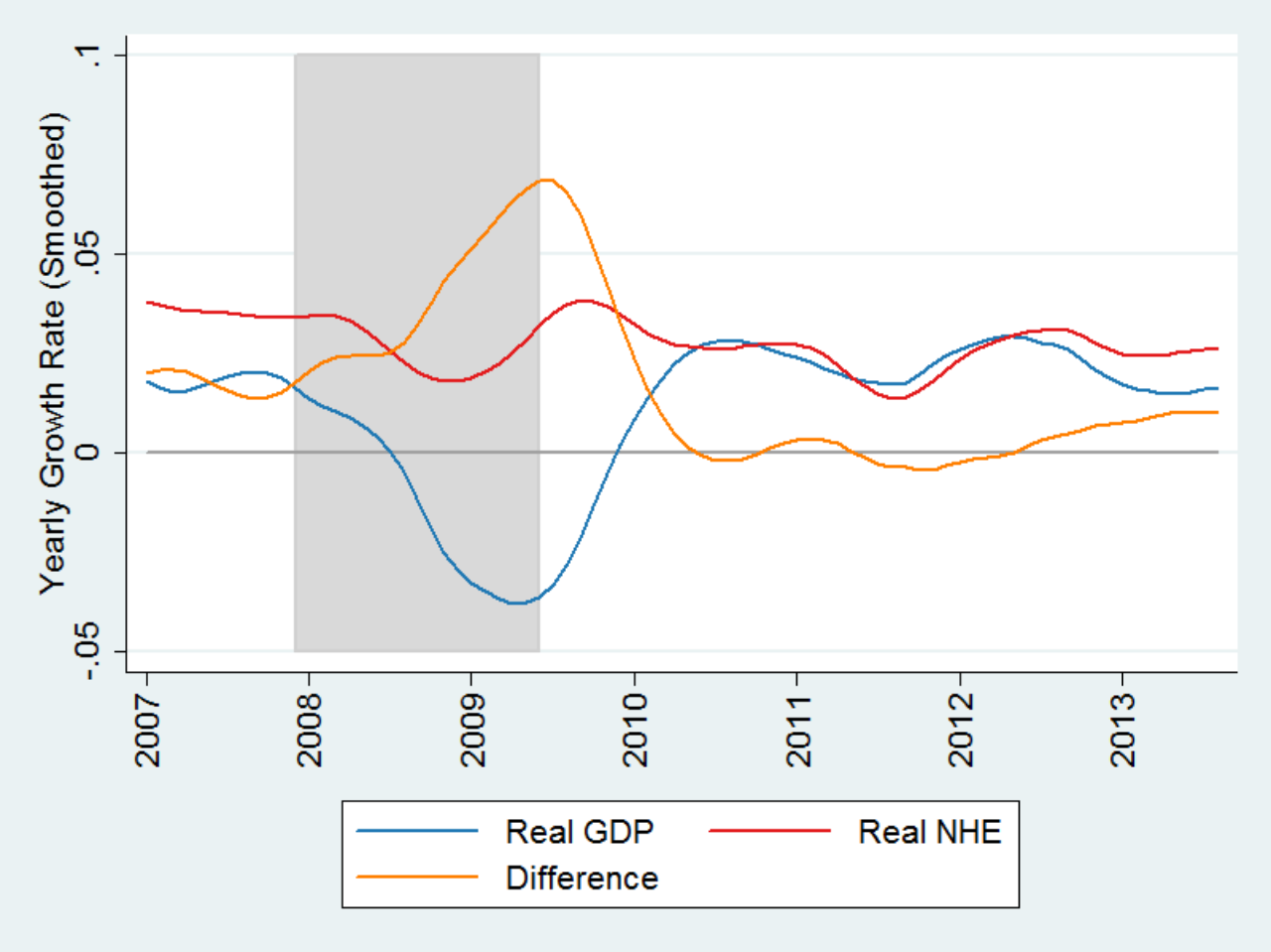
SOURCE: Particle Therapy Co-Operative Group

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 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.

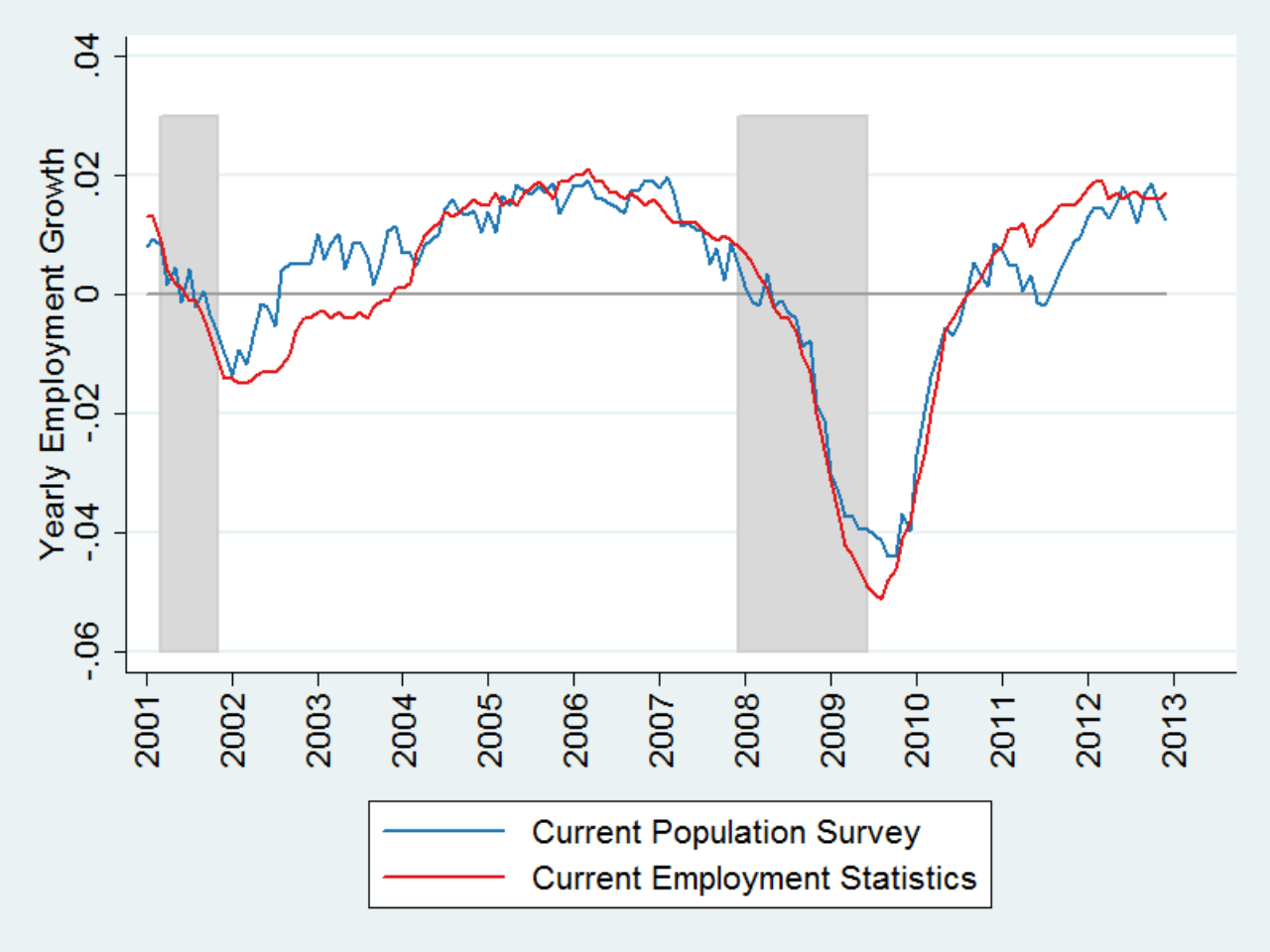
Figure 10: Difference Between National Health Expenditure Growth and GDP Growth, 2007-2013



SOURCES: Monthly Health Expenditure Data are calculated by the Altarum Institute, and monthly GDP is estimated by Macroeconomic Advisors. Graph is smoothed using a kernel density estimator with an epanechnikov kernel and a bandwidth of 2 months.

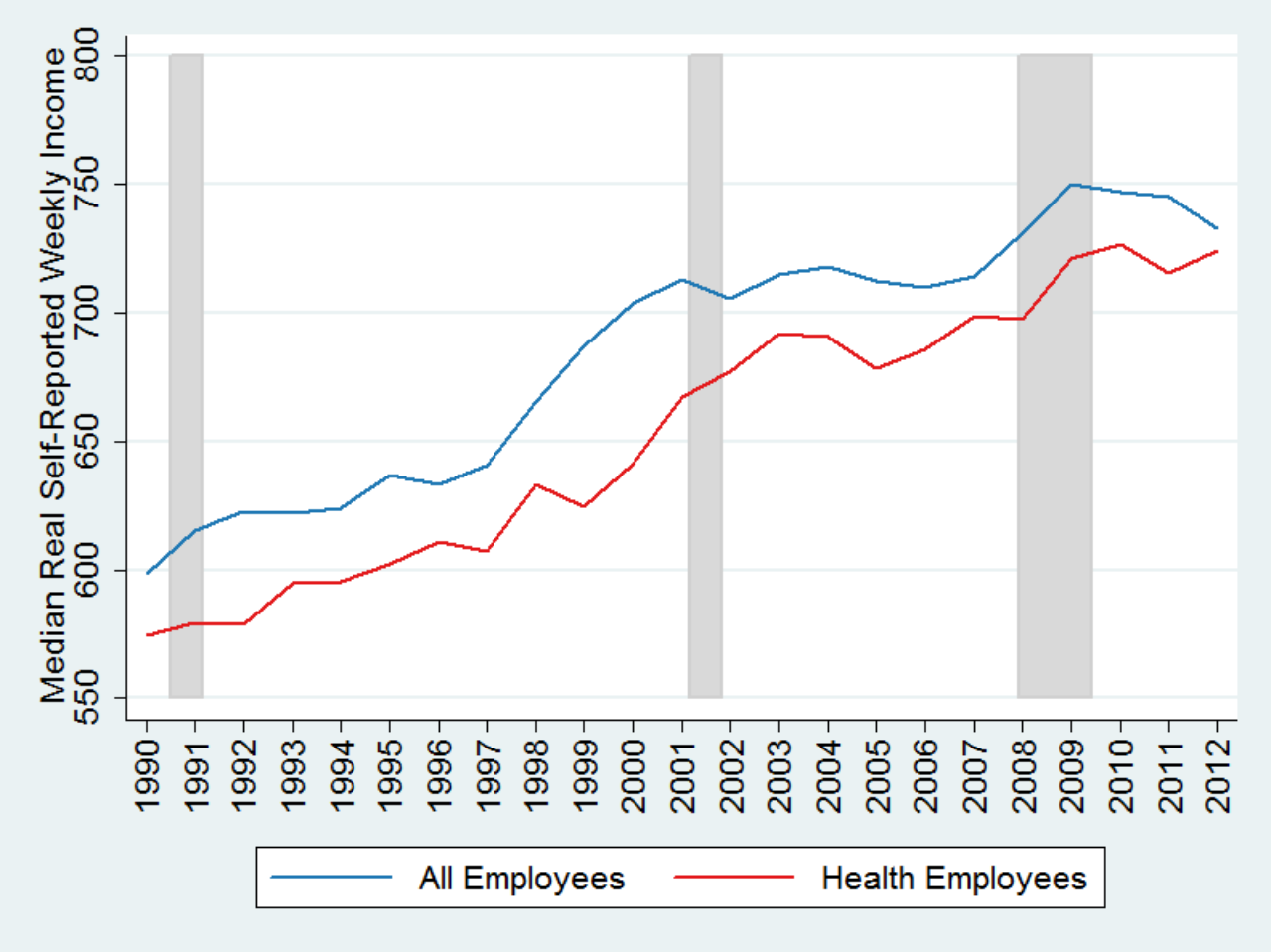
Appendix A

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



SOURCES: Current Employment Statistics and author calculations based on the Current Population Survey Merged Outgoing Rotation Groups, which are maintained by the NBER. Current employment statistics measure the growth in all non-farm jobs, and the Current Population Survey sample is restricted to those aged 18-64.

Appendix Figure A.2: Real Median Wages of Full-Time Employees Aged 18-64, All Employees vs. Health Sector Employees, By Year, 1990-2012 (2009 dollars)



SOURCE: Author calculations based on the Current Population Survey Merged Outgoing Rotation Groups, which are maintained by the NBER. Sample excludes self-employed workers, and nominal wages are deflated using the GDP deflator published by the Bureau of Economic Analysis.

Appendix Table A.1: Growth in Real National Health Expenditures and Real GDP By Year

	Real Growth (July to July)		
Year	NHE	GDP	NHE Minus GDP
2001-02	8.8%	2.7%	6.1%
2002-03	6.1%	2.5%	3.6%
2003-04	4.0%	3.8%	0.2%
2004-05	3.5%	3.3%	0.2%
2005-06	3.2%	2.0%	1.2%
2006-07	3.6%	1.9%	1.7%
2007-08	2.4%	1.0%	1.4%
2008-09	3.7%	-4.3%	8.0%
2009-10	2.6%	3.3%	-0.7%
2010-11	1.2%	1.5%	-0.3%
2011-12	3.5%	3.6%	-0.1%
2012-13	2.5%	1.2%	1.3%
AVERAGE	**3.8%**	**1.9%**	**1.9%**
AVERAGE 2006-13	**2.8%**	**1.2%**	**1.6%**

SOURCE: Estimates of nominal national health expenditures each July by year are from the Altarum Institute. Estimates of GDP each July are from Macroeconomic Advisors. We use the implicit GDP deflator from Macroeconomic Advisors to deflate nominal national health expenditures.

Appendix Table A.2: Real, Per Capita Sending Growth By Payer vs. Gdp Growth Rate, 1970-2012

	Dependent Variable: Growth in Real, Per Capita Costs Paid By:					
	Total	Personal	Medicare	Medicaid	Private Insurance	Out of Pocket Spending
Panel A: No Lags						
Real, Per Capita GDP Growth	0.165	0.0625	-0.217	-0.370	0.512**	0.508***
(Current Period)	(0.105)	(0.0939)	(0.256)	(0.433)	(0.233)	(0.168)
R2 (Model 1)	0.044	0.007	0.017	0.022	0.089	0.164
Panel B: With 3 Lags						
Sum of Current and Lagged Real Per Capita GDP Growth	0.553**	0.544***	-0.463	0.313	0.980*	0.962**
Wald F Statistic	6.77	8.81	.998	.323	3.7	7.33
P-Value	0.013	0.005	0.324	0.573	0.062	0.010
R2	0.189	0.170	0.025	0.105	0.190	0.229
Panel C: With 5 Lags						
Sum of Current and Lagged Real Per Capita GDP Growth	1.398***	1.187***	-0.820	2.179**	3.076***	1.589***
Wald F Statistic	54.4	41.4	1.06	6.35	58.4	15
P-Value	0.000	0.000	0.311	0.016	0.000	0.000
R2	0.561	0.437	0.040	0.244	0.570	0.338
First Year	1970	1970	1970	1970	1970	1970
Last Year	2012	2012	2011	2011	2011	2011
N	43	43	42	42	42	42

* $p < .10$, ** $p < .05$, *** $p < .01$

Standard errors in parenthesis. Results are from OLS regressions with robust standard errors. F statistics are against the null that the current and all lagged coefficients are all equal to zero.

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.3: Health Spending Growth vs. Gdp Growth Rate

	Dependent Variable: Growth in Real, Per Capita Total National Health Expenditures							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Real Per Capita GDP Growth	0.165							
	(0.105)							
Average 2-Year GDP Growth		0.164						
		(0.116)						
Average 3-Year GDP Growth			0.183					
			(0.167)					
Average 4-Year GDP Growth				0.428**				
				(0.196)				
Average 5-Year GDP Growth					0.938***			
					(0.192)			
Average 6-Year GDP Growth						1.328***		
						(0.176)		
Average 7-Year GDP Growth							1.475***	
							(0.207)	
Average 8-Year GDP Growth								1.488***
								(0.249)
Constant	0.0385***	0.0385***	0.0381***	0.0337***	0.0240***	0.0161***	0.0125***	0.0116**
	(0.00320)	(0.00351)	(0.00442)	(0.00448)	(0.00391)	(0.00359)	(0.00439)	(0.00545)
First Year	1970	1970	1970	1970	1970	1970	1970	1970
Last Year	2012	2012	2012	2012	2012	2012	2012	2012
R2	0.0439	0.0277	0.0225	0.0827	0.270	0.402	0.388	0.327
N	43	43	43	43	43	43	43	43

* $p < .10$, ** $p < .05$, *** $p < .01$

Standard errors in parenthesis. Results are from OLS regressions with robust standard errors.

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.