

Medical Care Expenditure Indexes for the US, 1980-2006¹

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ABSTRACT

We construct historical medical care expenditure indexes (MCEs) for the US economy for the period 1980-2006, thus supplementing the MCEs provided in the BEA health account for the period 2001-2010 (Dunn et al, 2015). Comparing our MCEs to the official deflators used in the national accounts, our results depend on the specific time period. We find that the MCEs show slower price growth than the official BEA deflator from 1987-1996, consistent with the fact indexes that improve on the official statistics typically find slower price growth than the official indexes. However, for the 1996-2006 time period, the result is reversed: our MCE price indexes grow faster than the official price deflator over this period.

To better understand this result, we develop a decomposition that parses out the numerical differences in these indexes into three factors that are held constant in the official price indexes but are not in the MCEs: changes in the industry providing care, changes in the type of insurance plan used by the patients, and changes in the bundle of procedures used to treat patients. We argue that our results reflect the impact on the cost of treatment from the well-known shift from relatively generous fee-for-service plans to more restrictive managed care plans between the late 1980s and early 1990s and the subsequent backlash. As the less-generous managed care plans grew in the earlier period, physicians received less payment for their services and used fewer procedures to treat episodes of care which would hold down the growth of the MCE but not that of the official deflators. The opposite appears to have happened in the latter period: there, the managed care backlash took hold, undoing much of the cost constraint phenomenon that was associated with the earlier rise of managed care.

With regard to other factors that potentially drive a wedge between growth in the MCE vs official deflators, we find that industry shifts provided a check on cost growth across all three periods: absent these shifts, the MCE would have risen 6 to 13 percent faster. With regard to shifts in insurance plans or in the utilization of procedures, our results are consistent with the notion that shifts in insurance plans, per se, did not affect price growth much over this period but changes in utilization did.

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1. Introduction

In this paper, we provide new Medical Care Expenditure (MCE) price indexes for medical care using data from nationally-representative surveys of medical expenditures in the civilian non-institutional population in 1980, 1987, 1996 and 2006. Our empirical contribution is to provide these price measures for a more comprehensive population of patients than previously done (civilian non-institutional population) and for earlier periods (1980-87 and 1987-96).

Our indexes are similar in coverage to the official statistics in that they are constructed for a comprehensive list of conditions and patients. The official statistics are often interpreted as an upper bound to true price change and, empirically, price indexes that improve on the official statistics typically show slower price growth. However, comparing our MCEs to the official PPIs, we find that our indexes sometimes show slower price growth and sometimes faster price growth than the official statistics. For the earliest time periods, our disease-based price indexes grow at a compound annual rate of 9.2% from 1980-87, very close to the 8.9% price increases currently in the national accounts; over the period 1987-96, our indexes grow 2.9%, substantially slower than the 6.4% growth rate in the national accounts. For the most-recent time period, we find that disease-based price indexes show faster growth than the official statistics in that period (5.3% vs 2.7%).

We develop a simple decomposition to parse out differences in the MCEs that we construct and the official price index used in the national accounts into three components: differences that stem from shifts in treatments across industry lines, those stemming from shifts in patients across type of insurance plans, and a residual category that captures changes in utilization. We find that industry shifts hold down growth in the MCE indexes relative to PPIs in all three periods, with higher effects in the earlier period than later. With regard to the other two effects, the net effect of insurance shifts and utilization changes are positive in the first and last periods, and very small in the 1987-2001 period. We argue that the well-known shift from relatively generous fee-for-service plans to more restrictive managed care plans between the late 1980s and early 1990s and the subsequent backlash that began in the early 2000's likely played a role in generating this pattern. In particular, our results are consistent with the notion that the sharp growth in managed care plans over the 1987-2001 period likely held down

growth in the MCEs as the arrival of less-generous managed care plans held down utilization growth in that segment and generated spillovers that held increases in utilization in check in other insurance segments as well. Although our data only allow us break out the effect of shifts across insurance types in the last period (2001-2006), we find that this effect is very small, despite the managed care backlash that prompted patients to switch back to more-generous plans. Instead, most of the growth in the MCE above that in the PPI in that period is accounted for by growth in utilization, a result consistent with Dunn et al (2014). We argue that this makes it unlikely that insurance shifts account for much of the differences in MCE and PPI during the earlier run-up.

The paper is organized as follows. The next section compares how the official PPIs and the MCEs define the commodity provided by the health sector, discusses the factors that can cause these indexes to diverge, and provides a decomposition to attribute any observed differences to these factors. After a brief discussion of our data sources, we apply the decomposition to our data and argue that the observed patterns are consistent with the growth and decline of managed care over this period.

2. Comparison of PPI and MCE concepts of the “good”

2.1 Producer Price Index

“The Producer Price Index is a family of indexes that measures the average change over time in the selling prices received by domestic producers of goods and services. PPIs measure price change from the perspective of the seller.² For providers in the health sector, a PPI tracks the prices of commodities at a very granular level. For example, prescription drugs are defined using the drugs’ active ingredient, whether it is a brand or generic product, its form and strength, the size of the container, and type of payer.³ For physician services, the transaction is defined as a “bill” for surgeries, lab work, and other procedures, provided at a particular doctor’s office, to treat a particular condition, for a patient with a specific type of insurance (e.g., Blue Cross Blue Shield, Standard Option Plan with \$200 deductible and \$10 copay for office visits).

² <http://www.bls.gov/ppi/ppifaq.htm#1>

³ <http://www.bls.gov/ppi/pharmpricescomparison.pdf> <http://www.bls.gov/ppi/healthcarebypayer.htm>

We can illustrate the idea behind the PPIs formally. For simplicity, we use a Laspeyres formula.⁴ Let s denote a particular procedure performed by a provider, p , to treat disease d for a patient with a particular type of health plan, h . Then, letting c and x represent the cost and number of procedures, a Laspeyres PPI that tracks prices of procedures and services used to provide medical care from period 1 to period 2 may be written:

$$\begin{aligned} \text{PPI}^{\text{laspeyres}} &= \left[\sum_s \sum_p \sum_d \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^1) \right] / \left[\sum_s \sum_p \sum_d \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) \right] \\ &= \left[\sum_s \sum_p \sum_d \sum_h \left\{ c_{s,p,d,h}^2 / c_{s,p,d,h}^1 \right\} x_{s,p,d,h}^1 \right] / \left[\sum_s \sum_p \sum_d \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) \right] \end{aligned}$$

The first equality gives the familiar Laspeyres formula that tracks how prices of a particular bundle of services (the x 's in period 1) change over time: the denominator gives total spending in period 1 and the numerator prices same bundle using period 2 prices.

The second equality restates this price index as a weighted average of price change: the change in the price of each service, $c_{s,p,d,h}^2 / c_{s,p,d,h}^1$, or the price relative, is weighted by the period 1 expenditure share for that service, $[c_{s,p,d,h}^1 x_{s,p,d,h}^1 / \sum_s \sum_p \sum_d \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)]$. Written in this way, it is clear that changes in this $\text{PPI}^{\text{laspeyres}}$ only occur when there is a change in the price relatives; use of the initial period weights means that the following are held constant: the composition of conditions (i.e., the "bills"), number and mix of procedures used to treat the conditions, the location where the treatment was provided (hospital vs. office), and type of health plan.

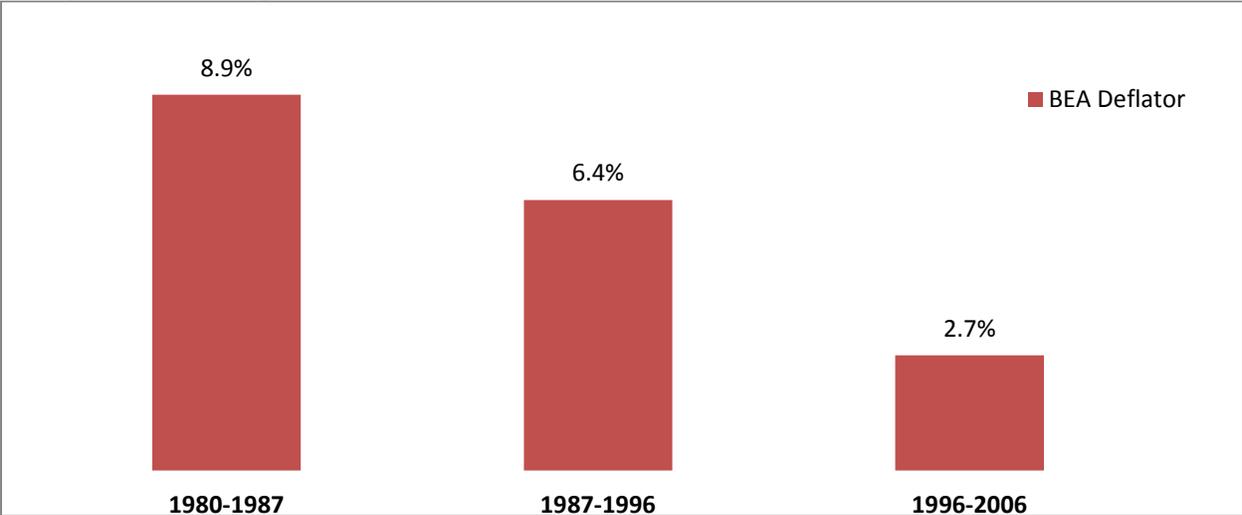
Indexes like these are used in the National Income and Product Accounts (NIPA) to measure price growth for health-related spending in Personal Consumption Expenditure. The indexes

⁴ Official statistics like Consumer Price Indexes (CPIs) are actually calculated using a Lowe index, which compares prices from the current month, say, and the previous month using quantities from some other past year. See the CPI and PPI manuals recently published by the ILO/IMF/OECD/EUROSTAT/World Bank for a discussion of the Lowe Index and for detailed information on how the official statistics are produced by statistical agencies (ILO, 2004; IMF, 2004).

are called *deflators* because they are used to back out how much of the growth in nominal spending can be attributed to inflation (growth in prices); the remainder is attributed to growth in real (deflated) spending.

Numerically, we can construct an overall deflator for spending on medical care that uses the official BEA deflators for a bundle of services comparable to what we will construct here using the survey data. Those services are Prescription Drugs, Physician Services and Hospitals and we aggregate over them using Laspeyres weights.⁵ The resulting index tells us the average change in procedure prices, across all conditions, providers, and payment types. That deflator shows decelerating price growth over the 1980-2006 period: a nearly 9 percent compound annual growth rate in the 1980-1987 period that slows to about 6 percent growth in 1987-1996 and slows further to about 2-1/2 percent in the last period.

Figure 1. Growth in prices for medical care spending, average of BEA deflators (compound annual growth rates)



Source: Authors' calculations.

⁵ The price indexes used to deflate medical care in the national accounts are typically PPIs, except for prescription drugs, where the CPI is used because it is thought to do a better job of incorporating generic drugs than the PPI.

2.2 Medical Care Expenditure Indexes

A “Medical Care Expenditure Index” redefines the commodity provided by the health sector as the overall treatment of a disease.⁶ Conceptually, the idea is to think in terms of episodes of care (a heart attack, or acute depression). Then, define the “price” of the episode as the total spending that went into treatment (drugs, office visits, surgery, etc.).

To illustrate how an MCE index is constructed, assume all episodes last one day. Then, the relevant spending to treat an episode of care for disease d in period 2 is the sum of all spending on all the individual treatments provided, the x 's, over all the s types of services (procedures), providers and health plan types: $\sum_s \sum_p \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2)$. Then the output or commodity provided is defined as the number of episodes for disease d , E_d^2 , and the average price of these episodes is defined as a unit value: the total expenditures used to treat the episode divided by the number of episodes: $\sum_s \sum_p \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2) / E_d^2$.⁷ The d 'th component of the MCE index is a price relative that compares the cost per episode for disease d in period 2 to that in period 1:

$$MCE_d = \left[\sum_s \sum_p \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2) / E_d^2 \right] / \left[\sum_s \sum_p \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) / E_d^1 \right]$$

And, again taking the Laspeyres formula to aggregate, the overall MCE index takes a weighted average of these price relatives over all diseases:

$$MCE^{lasp} = \sum_d \left[\left(\sum_s \sum_p \sum_h c_{s,p,d,h}^1 x_{s,p,d,h}^1 \right) / \left(\sum_s \sum_p \sum_d \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) \right) \right] \left[\sum_s \sum_p \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2) / E_d^2 \right] / \left[\sum_s \sum_p \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) / E_d^1 \right]$$

⁶ The term Medical Care Expenditure price index was coined in the CNSTAT report “At What Price?” Among the recent studies that construct these measures are Aizcorbe and Nestoriak (2011) and Dunn, Liebman and Shapiro (2013) for commercially-insured patients; Hall and Highfill (2013) for medicare patients, Aizcorbe et al (2011) for the civilian non-institutionalized population.

⁷ If the episodes can be defined to be homogeneous, this unit value is the appropriate way to define the price (for a recent discussion of when it is appropriate to use unit values, see, Silver, 2011).

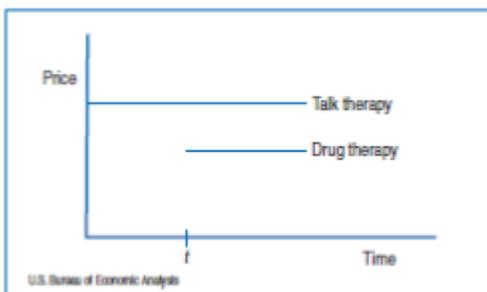
We can compare this index to the weighted average version of the overall PPI^{health}, where we rearrange the summations in the numerator:

$$PPI^{Iasp} = \sum_d \left[\sum_s \sum_p \sum_h c_{s,p,d,h}^1 x_{s,p,d,h}^1 \right] / \sum_s \sum_p \sum_d \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) \left\{ c_{s,p,d,h}^2 / c_{s,p,d,h}^1 \right\}$$

The MCE^{Iasp} and PPI^{Iasp} indexes are both weighted averages that, conceptually, use the same initial period weights: $\left[\sum_s \sum_p \sum_h c_{s,p,d,h}^1 x_{s,p,d,h}^1 \right] / \sum_s \sum_p \sum_d \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)$. The difference arises in the way the price relative is defined. The price relative in the PPI is for very granular commodities: it tracks price changes for a particular procedure, performed by a specific provider type, to treat condition d under health plan h $\left\{ c_{s,p,d,h}^2 / c_{s,p,d,h}^1 \right\}$. Hence, only movements in this very narrowly defined price will cause the overall price index to change; everything else is held fixed at the initial period levels.

In contrast, the MCE index defines the price relative at a very coarse level: it sums over all services used to treat an episode for condition d , regardless of where they were performed, which bundle of procedures were used, or what insurance plan the patient had. Therefore, shifts in the location where services are provided (inpatient stay vs ambulatory surgical centers), changes in the number and mix of procedures provided to treat condition d (30 minute office visit vs. 15 minute visit), and changes in the generosity of patients' health plans could conceivably cause movements in the MCE index. But, they would not cause movements in the PPI because those factors are held fixed at period 1 levels.

Figure 2. An Example of Shifts of treatments across industries



Source: Aizcorbe et al (2008)

Figure 2 provides a simple example to illustrate how the two indexes can imply different price growth. Suppose that drug therapy may be substituted for talk therapy in the treatment of depression starting at time t and that the prices of both types of treatment remain unchanged. If one tracks prices of each service separately, as in the PPI^{IASP} , and forms a weighted average, one would conclude that there has been no overall change in prices.

However, tracking the treatment of the disease—in this case, depression—suggests that the price of treating depression might have fallen in this example. It's entirely possible that patients would begin to substitute the higher cost talk therapy with lower cost drug therapy when drug therapy is introduced into the market. Assuming that the number of patients suffering from depression does not change, expenditures would fall, reflecting a drop in the cost of treating depression. Note that if one uses the traditional price indexes to “deflate” expenditures, the resulting measure of real services (the quantities) would show a decline, even if the number of patients, in fact remains the same. This is because the traditional price index would show no price change and, hence, would attribute all the declines in expenditures to a decline in the quantities. In general, this type of substitution of treatments will not be reflected as a price change in the traditional indexes.

This illustrates how shifts in the industry where care is provided (talk to drug therapy in this case) can cause measured price growth in the MCE to differ from that in the PPI^{IASP} . This issue is also relevant for type of health insurance and changes in the bundle of procedures used, the two other factors held constant in the PPI^{IASP} .^{8 9}

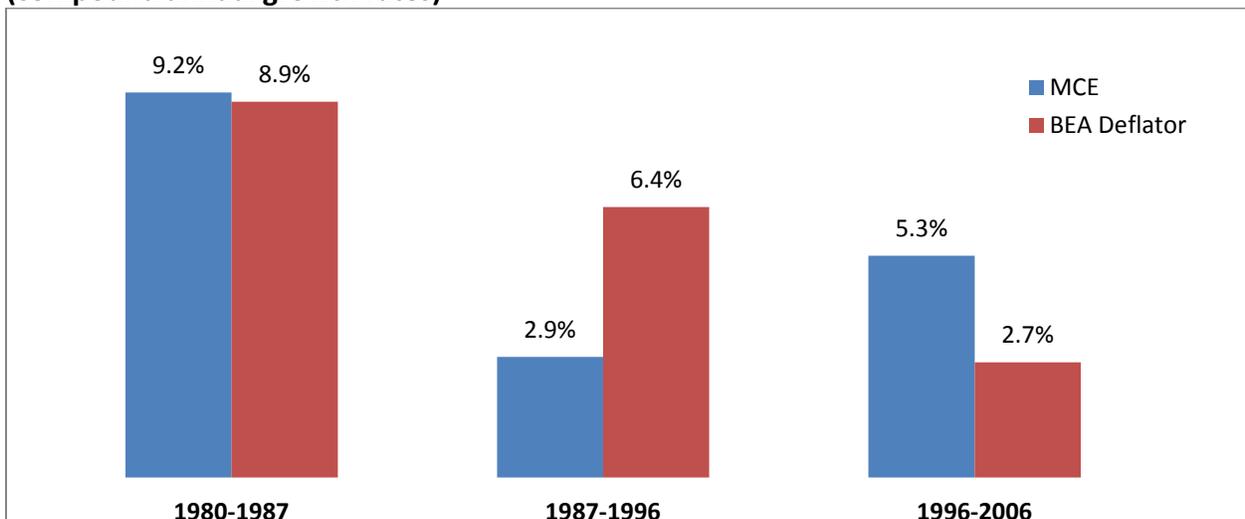
⁸This issue is related to the “outlet substitution” bias problem discussed first by Reinsdorf (1994) and most recently by Nakamura et al (2014). The problem arises in various contexts. Beyond outlet substitution, the issue arose in studies of generic drugs (Griliches and Cockburn (1994), Fisher and Griliches (1995)). In that context, if one thinks that the branded and generic versions of a drug are identical, then the shift of consumers from branded to the lower-cost generic drug should be recorded as a price decline. Again, because the official statistics defined the two versions of the drug as separate products, the shifts were not recorded as price declines. The issue has also come up in the context of input prices, where firms were shifting the sourcing of their materials from domestic suppliers to lower-cost imported ones (Houseman et al, 2011).

⁹ One would think that changing the weights in the PPI (switching to a superlative index like the Fisher) would solve this problem (as in the substitution bias problem). But, this is not so. All these indexes are functions of weighted averages of price relatives: the Fisher index, for example, is a ratio of two weighted averages. Choosing different weights will not change the fact that the PPI and MCE indexes use different price relatives. So, this problem is not like the traditional substitution bias problem.

Like the official PPIs, this index does not take marginal improvements to health from treatment (outcomes, “quality”) into account, so it cannot be interpreted as a COLI. Also, it does not in any way control for the possibility that treatments can be improving over time (higher quality). So, like the official price indexes, so long as quality is improving over time, we can interpret this MCE as an upper bound to a “true” price index that would adequately control for quality change.

As detailed below, we constructed MCE price indexes for our sample period that, like the PPI plotted above, includes prescription drugs, hospitals and physician services. The resulting MCE price indexes show a different pattern of price growth than the PPIs. In particular, they do not show continuing deceleration of price growth over the three time periods. Instead, the MCEs show much slower growth in 1987-96 than in 1980-87 (3.6 percent vs 8.9 percent) and acceleration of growth in 1996-2006 (4.7 percent vs 3.6 percent). Moreover, when comparing the growth in the two indexes, the MCEs show faster growth than the PPI in 1996-2006, a counterintuitive finding that we explore here.¹⁰

Figure 3. Growth in prices for medical care spending: MCE vs BEA deflator. (compound annual growth rates)



Source: Authors’ calculations.

¹⁰ A previous version of this paper used 1997 as the reference point for comparisons rather than 1996. Those growth rates (cited in Dunn et al 2015) are 3.6% and 5.9% growth in the MCE and BEA deflator from 1987-96 and 4.7% and 2.6% growth, respectively, from 1997-2006.

2.3 Sources of numerical differences in PPI^{lasp} vs MCE

To understand the underlying causes for the differences in these two indexes, we use the expressions given above to develop a decomposition of numerical differences into three components: shifts in the industry where treatment is provided, shifts in enrollment across insurance plans, and a residual that we attribute to changes in utilization and any differences in the official price indexes and our laspeyres-based PPI^{lasp}.

2.3.1 Industry shifts

When the cost of services differ across industries and patients change the industry where they receive services for a medical condition, the MCE index will reflect this as a change in price while the PPI index will not. Empirical work has documented that this type of substitution occurs and that it tends to lower costs or restrain increases in the price of treating certain conditions. Early empirical work demonstrated the importance of this effect for some important medical conditions: heart attacks (Cutler and others 1998), depression (Frank, Berndt, and Busch 1999), cataracts (Shapiro, Shapiro, and Wilcox 2001), and schizophrenia (Frank and others 2004). Later studies explored this issue over a more comprehensive list of conditions: Aizcorbe and Nestoriak (2011), Dunn et al (2013). These later studies confirmed earlier results for mental conditions and cataracts. In addition, they also found the shift of surgeries from inpatient hospitals to ambulatory surgical centers to be significant. It is worth noting that the effect goes the other way for some conditions such as neonatal conditions, where the increased use of inpatient care at neonatal intensive care units likely increased the cost of treating newborns (and saved lives).

We can quantify the importance of these industry shifts in generating differences between the MCE and PPI^{lasp} by subtracting a provider-specific MCE from the overall MCE. For example, in the case of an acute episode of depression, we would compare the overall MCE for depression to one that tracks provider types separately. Specifically, we first define the number of episodes of depression treated by provider type p in period 1 as $E_{\text{depression},p}^1$. If depression can only be treated using both talk and drug therapy, then $E_{\text{depression,office visits}}^1$ and $E_{\text{depression,prescription drugs}}^1$ would be positive and $E_{\text{depression,inpatient}}^1$, $E_{\text{depression,outpatient}}^1$, and $E_{\text{depression,}}$

emergency¹ would be zero. As the use of drug therapy in the treatment of depression increases over time, the share of episodes that included drug therapy would increase: $(E_{\text{depression, prescription drugs}}^2 / E_{\text{depression}}^2) > (E_{\text{depression, prescription drugs}}^1 / E_{\text{depression}}^1)$. If drug therapy costs less than talk therapy, these shifts would yield an overall MCE that rises slower than an MCE that tracks these services separately.

More generally, we define an MCE for disease d that holds the provider mix constant as a weighted average of the provider-specific growth rates:

$$\begin{aligned} \text{MCE}_d(p) &= \sum_p \left[\frac{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)}{\sum_s \sum_p \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)} \right] \\ &\quad \left[\frac{\sum_s \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2) / E_{d,p}^2}{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) / E_{d,p}^1} \right] \\ &= \sum_p w_{p,d}^1 (c_{p,d}^2 / E_{d,p}^2) / (c_{p,d}^1 / E_{d,p}^1) \end{aligned}$$

In the second equality, we define the provider-specific weights as $w_{p,d}^1 = \left[\frac{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)}{\sum_s \sum_p \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)} \right]$, costs as $c_{p,d}^t = \sum_s \sum_h (c_{s,p,d,h}^t x_{s,p,d,h}^t)$ and episodes by provider type as defined above. Thus, $\text{MCE}_d(p)$ is a weighted average of the provider-specific changes in cost.

We compare this to the overall MCE defined above, that tracks the growth in cost per episode regardless of where the services are provided. First, we rewrite the overall MCE for disease d using the condensed notation:

$$\text{MCE}_d = \sum_p \left[w_{p,d}^1 (c_{p,d}^2 / E_{d,p}^2) / (c_{p,d}^1 / E_{d,p}^1) \right] \left[(E_{d,p}^2 / E_d^2) / (E_{d,p}^1 / E_d^1) \right]$$

The MCE_d sums over the different provider types, just as the $\text{MCE}_d(p)$ does. For each payer type, the first two terms (the weights and the price relatives) are now written the same as in

the provider-specific MCE. The difference in the two indexes is that the overall MCE has an additional term that allows shifts in the share of episodes that are treated by different types of providers. For example, if the number of depression patients that receive talk vs drug therapy stays the same in the two periods, then $(E_{d,p}^2 / E_d^2) = (E_{d,p}^1 / E_d^1)$ and the two indexes are the same: $MCE_d = MCE_d(p)$.

As shown in the appendix, the difference in the two indexes may be stated as:

$$MCE_d - MCE_d(p) =$$

$$\sum_p w_{p,d}^1 \left[(C_{p,d}^2 / E_{d,p}^2) / (C_{p,d}^1 / E_{d,p}^1) \right] \left[(E_{d,p}^2 / E_d^2) / (E_{d,p}^1 / E_d^1) - 1 \right]$$

Provider types that are treating an increasing share of episodes will, all else held equal, push the overall MCE to grow faster than the provider-specific MCE, and vice versa.¹¹

2.3.2 Insurance type¹²

An analogous problem arises when patients shift across health insurance plans. Specifically, the PPI^{Iasp} and MCE^{Iasp} indexes might show different trends if the revenue that providers receive to treat condition d differs across health plans, and if there are shifts in the composition of patients across plans: shifts towards more generous plans that raise the revenue that providers are paid would be reflected as an increase in the MCE, and vice versa.

The potential importance of shifts across industry types has not been studied. As mentioned above, in the official statistics, prices for medical procedures are priced separately by type of insurance plan. For example, the price of an MRI conducted at a doctor's office and paid for by

¹¹ There are important differences between this type of decomposition and that used in previous studies (Aizcorbe and Nestoriak, 2011, for example.) In the Aizcorbe and Nestoriak decomposition, differences between the MCE and a PPI^{Iasp} arise from two factors: shifts in treatments across industries and increases in the intensity of treatments within industries. The decomposition used here isolates the effect of industry shifts in $MCE_d - MCE_d(p)$.

¹² Starting in July 2014, the BLS PPI program began to provide PPIs for providers, broken out into 4 types of health plans: medicare, Medicaid, private insurance and all other patients.
<http://www.bls.gov/ppi/healthcarebypayer.htm>

BCBS standard option plan is tracked separately from the lower price received by the same doctor from a patient with a less generous insurance plan. Controlling for insurance plan makes sense from a consumer perspective, where one is interested in tracking what consumers are paying. However, if one takes a producer price index perspective, where one is interested in tracking the prices that doctors receive, say, then comparing the high revenue received for an MRI from a patient with a generous insurance plan to the lower revenue received for the same MRI from a patient with less generous insurance should be treated as a different price received by the provider. The current practice in the official statistics of defining these as different goods means that official statistics will not show price declines if consumers shift towards less generous plans, for example.

Following the same logic that we used to isolate the effect of shifts across industries, we can define an MCE that is both provider- and plan-specific, $MCE_d(p,h)$, and subtract it from the provider-specific MCE above to obtain an expression for the differences in the two indexes:

$$MCE_d(p) - MCE_d(p,h) =$$

$$\sum_p \sum_h \left[w_{p,d,h}^1 (C_{p,d,h}^2 / E_{p,d,h}^2) / (C_{p,d,h}^1 / E_{p,d,h}^1) \right] \left[(E_{p,d,h}^2 / E_{d,p}^2) / (E_{p,d,h}^1 / E_{d,p}^1) - 1 \right]$$

Both the provider-specific MCE, $MCE_d(p)$, and the provider- and health plan-specific MCE, $MCE_d(p,h)$, hold constant the mix of provider types. However, the $MCE_d(p,h)$ also holds the composition of insurance plans constant. As before, if the insurance mix of the patients receiving care from provider type p stays constant over time, then $(E_{d,p,h}^2 / E_{d,p}^2) / (E_{d,p,h}^1 / E_{d,p}^1) = 1$ and the two indexes will coincide: $MCE_d(p) = MCE_d(p,h)$. Thus, numerical differences in the two indexes will quantify the effect of insurance shifts on overall price growth.

2.3.3 Utilization of procedures

The final issue that can cause movements in the PPI^{lasp} and MCE^{lasp} indexes to diverge has to do with utilization. In this setting, we use the term utilization to refer to the intensity of treatments during a medical episode, measured as the number and mix of procedures used to treat conditions over the course of an episode. So, for example, a decrease in the number of procedures required to treat an ear infection would be reflected in the MCE index as a drop in the cost of those episodes. However, because the PPI tracks a fixed basket of procedures, it will not reflect the decline in episode costs.

The available evidence suggests that these utilization shifts can be numerically important. Using a database of commercially insured patients, Dunn, Liebman, and Shapiro (2014) confirmed previous research (Aizcorbe and Nestoriak, 2011) showing that indexes that account for substitution across industries show slower price growth, compared with indexes that do not allow for substitution. The more intriguing finding, however, was that the number or intensity of procedures performed to treat episodes of illness increased over time in their sample and that those increases translated into increases in the cost of treating individual diseases. That is, an MCE that treats changes in the number and intensity of procedures as a change in the price of treating conditions can show faster growth than a price index of procedure prices that holds utilization constant.

As detailed below, our data do not contain procedure-level information with which to calculate this effect directly. Instead, we quantify the importance of utilization changes as a residual. Specifically, because the MCE(p,h) strips out any changes in price due to shifts in the composition of plan and provider types, we assume that the only remaining differences in the MCE(p,h) and the PPI^{lasp} arise from differences in this type of utilization. The logic is that PPI^{health} may be viewed as an MCE that holds all three factors constant, MCE(p,h,s):

$$PPI^{lasp} = MCE(p,h,s) = \frac{\sum_p \sum_h \sum_s [C_{s,p,d,h}^1 x_{s,p,d,h}^1]}{\sum_p \sum_h \sum_s (C_{s,p,d,h}^1 x_{s,p,d,h}^1)} \left[\frac{(C_{s,p,d,h}^2 x_{s,p,d,h}^1 / E_{d,h,p}^1)}{(C_{s,p,d,h}^1 x_{s,p,d,h}^1 / E_{d,h,p}^1)} \right]$$

Following the logic used to quantify the other two effects, differences between MCE(p,h) and MCE(p,h,s) can be attributed to movements in utilization that show through as a price change in MCE(p,h) but not in MCE(p,h,s).

Because we cannot calculate MCE(p,h,s) directly, the comparison we make is between MCE(p,h) and the official PPI. That difference will include both utilization effects and any differences in PPI^{lasp} and the official PPI. Those differences will reflect the fact that: (1) the official price indexes apply a different formula than we use here (Lowe vs Laspeyres), (2) to different data sources. While we can imagine any number of reasons that would cause these two types of indexes to differ, we have no reason to believe that these differences will follow any particular pattern.

Table 1. Decomposition

MCE - PPI =	(MCE – MCE(p))	Industry Shifts
	+ MCE(p) – MCE(p,h)	Insurance shifts
	+ MCE(p,h) – official PPI	Utilization changes and differences in PPI ^{lasp} and the official price indexes

4. Data for index construction and decomposition

Constructing the MCE indexes described above requires data for all the medical treatments received by patients over some period of time, including information on the medical conditions that were associated with those treatments. Our study uses available household survey data for the time period 1980-2006. The four surveys used in this study are the National Medical Care Utilization and Expenditure Survey (NMCUES) for 1980,¹³ the National Medical

¹³ Inter-university Consortium for Political and Social Research. National Medical Care Utilization and Expenditure Survey, 1980: household survey, health status questionnaire, and access to care supplement [public use tape 9] (ICPSR 08239) [Internet]. Ann Arbor (MI): University of Michigan Institute for Social Research [cited 2013 Mar 20]. Available from: <http://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/08239>

Expenditure Survey (NMES) for 1987,¹⁴ and the Medical Expenditure Panel Surveys (MEPS) for 1996, 2001 and 2006.^{15 16} All the surveys contain sampling weights designed to provide consistent estimates of the civilian, non-institutional population as a whole which we use in the usual way. These surveys have been used in studies that seek to explain the growth in per capita health care costs into cost per patient vs. prevalence.¹⁷

For each patient surveyed, the data contain event-level observations for each medical encounter with variables for the date of service, type of service, what providers received for their services (both what the patient paid out-of-pocket and what the insurance company paid), and diagnosis codes that provide information on the particular condition treated during that event. We include observations for the five classes of providers: hospitals (broken out by inpatient, outpatient and emergency room care), office visits, and prescription drugs.

Though the conceptual underpinnings of the MCE index is the “episode of care” concept, we use annual spending per patient for each condition as the price rather than the price of an episode of care. To allocate spending by disease, we used the primary diagnosis method which assigns the spending for each event to the first diagnosis listed on the event record. This is admittedly arbitrary but, as a practical matter, has little impact on how spending is allocated in these data and the resulting price indexes (Aizcorbe et al, 2011).

¹⁴ Inter-university Consortium for Political and Social Research. National Medical Expenditure Survey, 1987: household survey, health status questionnaire, and access to care supplement [public use tape 9] (ICPSR 9674) [Internet]. Ann Arbor (MI): University of Michigan Institute for Social Research; [cited 2013 Mar 20]. Available from: <https://www.icpsr.umich.edu/icpsrweb/ICPSR/series/45/studies/9674?archive=ICPSR&sortBy=7&permit%5B0%5D=AVAILABLE>

¹⁵ Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey, household full year file, 1996 [Internet]. Rockville (MD): AHRQ; 1996 [cited 2013 Mar 20]. Available for download from: <http://meps.ahrq.gov/mepsweb/>

¹⁶ Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey, household full year file, 2006 [Internet]. Rockville (MD): AHRQ; 2006 [cited 2013 Mar 20]. Available for download from: <http://meps.ahrq.gov/mepsweb/>

¹⁷ There is a large literature that studies the sources of growth in per-capita medical care spending into treated prevalence and cost per case (Thorpe et al (2004) ; Roehrig and Rousseau (2010); Thorpe (2013) Starr, Dominiak and Aizcorbe (2014). The price relatives that we use for different medical conditions are a ratio of cost per case measures and conceptually very similar to the measures in this literature. However, because we are interested in tracking homogeneous conditions, we define and measure diseases at a more granular level than is typically done in the sources of growth literature.

The decomposition described above requires information on the types of providers that treated different conditions for patients and information on the type of health plan the patient had. We use the five types of providers identified in the data. With regard to health plan type, we would like sufficient detail to capture the shifts to and from managed care plans over our sample period. As detailed in the appendix, the survey questions related to health plan type are not consistent across the three types of surveys we use. For that reason, we can only quantify the importance of health plan shifts using data from the MEPS for 2001-2006, the period of the managed care backlash. Moreover, the information that is available in the MEPS for public plans has been shown to be imprecise. A comparison of figures on enrollment in Medicare managed care plans from the MEPS to those obtained using administrative data provided by CMS shows that the annual MEPS estimate can range from 63% to 117% of the CMS estimates over the period 1996-2005 (Sing et al, 2006). We suspect that this lack of precision is related to the small number of observations in the MEPS survey for patients in public managed care plans. For those reasons, we focus on patients in private plans, where the MEPS data show large enrollment numbers and the estimates are more likely to be precise. That is, we ignore any potential shifts across public insurance plans and, instead, focus on shifts across private plans.

Because the variables that we use were not coded consistently across the surveys, much of the effort in pulling together these data involved building concordances and making adjustments to make the variables consistent over time. A data appendix details the edits and adjustments that were made to obtain consistent definitions of type of service (splitting out inpatient, outpatient and emergency care for hospitals), spending (applying the Zuvekas and Cohen (2002) adjustment to the 1987 charges to obtain estimates of transaction prices), and disease treated (apply the Thorpe et al (2010) programs to represent all conditions using CCS codes).

5. Results of the decomposition and discussion

As stated above, for the earlier time periods, we can decompose the difference between MCE and PPI into only two components: industry shifts, and the residual difference, which we attribute to the effect of both changes in insurance types and changes in utilization. In the last period we can parse out the relative importance of the three components separately.

In the first period (1980-87), growth in the MCE and PPI is very similar: both indexes grew to about 1.8 of the 1980 level by 1987. The observed difference of .026 is made up of changes in the underlying pieces that nearly offset each other: industry shifts held the growth in the MCE down by about 12 percent over this period, while the residual suggests that the combined effect of increases in utilization and any insurance shifts was to push the MCE up about 13 percent.

Table 2. Decomposition of Growth

	1980-87	1987-2001	2001-2006
MCE	1.848	1.657	1.302
PPI	1.822	1.941	1.179
MCE-PPI	+0.026 (1.4%)	-.284 (-17.1%)	+.123 (9.5%)
Industry Shifts MCE – MCE(p)	-.221 (-11.9%)	-.229 (-13.8%)	-.071 (-5.5%)
Insurance Shifts + MCE(p) – MCE(p,h)	+.247 (+13.4%)	-.054 (-3.3%)	-.008 (-0.6%)
Utilization changes +MCE(p,h) – PPI			+.201 (+16%)

Note:

1. Our decision to use 2001 as a reference point was data-driven; 2001 is the first year that MEPS reports the health plan information necessary to quantify insurance shifts vs utilization changes separately.
2. Growth rates are for the entire period, not annual averages.
3. Growth rates are expressed as a percent of MCE in parentheses.

In the second period (1987-2001), the MCE index shows substantially slower growth than the BEA deflator: 1.7% versus 1.9%; about 17 percent slower. The decomposition suggests that most of this came from industry shifts that held down the MCE by about 14 percent and insurance shifts and utilization changes that held down the MCE by another 3 percent.

In the last period, growth in the MCE is faster by about 10 percent: 1.3 vs 1.2 percent growth from 2001-2006.¹⁸ For this period, the data allow us to decompose the difference into the three components. The decomposition suggests that differences in growth rates is more than explained by increases in utilization over this period; increases in utilization pushed up the MCE by 16% of the 2001 level. Shifts in industries and insurance types work in the opposite direction, holding down growth in the MCE by about 6 percent, not enough to offset the utilization effect. To summarize, the MCE index shows about the same growth as the BEA deflator in 1980-87, slower growth in the 1987-2001 period, and faster growth in the latter period, 2001-2006.

Discussion. These differences in the MCE and PPI growth rates are consistent with developments in insurance markets over this period. Using dates roughly consistent with those for our sample, before the 1980s, most health insurance plans were conventional fee for service. The growth in managed care plans took place in the 1980-1990s, with enrollment in all types of managed care rising to 25% by 1987 and over 75% by 1996. Over this period, however, there was a growing sense that patients in managed care plans did not receive needed services and this sentiment gave rise to the so-called “managed care backlash” that began in the late 1990s.

These shifts could cause MCEs and PPIs to diverge in one of two ways. The first channel is a direct one: as discussed above, if prices diverge across plans then patient shifts in and of themselves could cause the indexes to differ. It is well known that the revenues taken in by providers for medical care has historically depended on the type of insurance coverage.¹⁹ We

¹⁸ The growth in this MCE from 2001-2006 is very similar to what is provided in the Bureau of Economic Analysis health account: 1.32 in the MEPS account and 1.29 in the Blended account.

http://www.bea.gov/national/health_care_satellite_account.htm

¹⁹ They are typically highest for uninsured patients. Within patients enrolled in health plans, Cutler, Altman and Zeckhauser (2003) have shown that providers typically receive lower revenues from managed care plans than they do from traditional indemnity plans. In principle, care could be less expensive for managed care patients either because patients with managed care pay lower unit prices or because they receive lower utilization of treatments. Looking at eight conditions representing over 10 percent of health care costs in their sample, they find that providers receive lower prices for HMO patients than for others. Specifically, they find that one-half of the difference is that HMOs pay less for the same treatment and that the other ½ stems from differences in utilization—HMO patients receive different treatments than other patients. Similarly, Miller and Luft (1994, 1997) find that HMO patients have fewer and shorter hospital stays. Eichner, McClellan and Wise (1999) document the

also see those differences in the survey data that we use. Consistent with the shifting trends over our sample, the overall MCE index rises slower than the official price indexes in periods where patients were switching into the less-generous managed care plans and rises faster in later years when the shift went in the other direction.

Table 3. Managed Care Timeline

< 1980	Most health insurance plans are conventional fee for service	
1987	Enrollment in HMOs is up to 10 percent (Maxims paper); enrollment in all types of managed care plans up to 25 percent (Gable et al; cited in Cutler, McClellan and Newhouse)	Increased enrollment in lower-cost managed care plans and the attendant competitive spillovers imply declines in revenue per patient
1997	Managed care is the dominant form of health insurance. Jensen et al (1997) cited in Cutler, McClellan and Newhouse cite >3/4 of the privately insured population is enrolled in managed care plans. Among public plans, managed care is integrated into medicare voluntary part C coverage; Medicaid shifts into managed care. (Maxim)	
>1997	Managed care backlash. States pass legislation to protect patients “Patients Bills of Rights” and four other types of legislation (Maxim)	Backlash towards higher cost plans implies increases in revenue per patient

The second channel through which the rise and fall of managed care plans could have caused divergent movements in PPI and MCEs is more nuanced. In particular, Pinkovsky and others have argued that the developments in insurance markets over this period had significant spillover effects: that the growth in managed care enrollment held down cost growth for

importance of treatment intensity and price across health attack patients with different coverage: in their data, HMOs have 30-40% lower expenditures for those patients than traditional indemnity plans, with virtually all of the differences coming from lower unit prices.

patients in other plans as well²⁰ As discussed by Bloch and Studdert (2004), physicians and hospitals would be likely to use the same practice style for all their privately insured patients, whether those belonging to HMOs or not, which would lead to spillovers. Similarly, Baicker and Goldman (2011) 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). Finally, a series of papers show that increases in HMO penetration in a region decrease the health cost growth rate of conventional insurers in the same region (Baker 1997, Chernew et al. 2008).

In our decomposition, the direct and spillover effects are represented in the insurance shifts and the residual component, respectively. These two effects taken together pushed up the MCE in the first and last periods when enrollment in managed care plans was relatively low; the period before the runup in the 1990s and the subsequent backlash. In the middle period, when enrollment in managed care plans boomed, the combined effect of the insurance and utilization components was to hold down MCE growth by only a modest amount (3% of the growth in the MCE).

One way to interpret these results is that there was substantial growth in utilization in the two periods where managed care enrollment was low, and that the growth in utilization was held in check in the period where enrollment in managed care was high. Though it is possible that the effect of shifts across insurance types could be driving this pattern, in that case we would have expected to see the insurance component play more of a role in the one period where we could measure it (2001-2006). Instead, the effect of insurance shifts was negligible in that period, despite the shifts away from managed care that occurred during the backlash.

Conclusion

Using available survey data, we construct Medical Care Expenditure (MCE) indexes for the period 1980-2006. Comparing those indexes to the deflators currently used in the national accounts shows periods where the MCE grows at about the same rate as the official deflator

²⁰ <http://economics.mit.edu/files/8448>

(1980-1987), a period where the MCE grows slower (1987-2001) and a period where the MCE shows faster growth (2001-2006).

The faster growth in the 2001-2006 period is counterintuitive, since the usual result is that price indexes that make improvements to the official indexes typically show slower (not faster) price growth. However, our indexes use a different definition for the “commodity” provided by the health sector as episodes of care and provide an upper bound to the true price growth for *that* commodity. The interpretation of MCEs as an upper bound stems from the lack of quality adjustment and the assumption that marginal improvements to health from medical care have not declined over time.

The pattern that we see in the growth rates in the MCEs vs those in the official deflator is consistent with shifts in insurance plans that occurred over this period. In periods where enrollment in managed care plans was relatively low, the combined effects of industry shifts and changes in utilization was to push up the MCE above the official indexes. In the middle time period, where enrollment in managed care plans grew to over 75% of the market, the effect of insurance shifts and changes in utilization was quite small.

References

- Aizcorbe A, R Bradley, R Greenaway-McGrevy, B Herauf, R Kane, E Liebman, S Pack, L Rozentel. (2011) Alternative price indexes for medical care: evidence from the MEPS survey. Bureau of Economic Analysis working paper (WP2011-01). February.
- Aizcorbe A, E Liebman, S Pack, DM Cutler, ME Chernew, AB Rosen. (2012) Measuring health care costs of individuals with employer-sponsored health insurance in the US: a comparison of survey and claims data. *Statistical Journal of the IAOS* 28 :43–51 43 DOI 10.3233/SJI-2012-0743
- Aizcorbe A, N Nestoriak. (2011) Changing mix of medical care services: stylized facts and implications for price indexes. *Journal of Health Economics*. 30(3):568-74. DOI: 10.1016/j.jhealeco.2011.04.002
- Aizcorbe, A, B. Retus and S. Smith (2008) ["Toward a Health Care Satellite Account"](#) *Survey of Current Business* 88 (May): 24–30
- Analysis Group, Inc. (2006) "The use of employer claims data in developing price indexes for medical care." Report prepared for the Bureau of Economic Analysis. May 8.
- Baicker K, D Goldman. (2011) "Patient Cost-Sharing and Healthcare Spending Growth." *Journal of Economic Perspectives* 25(2): 47-68.
- Baker LC. (1997) "The effect of HMOs on fee-for-service health care expenditures: evidence from Medicare." *Journal of Health Economics* 16(1)453-481.
- Berndt ER, DM Cutler, R Frank, J Newhouse, J Triplett (2000) "Medical care prices and output." In: Culyer, A., Newhouse, J.P. (Eds.), *Handbook of Health Economics*. Elsevier, Amsterdam, pp. 119–180.
- Berndt ER, A Bir, SH Busch, RG Frank, SL Normande (2002) "The Medical Treatment of Depression, 1991.1996: Productive Inefficiency, Expected Outcome Variations, and Price Indexes." *Journal of Health Economics*, 21(3):373-396
- Bloche, GM, DM Studdert (2004) "A Quiet Revolution: law as an agent of health system change." *Health Affairs* 23 (2): 29-42.
- Bradley, R, E Cardenas, DH Ginsburg, L Rozentel, F Velez (2010) "Producing disease-based price indexes." *Monthly Labor Review* 133(February):20–28.
- Bradley, R 2013. "Feasible Methods To Estimate Disease-Based Price Indexes," *Journal of Health Economics* 32(3): 504–514.

Bundorf, M, A Royalty, L Baker (2009) "Health care cost growth among the privately insured." *Health Affairs* (Millwood). 2009; 28(5):1294-1304. DOI:10.1377/hlthaff.28.5.1294

Chernew, ME, P DeCicca, Town, R (2008) "Managed care and medical expenditures of Medicare beneficiaries." *Journal of Health Economics*, 27(6):1451-1461.

Cohen J, N Krauss (2003) "Spending and service use among people with the fifteen most costly medical conditions, 1997." *Health Affairs* (Millwood). 2003; 22(2):129–38. DOI: 10.1377/hlthaff.22.2.129

Cohen JW, SB Cohen, JS Bantlin (2009) "The medical expenditure panel survey: a national information resource to support healthcare cost research and inform policy and practice." *Medical Care*. 2009; 47(7 supp):S44–50. DOI: 10.1097/MLR.0b013e3181a23e3a

Cutler, DM, M McClellan, JE Newhouse, D Remler (1998) "Are Medical Prices Declining? Evidence from Heart Attack Treatments." *Quarterly Journal of Economics* 113(4):991–1,024.

Cutler, DM, D Altman, R Zeckhauser (2003) "Enrollee Mix, Treatment Intensity, and Cost In Competing Indemnity And HMO Plans." *Journal of Health Economics* 22 (1): 23-45.

Diewert, WE, AO Nakamura (2010/2011), "Bias Due to Input Source Substitutions: Can It Be Measured?" Discussion Paper 10-06, Department of Economics, University of British Columbia; available online in the attachment to.

Diewert, WE (1995/2012), "Axiomatic and Economic Approaches to Elementary Price Indexes," Discussion Paper, Department of Economics, University of British Columbia.
<http://faculty.arts.ubc.ca/ediewert/axio.pdf>. Published in W. Erwin Diewert, Bert M. Balk, Dennis Fixler, Kevin J. Fox, and Alice O. Nakamura (eds.), *Price and Productivity Measurement: Index Number Theory, Vol. 6*, Trafford Press.

Diewert, WE (1998), "Index Number Issues in the Consumer Price Index," *Journal of Economic Perspectives* Winter, 12 (1), 47–58.

Dunn, A, EB Liebman, A Shapiro, L Rittmueller, (2014). "Defining Disease Episodes and the Effects on the Components of Expenditure Growth," Bureau of Economic Analysis, Working Paper.

Dunn, A, EB Liebman, S Pack, A Shapiro. (2013). "Medical Care Price Indexes for Patients with Employer-Provided Insurance: Nationally Representative Estimates from MarketScan Data" *Health Services Research* 48, no.3 (June): 1,173–1,190.

Dunn, A, EB Liebman, A Shapiro (Forthcoming) Implications of Utilization Shifts on Medical-Care Price Measurement., *Health Economics*.

Dunn, A, L Rittmueller, B Whitmire (2015) "Introducing the New BEA Health Care Account." *Survey of Current Business*, January, Pp. 1-21.

Eichner, M, M McClellan, DA Wise "The Sources of Cost Difference in Health Insurance Plans: A Decomposition Analysis." NBER working paper 7443 Dec. 1999

Fisher, F, Z Griliches (1995) "Aggregates Price Indices, New Goods, and Generics," *The Quarterly Journal of Economics* 110(1):229-244.

Frank, RG, ER Berndt, SM Busch (1999) "Price Indexes for the Treatment of Depression." In *Measuring the Prices of Medical Treatments*, ed. Jack E. Triplett, 72–102. Washington DC: The Brookings Institution.

Frank, RG, ER Berndt, SM Busch, AF Lehman (2004) "Quality-Constant Prices for the Ongoing Treatment of Schizophrenia: An Exploratory Study." *Quarterly Review of Economics and Finance*. 44(3):390-409.

Glied, S, J Graff Zivin (2002) "How do doctors behave when some (but not all) of their patients are in managed care?" *Journal of Health Economics* 21(2): 337–353.

Griliches, Z, I Cockburn (1994) "Generics and New Goods in Pharmaceutical Price Indexes," *American Economic Review* 84(5):1213-32.

Hall, A, T Highfill, (2013) "Calculating Disease-Based Medical Care Expenditure Indexes for Medicare Beneficiaries: A Comparison of Method and Data Choices. Measuring and Modeling Health Care Costs." BEA Working Paper.

Houseman, SN, C Kurz, P Lengermann, B Mandel (2011), "Offshoring Bias in US Manufacturing," *Journal of Economic Perspectives*, 25(2), 111–132.

Houseman, SN (2011), "Research Spotlight Offshoring and Import Price Measurement Selected Research from the Measurement Issues Arising From the Growth of Globalization Conference," *Survey of Current Business*, 91(2), 237–266. <http://www.bea.gov/scb/toc/0211cont.htm>

Miller, RH, HS Luft (1994) "Managed Care Plan Performance since 1980: A Literature Analysis," *Journal of the American Medical Association* 271(19): 1512–1519.

Miller, RH, HS Luft (1997) "Does Managed Care Lead to Better or Worse Quality of Care?" *Health Affairs* (Sep/Oct): 7–25.

Miller, RH, HS Luft (2002) "HMO Plan Performance Update: An Analysis Of The Literature, 1997-2001." *Health Affairs*, 21(4):63-86

Nakamura, A, WE Diewert, J Greenlees, L Nakamura, M Reinsdorf (2014) “Sourcing Substitution and Related Price Index Biases” [FRB of Philadelphia Working Paper No. 14-34](#) March 29.

National Research Council. *Accounting for Health and Health Care: Approaches to Measuring the Sources and Costs of Their Improvement*. Washington DC: The National Academies Press; 2010.

Pinkovskiy, ML (2013) the impact of the managed care backlash on health care costs: evidence from state regulation of managed care cost containment practices. mimeo, Federal Reserve Bank of New York.

Roehrig C, G Miller, C Lake, J Bryant(2009) “National health spending by medical condition.” *Health Affairs* (Millwood) 28(2):w358–67. DOI: 10.1377/hlthaff.28.2.w358

Roehrig CS, DM (2011) The growth in cost per case explains far more of US health spending increases than rising disease prevalence, *Health Affairs* 30(9):1657-1663. DOI: 10.1377/hlthaff.2010.0644

Rosen AB, DM Cutler (2009) “Challenges in Building Disease-Based National Health Accounts.” *Medical Care* 47(7_Supplement_1):S7-S13 10.1097/MLR.1090b1013e3181a1023e1012 .

Rosen AB, DM Cutler (2007) “Measuring medical care productivity: a proposal for U.S. National Health Accounts. *Survey of Current Business* 87 (June), 54–58.

Schultze, CL, C Mackie, ed. 2002. *At What Price? Conceptualizing and Measuring Cost-of-Living and Price Indexes*. National Academies Panel on Conceptual, Measurement and Other Statistical Issues in Developing Cost-of-Living Indexes. Washington, DC: National Academy Press for the National Research Council.

Shapiro, I, MD Shapiro, DW Wilcox (2001) Measuring the Value of Cataract Surgery. In *Medical Care Output and Productivity*, ed. David M. Cutler and Ernst R. Berndt, 411–437. Studies in Income and Wealth, vol. 62. Chicago: University of Chicago Press.

Silver, M (2011). “[An Index Number Formula Problem: The Aggregation of Broadly Comparable Items.](#)” *Journal of Official Statistics* 27(4): 553–567

Sing M, J Banthin, T Selden, C Cowan, S Keehan (2006) “Reconciling Medical Expenditure Estimates from the MEPS and NHEA, 2002.” *Health Care Financing Review*, Fall, Volume 28, Number 1

Slesnick D, B Wendling (2010) “Prices, utilization and expenditure growth: a new look at physician services.” University of Texas working paper. January, 2010.

Song, X., WD Marder, R Houchens, JE Conklin, R Bradley (2009) "Can a disease- based price index improve the estimation of the medical consumer price index." In: Diewert,W.E., et al. (Eds.), *Price Index Concepts and Measurement*. University of Chicago Press, Chicago.

Starr, M., L Dominiak, A. Aizcorbe "Decomposing Growth In Spending Finds Annual Cost Of Treatment Contributed Most To Spending Growth, 1980–2006 " *Health Aff* **May 2014** vol. 33 no. 5 **823-831**

Thorpe, KE (2013) "Treated Disease Prevalence And Spending Per Treated Case Drove Most Of The Growth In Health Care Spending In 1987–2009" *Health Aff* 32(5): **851-858**.

Thorpe KE, CS Florence, DH Howard, P Joski(2004) "The impact of obesity on rising medical spending." *Health Affairs* (Millwood). 23(w4):480–6. DOI: [10.1377/hlthaff.w4.480](https://doi.org/10.1377/hlthaff.w4.480)

Thorpe KE, DH Howard (2006) "The rise in spending among Medicare beneficiaries: the role of chronic disease prevalence and changes in treatment intensity." *Health Affairs* (Millwood). 2006; 25(5):w378–88. DOI: [10.1377/hlthaff.25.5.w378](https://doi.org/10.1377/hlthaff.25.5.w378)

Thorpe, KE, L Ogden, K Galactionova (2010) "Chronic conditions account for rise in Medicare spending from 1987 to 2006." *Health Aff* (Millwood) 29(4):718-24.

Zuvekas SH, JW Cohen (2002) "A guide to comparing health estimates in the 1996 Medical Expenditure Panel Survey to the 1987 National Medical Expenditure Survey." *Inquiry*. 2002; 39(1):76-86.

Appendix 1. Data sources and variable definitions

Data sources. The four surveys used in this study are the National Medical Care Utilization and Expenditure Survey (NMCUES) for 1980,¹ the National Medical Expenditure Survey (NMES) for 1987,² and the Medical Expenditure Panel Surveys (MEPS) for 1996, 2001 and 2006.^{3,4} All surveys were funded by U.S. government agencies.⁵ In all analyses in this paper, sample weights are used to make the survey data representative of the civilian, non-institutional population as a whole. In reporting numbers of cases, we follow the MEPS practice of reporting cases with positive weights only, as other cases are not used in the analysis.

Variable definitions.

Services. The analysis includes all spending in the three main categories of healthcare spending: hospital services (including inpatient, outpatient, and emergency room); office visits to physicians and other medical professionals; and prescription drugs. Our analysis does not cover medical equipment, dental services, home healthcare, and miscellaneous other items, so that our estimates of total average spending are somewhat below those of other studies using these data (e.g. Table 3 in the MEPS website). Our analysis also omits phone calls to physicians, which were classified as free events in the office-visit files in the early years.

For the 1987, 1996, 2001 and 2006 surveys, there are separate event files for these three categories of services, so it is straightforward to identify the type. In the 1980 data, inpatient stays are recorded in the hospital file, while outpatient, emergency-room, and office visits are included in the ambulatory care file; we use the variable for “type of service” in the ambulatory file to categorize visits into the categories used in the later years of data. For all years, physicians’ fees associated with inpatient hospital admissions are included in spending on hospital services, whether or not the physicians’ fees were billed separately from those of the hospital. We count the number of prescriptions as the number of prescription-level records, except in 1980, where we use a variable that gives the number of times a particular medicine was prescribed that year. Finally, for 1980, prescriptions are pulled from the “other expenses”

file and identified using the “type of expense” variable.

Spending. Amounts of spending are taken from the event-level files. All four surveys aimed to measure all sources of spending directly associated with a person’s care, including out-of-pocket payments by the household and amounts covered by insurance. Thus, the survey data do not cover certain types of spending not directly associated with care of individual patients, including some government payments to providers, administrative costs, costs of medical research, or public health programs.⁶

However, specifics of how spending was measured differed somewhat across the surveys. The 1980 survey collected information on charges, which were thought to constitute a good proxy for spending under then-prevalent indemnity insurance. The 1987 survey also measured charges, but with changes in payments methods by then underway (prospective payments in Medicare, capitated payments in health-maintenance organizations, and preferred-provider arrangements in private insurance), the extent to which charges provided a good proxy for payments was less clear. Thus, Zuvekas and Cohen developed a method of adjusting charges to payments for the 1987 survey, which we also use.⁷

In brief, they use information collected from providers on a subset of healthcare events as part of the 1987 NMES. This information enables them to characterize how charges relate to payments for patients with different types of insurance coverage and for different types of services; resulting estimates of ratios of payments to charges can then be used to adjust the charge data. The 1996, 2001 and 2006 surveys specifically measure total expenditure via its various components. Specifically, for each event, the survey collects information on copayments, out-of-pocket payments, insurance payments, reimbursements, discounts, balances due, and other sources of payment. In addition to information provided by respondents, the surveys use complementary surveys of healthcare providers and health insurers to validate and/or complete respondent-provided data. Missing values not resolved by these efforts are imputed, with values of services provided under capitated plans imputed from similar cases paid on a fee- for-service basis. This method of imputing service costs for persons having private-insurance under capitated plans may potentially mask some slowdown in spending growth for the privately-insured group in 1987-96 due to HMOs.

Diseases and conditions. For each of the above types of event, survey respondents reported the specific health condition or conditions for which treatment was sought by them or their family member. This information was then coded into the International Classification of Diseases (ICD) system by trained survey staff. While self-reported information on diseases and conditions is potentially subject to reporting error, the concern that it tends to lack specificity relative to physician-reported information is not a problem for our analysis, given that we analyze diseases and conditions at a relatively high level of aggregation.⁸

To classify events uniquely, we use the first diagnosis reported.⁹ While there is some arbitrariness to this method, the majority of events have only one diagnostic code, so that different methods of allocating spending using information from additional codes tend to give very similar results.¹⁰

Because the ICD system contains thousands of detailed diagnostic codes, the MEPS surveys have also reported events in terms of the Clinical Classification System (CCS), which was developed by the Agency for Healthcare Research and Quality (AHRQ) to cluster codes from the ninth edition of the ICD system (ICD-9 codes) into a more manageable number of analytical categories. The 1980 and 1987 surveys do not group the ICD codes into CCS categories so we use the AHRQ crosswalk to map the ICD codes to 259 CCS classes used in the 1996, 2001 and 2006 MEPS. Following Thorpe, Ogden, and Galactionova¹¹, we ignore the supplemental E-codes available in the MEPS that give information on external causes of injury and poisoning because those were not available for the earlier years. The way that diseases were coded changed over time in other ways that required edits to put the data on a consistent basis. There were three main issues: reclassification of X-codes, unclassified events, and newborns.

Reclassifying X-codes. The 1980 and 1987 surveys contain X-codes (recodes of the ICD-9 codes) for events associated with the treatment of “special impairments.” We used mappings developed by Thorpe et al. to translate these codes from the 1987 survey into CCS categories, and extended their mapping to the 1980 data. A small number of ICDs appeared

in the 1980 data but not the 1987 data, so we identified relevant CCS classes for these diseases.

Appendix Table 1. Data edits to create consistent time series			
	1980	1987	1996, 2001, 2006
Created prescribed medicine events from variable that gives the number of times a medicine was prescribed that year	x		
Adjusted charges to reflect actual costs		x	
X-codes for “select impairments” reclassified to CCS categories	x	x	
ICD-9 codes converted to CCS codes using AHRQ mapping	x	x	
Combined mother and newborn event when birth classified as “normal”	x	x	
Legitimate skips reclassified using reason for visit; conditions aggregated	x	x	x

Unclassified events. Certain encounters are not assigned a diagnosis code and instead are coded as “legitimate skips” since the patient did not have a disease. The only information available with which to allocate this spending is a set of variables that list reasons for the visit (RFV). Unfortunately, the RFV variables are not very granular and in some cases we were forced to aggregate over CCS categories to create a consistent time series. The diseases that were combined into single CCS categories include: Administrative care (254-258,10), Mental

illness (65-75,650-670), OB/GYN (176-196), Birth-related (218-224), Congenital conditions (213-217), Other gastrointestinal (153-155), Bone-related musculoskeletal conditions (206-209,212), and Trauma (225-236,239,240,244). Encounters that could not be classified to a CCS category were excluded from the analysis.

Newborns. We adjust 1980 and 1987 childbirth information to make it consistent with later years. In 1980 and 1987, all births resulted in an ‘event’ in the inpatient file for both the mother and the newborn, but in the MEPS, the newborn is given a separate record only if the birth was unusual; to make the data consistent over time, we remove ‘events’ for newborns from the 1980 and 1987 data if the birth was normal. Note that, in our analysis, all care associated with childbirth anyway appears in a single disease category.

Appendix 2. Derivation of Decompositions

For each factor that could drive a wedge between the MCE and PPI lasp indexes, the decomposition compares an MCE that holds the factor constant with one that does not. We use the industry shifts case to illustrate how these comparisons are derived, though the logic is the same for the other two factors.

We restate the MCE for disease d as a weighted average of the provider-specific pieces: (each piece gives the contribution of each provider type to the overall MCE)

$$\text{MCE}_d = \sum_p \left\{ \frac{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)}{\sum_s \sum_p \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)} \right\} \\ \left\{ \frac{\sum_s \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2)}{E_d^2} / \frac{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)}{E_d^1} \right\}$$

We, then, define the provider-specific MCEs as:

$$\text{MCE}_d(p) = \sum_p \left\{ \frac{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)}{\sum_s \sum_p \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)} \right\} \\ \left\{ \frac{\sum_s \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2)}{E_{d,p}^2} / \frac{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)}{E_{d,p}^1} \right\}$$

If the within-provider cost per episode is flat for all providers ($\{\sum_s \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2) / E_{d,p}^2 / \sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) / E_{d,p}^1\}$), then the provider-specific MCE will show no price growth. But, the overall MCE can still show price change if there are shifts in the composition of provider types. To see this, subtract $MCE_d(p)$ from MCE_d :

$$MCE_d - MCE_d(p) = \sum_p \left\{ \frac{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)}{\sum_s \sum_p \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)} \right\} \\ \left\{ \frac{\sum_s \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2) / E_d^2}{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) / E_d^1} \right\} \\ - \left(\frac{\sum_s \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2) / (E_{p,d}^2)}{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) / (E_{p,d}^1)} \right)$$

And simplifying:

$$MCE_d - MCE_d(p) = \sum_p \left[\frac{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)}{\sum_s \sum_p \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1)} \right] \\ \left[\frac{\sum_s \sum_h (c_{s,p,d,h}^2 x_{s,p,d,h}^2) / E_{p,d}^2}{\sum_s \sum_h (c_{s,p,d,h}^1 x_{s,p,d,h}^1) / E_{p,d}^1} \right] \\ \left[\frac{(E_{p,d}^2 / E_d^2)}{(E_{p,d}^1 / E_d^1)} - 1 \right]$$

Endnotes for appendix material

- ¹ Inter-university Consortium for Political and Social Research. National Medical Care Utilization and Expenditure Survey, 1980: household survey, health status questionnaire, and access to care supplement [public use tape 9] (ICPSR 08239) [Internet]. Ann Arbor (MI): University of Michigan Institute for Social Research [cited 2013 Mar 20]. Available from:
<http://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/08239>
- ² Inter-university Consortium for Political and Social Research. National Medical Expenditure Survey, 1987: household survey, health status questionnaire, and access to care supplement [public use tape 9] (ICPSR 9674) [Internet]. Ann Arbor (MI): University of Michigan Institute for Social Research; [cited 2013 Mar 20]. Available from:
<https://www.icpsr.umich.edu/icpsrweb/ICPSR/series/45/studies/9674?archive=ICPSR&sortBy=7&permit%5B0%5D=AVAILABLE>
- ³ Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey, household full year file, 1996 [Internet]. Rockville (MD): AHRQ; 1996 [cited 2013 Mar 20]. Available for download from:
<http://meps.ahrq.gov/mepsweb/>
- ⁴ Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey, household full year file, 2006 [Internet]. Rockville (MD): AHRQ; 2006 [cited 2013 Mar 20]. Available for download from:
<http://meps.ahrq.gov/mepsweb/>
- ⁵ Surveys of health expenditures were also conducted in 1963 and 1970, although they lack information on diagnoses and so cannot be used to track effects of changes in prevalence of given diseases and conditions.
- ⁶ See Selden TM, Sing M. Aligning the Medical Expenditure Panel Survey to aggregate U.S. benchmarks. Rockville (MD): Agency for Healthcare Research and Quality, 2008 July, Working Paper No. 08006. Available at:
http://meps.ahrq.gov/mepsweb/data_files/publications/workingpapers/wp_08006.pdf
- ⁷ Zuvekas SH, Cohen JW. A guide to comparing health estimates in the 1996 Medical Expenditure Panel Survey to the 1987 National Medical Expenditure Survey. *Inquiry*. 2002; 39(1):76-86.
- ⁸ For discussion, see Machlin SR, Cohen J, Elixhauser A, Beauregard K, Steiner C. Sensitivity of household reported medical conditions in the Medical Expenditure Panel Survey. *Medical Care* 2009;47(6):618-25.
- ⁹ The MEPS surveys record up to four CCS codes for each event.
- ¹⁰ This method of allocating spending by disease has been called the "primary diagnosis" method. A brief description of the alternatives may be found in Rosen AB, Cutler DM. Challenges in Building Disease-Based National Health Accounts. *Medical Care*, 2009;47(7 Supplement 1): S7-S13.
- ¹¹ Thorpe, KE, Ogden L, Galactionova K. Chronic conditions account for rise in Medicare spending from 1987 to 2006. *Health Aff (Millwood)*. 2010; 29(4):718-24.