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PRICE INDEXES FOR US MEDICAL CARE SPENDING, 1980–2006

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We construct price indexes for medical care spending in the US economy for the period 1980–2006. Our indexes show slower price growth than the official deflator from 1987–2001, consistent with the fact that indexes that improve on the official statistics typically find slower price growth than the official indexes. However, the result is reversed for the 2001–2006 time period. 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 our indexes: changes in the type of provider supplying care, changes in the type of insurance plan used by the patients, and changes in the bundle of procedures used to treat patients. Our results suggest that using the official price measures may provide misleading conclusions about spending trends and productivity growth in this important sector over this time period.

JEL Codes: I13, I19, C43

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1. INTRODUCTION

In this paper, we provide new price indexes for medical care in the United States using data from nationally-representative surveys of medical expenditures in the civilian non-institutional population in 1980, 1987, 1996 and 2006. Specifically, we provide indexes called Medical Care Expenditure indexes (MCEs), a term coined by a Committee on National Statistics (CNSTAT) panel (Schultze and Mackie, 2002). Like the official price indexes, MCEs allow one to decompose changes in expenditures into changes in price vs. changes in quantity. However, unlike the official price indexes, MCEs redefine the commodity of interest as the treatment of disease and can answer questions like: What is happening to the cost of treating cataract? In contrast, even when reweighted by disease, the official price indexes answer a related but different question: What is happening to prices of the specific procedures used to treat cataract?

Various previous studies report MCEs for different patient populations and time periods to assess potential biases in the official statistics.[1] Our empirical contribution is to provide these price measures for a more comprehensive population of patients than previously done (civilian non-institutionalized population) and

[1]Among the recent studies that construct these measures are Song et al. (2009), Aizcorbe and Nestoriak (2011) and Dunn et al. (2013) for commercially-insured patients; Hall and Highfill (2013) for Medicare patients, Bradley (2013) and Aizcorbe et al. (2011) for the civilian non-institutionalized population.

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for earlier periods (1980–87 and 1987–2001). We also develop a decomposition that parses out numerical differences in the two types of indexes. We apply the decomposition to help interpret the differences in the growth rates in the MCEs we calculate here and a weighted average of the price indexes used as deflators in the national accounts, something we call the BEA deflator.

A comparison of our MCE indexes to the BEA deflator revealed a counterintuitive result. Most empirical studies that aim to improve the official statistics typically provide new price indexes that show *slower* price growth than the official statistics. However, comparing our MCEs to the price indexes used in the national accounts, we find that, for one of the time periods that we consider, our indexes sometimes show *faster* price growth than the BEA deflator. For the earliest time period, our MCE index grows at a compound annual growth rate (CAGR) of 9.2 percent from 1980–87, very close to the 8.9 percent price increases currently in the national accounts; over the period 1987–2001, our indexes grow 3.7 percent, substantially slower than the 4.8 percent growth rate in the national accounts. The counterintuitive result occurs in the most-recent time period, where the disease-based price indexes show faster growth than the BEA deflator (a 5.4 percent vs 3.4 percent CAGR).

We develop a simple decomposition to help us explain these results by parsing out differences in our MCEs and the BEA deflator into three components: differences that stem from shifts in treatments across provider types, those stemming from shifts in patients across type of insurance plans, and a residual category that mostly captures changes in utilization. Consistent with previous studies, we find that shifts across provider types hold down growth in the MCE indexes relative to the BEA deflator 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 is positive in the first and last periods, and very small in the middle 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 to decompose the effect of shifts across insurance types separately 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 BEA deflator in that period is accounted for by growth in utilization, a result consistent with Pinkovskiy (2013) and Dunn et al. (2014). We argue that this makes it unlikely that insurance shifts, in and of themselves, account for much of the differences between the MCE and official price index during the earlier run-up.

The paper is organized as follows. The next section compares how the official price indexes 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 parse out any observed differences. 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. Definition of the "Commodity"

In this section, we formally define price indexes—which we call Service Price Indexes (SPIs)—that, like the indexes used in the BEA deflator, are based on a highly granular definition of the commodity. We then compare expressions for the SPIs to the MCE indexes that are based on a coarser definition and develop a decomposition to explain observed numerical differences in the price indexes.

2.1. *Service Price Indexes*

Official price indexes track 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.[2] 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).

We can illustrate the idea behind these indexes formally. For simplicity, we use a Laspeyres formula. Let s denote a particular procedure (or service) performed by a provider type, 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 service price index ($\mathrm{SPI}^{\mathrm{lasp}}$) that tracks prices of procedures and services used to provide medical care from period 1 to period 2 may be written:

$$\mathrm{SPI}^{\mathrm{lasp}} = \left[\sum_{s}\sum_{p}\sum_{d}\sum_{h}\left(c^{2}_{s,p,d,h} \times {}^{1}_{s,p,d,h}\right)\right] / \left[\sum_{s}\sum_{p}\sum_{d}\sum_{h}\left(c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h}\right)\right]$$

$$= \sum_{s}\sum_{p}\sum_{d}\sum_{h}\left\{c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h} / \sum_{s}\sum_{p}\sum_{d}\sum_{h}\left(c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h}\right)\right\} c^{2}_{s,p,d,h}/c^{1}_{s,p,d,h}$$

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 the 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, $c^{2}_{s,p,d,h}/\, c^{1}_{s,p,d,h}$, or the price relative, is weighted by the period 1 expenditure share for that service, $\left\{(c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h}) / \sum_{s}\sum_{p}\sum_{d}\sum_{h}\left(c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h}\right)\right\}$. Written in this way, it is clear that changes in this $\mathrm{SPI}^{\mathrm{lasp}}$ 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

[2]https://www.bls.gov/ppi/pharmpricescomparison.pdf

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. Therefore, if the mix of procedures used to treat a disease shifts to more-expensive procedures, for example, an SPI will not record this as an increase in price.

These indexes are sometimes reported broken out by disease.[3]

$$SPI_d = \left[\sum_s \sum_p \sum_h \left(c^2_{s,p,d,h} \times^1_{s,p,d,h}\right)\right] / \left[\sum_s \sum_p \sum_h \left(c^1_{s,p,d,h} \times^1_{s,p,d,h}\right)\right],$$

where the bundle of procedures given to patients that received care for condition *d* in period 1 are repriced at period 2 prices. This growth rate answers the question: How did the prices of commodities (procedures, drugs, etc.) used to treat patients with condition *d* in period 1 change from period 1 to period 2?

2.2. *Medical Care Expenditure Indexes*

A Medical Care Expenditure Index (MCE) redefines the commodity provided by the health sector as the overall treatment of a disease. 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.). These indexes answer the question: what happened to the cost of treating disease x? If, over time, the mix of procedures shifts toward more expensive procedures, then the MCE will reflect this shift as an increase in price—an increase in the cost of treating disease *x*. This is a key difference between MCE and SPI indexes; since the only source of price change in the SPI is a change in the prices of individual procedures.

To illustrate how an MCE index is constructed, assume all episodes last one period. 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 over all the *s* types of services (procedures), providers and health plan types: $\sum_s \sum_p \sum_h \left(c^2_{s,p,d,h} \times {}^2_{s,p,d,h}\right)$. The output or commodity provided is defined as the number of episodes for disease *d*, E^2_d, and the average price of these episodes is defined as a unit value:[4] the total expenditures used to treat episodes of type d divided by the number of episodes: $\sum_s \sum_p \sum_h (c^2_{s,p,d,h} \times {}^2_{s,p,d,h})/E^2_d$. 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:

$$MCE_d = [\sum_s \sum_p \sum_h (c^2_{s,p,d,h} \times {}^2_{s,p,d,h})/E^2_d]/[\sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})/E^1_d]$$

[3]For example, there are PPIs for General Medical and Surgical Hospitals (622110) that report price indexes by ICD-9 chapters starting in June 2008.

[4] 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).

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

$$\mathrm{MCE}^{\mathrm{lasp}} = \sum_{d}[(\sum_{s}\sum_{p}\sum_{h} c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h})/(\sum_{s}\sum_{p}\sum_{d}\sum_{h}(c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h})]$$
$$\{\sum_{s}\sum_{p}\sum_{h}(c^{2}_{s,p,d,h} \times {}^{2}_{s,p,d,h})/E^{2}_{d}/\sum_{s}\sum_{p}\sum_{h}(c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h})/E^{1}_{d}\}$$

We can compare this index to the weighted average version of the overall $\mathrm{SPI}^{\mathrm{lasp}}$, where we rearrange the summations in the numerator:

$$\mathrm{SPI}^{\mathrm{lasp}} = \sum_{d}[\sum_{s}\sum_{p}\sum_{h} c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h})/\sum_{s}\sum_{p}\sum_{d}\sum_{h}(c^{1}_{s,p,d,h} \times {}^{1}_{s,p,d,h})]\{c^{2}_{s,p,d,h}/c^{1}_{s,p,d,h}\}$$

The $\mathrm{MCE}^{\mathrm{lasp}}$ and $\mathrm{SPI}^{\mathrm{lasp}}$ indexes are both weighted averages and use the same initial period weights: $[\sum_s \sum_p \sum_h c^1_{s,p,d,h} \times {}^1_{s,p,d,h})/\sum_s \sum_p \sum_d \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})]$. The difference in the two indexes arises in the way the price relative is defined. The price relative in the SPI, $\{\mathbf{c^2_{s,p,d,h}/c^1_{s,p,d,h}}\}$, tracks price changes for a particular procedure, performed by a specific provider type, to treat condition *d* under health plan *h*. 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: $\{\sum_s \sum_p \sum_h (c^2_{s,p,d,h} \times {}^2_{s,p,d,h})/E^2_d/\sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})/E^1_d\}$. Therefore, shifts in the location where services are provided (inpatient stay vs. ambulatory surgical centers, for example), 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 would cause movements in the MCE index, if they changed the cost of treating the condition. But, they would not cause movements in the SPI because those factors are held fixed at period 1 levels.

2.3. *Treatment of Depression: An Example*

Figure 1 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 do not change over time. If one tracks prices of each service separately, as in the $\mathrm{SPI}^{\mathrm{lasp}}$, and forms a weighted average, one would conclude that there has been no overall change in prices because we have assumed that the prices of the underlying procedures did not change.

However, tracking the treatment of the disease—in this case, depression—suggests that the price of treating depression might have fallen in this example. If patients begin to substitute the higher cost talk therapy with lower cost drug therapy when drug therapy is introduced into the market, total spending on the treatment of depression would fall. Assuming that the number of episodes of

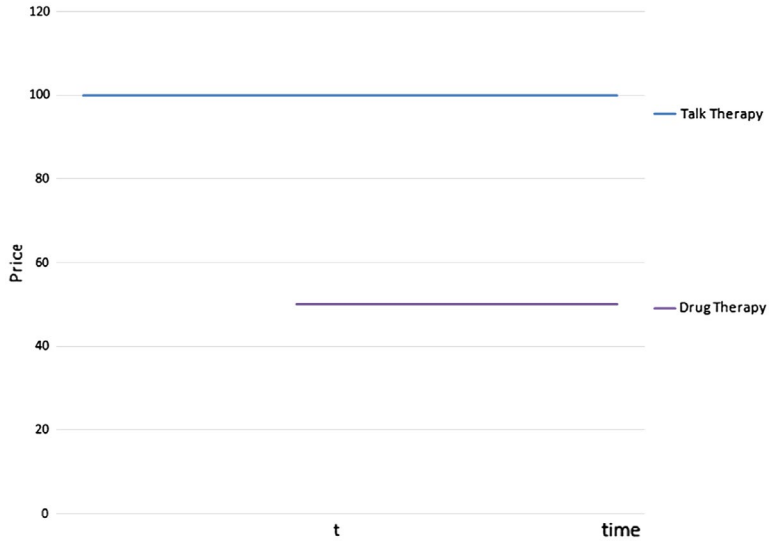

Figure 1. An Example of Shifts of Treatments Across Provider Types.
Source: Aizcorbe et al. (2008) [Colour figure can be viewed at wileyonlinelibrary.com]

depression does not change, this drop in expenditures would generate a drop in the spending per episode (i.e. 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 episodes, in fact, remained the same. This is because the SPI would show no price change and, hence, would attribute all the declines in expenditures to a decline in the quantities. In contrast, a drop in spending with the number of episodes constant would directly translate into a drop in the MCE, spending per episode, leaving quantities constant.

This issue is related to the "outlet substitution" bias problem discussed first by Reinsdorf (1994) and most recently by Nakamura et al. (2014). The arrival of discount outlets prompted consumers to shift their purchases from mainstream stores to discount outlets, where identical commodities were offered at a lower price but because prices at different outlets were tracked separately, the BLS price indexes did not reflect this switch as a drop in price. 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).

This issue is often mistaken as a problem akin to the traditional substitution bias problem that can be ameliorated by more frequent updating of the expenditure shares in the weighted average. However, as this example makes clear, changes in the weights applied to talk vs drug therapy will not change the growth rate as measured in the SPI—the result will always be zero price change given how we have constructed the example. This makes the point that the issue here is one of how the commodity is defined, not the weight that is placed on the price of each commodity. Indeed, the algebra provided above makes clear that both indexes use the same weights in the weighted average; the key difference is in how the price relative is defined.

This example illustrates how shifts to different provider types (talk to drug therapy in this case) can cause measured price growth in the MCE to differ from that in the $\mathbf{SPI}^{lasp}$. This issue is also relevant for type of health insurance and changes in the bundle of procedures used, the two other factors that are held constant in the $\mathbf{SPI}^{lasp}$.

2.4. *How these Indexes Handle Quality Change*

Neither the SPI nor MCE indexes take marginal improvements to health from treatment (outcomes, "quality") into account. In the case of the MCE index for this example, it is tempting to view the drop in the cost of treating depression as a good thing. But, that is only so if the two types of therapy are equally effective at treating depression. If, in fact, drug-therapy is a lower-quality (less effective) treatment, then talk- and drug-therapy are not perfect substitutes and the drop in the price of treating depression should not be taken as a better outcome.

More generally, MCE indexes do not in any way control for the possibility that treatments can be improving over time. Another example is the case of treating neonatal conditions. The arrival of neonatal intensive care units, allowed the possibility of improving survival rates for many premature babies. That improvement in care came at a cost, so an MCE that tracks expenditures per baby, for example, shows sharp increases in the cost of care, as those patients spend more time in the hospital and incur higher costs. However, the MCE does not reflect the fact that more babies survived and that their health improved. It is important to note, then, that higher or lower prices measured in MCEs does not say anything about whether the treatment is "worth it." That question can only be addressed if methods are developed to measure marginal improvements in health from treatments so that the costs may be weighed against the benefits.

Importantly, constructing indexes that are based on disease, like the MCEs constructed here, is an important first step in obtaining price indexes that take outcomes into account.

2.5. *Decomposing Numerical Differences in SPI and MCE Indexes*

To better understand the differences in the MCE and SPI indexes, we use the expressions given above to develop a decomposition of numerical differences into three components: shifts in the type of provider where treatment is provided,

shifts in enrollment across insurance plans, and a residual that reflects changes in utilization.

2.5.1. *Differences in Provider Types*

As explained above, when the cost of services differ across provider types (i.e. industries) and patients change where they receive services for a medical condition, the MCE index will reflect this as a change in price while the SPI 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 et al., 1998), depression (Berndt et al, 2002, Frank et al., 1999), cataracts (Shapiro et al., 2001), and schizophrenia (Frank et al., 2004). Later studies explored this issue over a more comprehensive list of conditions: Aizcorbe and Nestoriak (2011), Dunn et al. (2013), for example. 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.

We can quantify the importance of these provider shifts in generating differences between the MCE and $\mathbf{SPI}^{\text{lasp}}$ by subtracting an MCE that is specific to provider types 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 $E^1_{\text{depression,p}}$. If depression can only be treated using talk or drug therapy, then $E^1_{\text{depression, prescription drugs}}$ would be positive and $E^1_{\text{depression, inpatient}}$, and $E^1_{\text{depression, emergency}}$ 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: $\left(E^2_{\text{depression, prescription drugs}}/E^2_{\text{depression}}\right) > \left(E^1_{\text{depression, prescription drugs}}/E^1_{\text{depression}}\right)$. Because drug therapy is less costly than talk therapy, this shift would cause a drop in the overall MCE but no drop in the provider-specific MCEs.

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

$$\begin{aligned}\text{MCE}_{\text{d}}(p) = \sum_{\text{p}}\left[\sum_{\text{s}}\sum_{\text{h}}\left(c^1_{\text{s,p,d,h}}\times{}^1_{\text{s,p,d,h}}\right)/\sum_{\text{s}}\sum_{\text{p}}\sum_{\text{h}}\left(c^1_{\text{s,p,d,h}}\times{}^1_{\text{s,p,d,h}}\right)\right]\\ \left[\sum_{\text{s}}\sum_{\text{h}}\left(c^2_{\text{s,p,d,h}}\times{}^2_{\text{s,p,d,h}}\right)/E^2_{\text{p,d}}/\sum_{\text{s}}\sum_{\text{h}}\left(c^1_{\text{s,p,d,h}}\times{}^1_{\text{s,p,d,h}}\right)/E^1_{\text{p,d}}\right]\\ = \sum_{\text{p}} w^1_{\text{p,d}}(c^2_{\text{p,d}}/E^2_{\text{p,d}})/(c^1_{\text{p,d}}/E^1_{\text{p,d}})\end{aligned}$$

In the second equality, we define the provider-specific weights as $w^1_{p,d} = [\sum_s \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h}) / \sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})]$, expenditures as $c^t_{p,d} = \sum_s \sum_h \left(c^t_{s,p,d,h} \times {}^t_{s,p,d,h}\right)$ and episodes $\left(E^1_{p,d}\right)$. The number of episodes counted here are those that involved treatment by provider type p. Thus, $\mathrm{MCE}_d\,(p)$ is a weighted average of the provider-specific changes in spending per episode, for episodes that involved that provider type.

We compare this to an overall MCE for disease d that tracks the growth in cost per episode regardless of who provided the service. First, we rewrite the overall MCE for disease d:

$$\mathrm{MCE}_d = \sum_p [\sum_s \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h}) / \sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})]$$
$$[\sum_s \sum_h (c^2_{s,p,d,h} \times {}^2_{s,p,d,h}) / E^2_d / \sum_s \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h}) / E^1_d]$$
$$= \Sigma_p\, w^1_{p,d} (c^2_{p,d} / E^2_d) / (c^1_{p,d} / E^1_d)$$

The only difference in this MCE and the provider-specific one above is in how quantities are counted: here the price is spending per episode $\left(c^1_{p,d}/E^1_d\right)$ whereas the provider-specific price is spending for the selected episodes that involved provider type p $\left(c^1_{p,d}/E^1_{p,d}\right)$.

We can rewrite the overall MCE, MCE_d, as the product of the provider-specific MCE and a conversion factor:

$$\mathrm{MCE}_d = \Sigma_p\, w^1_{p,d} (c^2_{p,d}/E^2_{p,d}) / (c^1_{p,d}/E^1_{p,d}))[(E^2_{p,d}/E^2_d) / (E^1_{p,d}\,/\,E^1_d)]$$

So that the difference in the two indexes may be stated as:

$$\mathrm{MCE}_d - \mathrm{MCE}_d\,(p) = \Sigma_p\, w^1_{p,d} [(c^2_{p,d}/E^2_{p,d}) / (c^1_{p,d}/E^1_{p,d})][(E^2_{p,d}/E^2_d) / (E^1_{p,d}/E^1_d) - 1]$$

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 $(E^2_{d,p}/E^2_d) = (E^1_{d,p}/E^1_d)$ and the two indexes are the same: $\mathrm{MCE}_d = \mathrm{MCE}_d(p)$.

2.5.2. *Insurance Type*[5]

An analogous problem arises when the mix of patients shifts across health insurance plans. Specifically, the SPI^{lasp} and MCE^{lasp} 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

[5]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. https://www.bls.gov/ppi/healthcarebypayer.htm

plans: shifts towards more generous plans that raise providers' revenues would be reflected as an increase in the MCE, but not the SPI and vice versa.

The potential importance of shifts across provider 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 a generous insurance 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 revenues that doctors receive, 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.

Following the same logic that we used to isolate the effect of shifts across provider types, 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.

First, we define $MCE_d(p,h)$ as:

$$MCE_d(p,h) = \sum_p [\sum_s \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h}) / \sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})]$$
$$[\sum_s \sum_h (c^2_{s,p,d,h} \times {}^2_{s,p,d,h}) / E^2_{p,d,h} / \sum_s \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h}) / E^1_{p,d,h}]$$
$$= \Sigma_p \Sigma_h w^1_{p,d,h} (c^2_{p,d,h} / E^2_{p,d,h}) / (c^1_{p,d,h} / E^1_{p,d,h})$$

Now episodes for disease d are counted by the provider type and health plan types $\left(E^2_{p,d,h}\right)$ as is spending $\left(c^2_{p,d,h}\right)$. To quantify the effect of any changes in health plan types on spending we compare this MCE(p,h) to the producer-specific MCE(p).

To facilitate the comparison, we can rewrite $MCE_d(p)$ as:

$$MCE_d(p) = \sum_p \sum_h [\sum_s (c^1_{s,p,d,h} \times {}^1_{s,p,d,h}) / \sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})]$$
$$[\sum_s (c^2_{s,p,d,h} \times {}^2_{s,p,d,h}) / E^2_{p,d} / \sum_s (c^1_{s,p,d,h} \times {}^1_{s,p,d,h}) / E^1_{p,d}]$$
$$= \sum_p \sum_h w^1_{p,d,h} (c^2_{p,d,h} / E^2_{p,d}) / (c^1_{p,d,h} / E^1_{p,d})$$

And, comparing the two, we can write an expression for the difference:

$$MCE_d(p) - MCE_d(p,h) = \Sigma_p \Sigma_h [w^1_{p,d,h} (c^2_{p,d,h} / E^2_{p,d,h}) / (c^1_{p,d,h} / E^1_{p,d,h})][(E^2_{p,d,h} / E^2_{p,d}) / (E^1_{p,d,h} / E^1_{p,d}) - 1]$$

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 $(E^2_{p,d,h}/E^2_{p,d})/(E^1_{p,d,h}/E^1_{p,d}) = 1$ 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.

2.5.3. *Utilization of Procedures*

The final issue that can cause movements in the SPI^{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. 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 SPI tracks a fixed basket of procedures, it will not reflect the decline in episode costs.

To see this, we first recall the definition for the SPI for disease d:

$$SPI_d = [\sum_s \sum_p \sum_h (c^2_{s,p,d,h} \times {}^1_{s,p,d,h})]/[\sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})]$$
$$= [\sum_s \sum_p \sum_h [(c^1_{s,p,d,h} \times {}^1_{s,p,d,h})/\sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})]$$
$$\left(c^2_{s,p,d,h}/c^1_{s,p,d,h}\right)]$$

And, as before, we rewrite the MCE(p,h) in the same format at SPI_d:

$$MCE_d(p,h) = \sum_p \sum_h \sum_s [(c^1_{s,p,d,h} \times {}^1_{s,p,d,h})/\sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})]$$
$$[\sum_s (c^2_{s,p,d,h} \times {}^2_{s,p,d,h})/\mathbf{E^2_{p,d,h}}/\sum_s (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})/\mathbf{E^1_{p,d,h}}]$$

Comparing the two:

$$MCE_d(p,h) - SPI_d = \sum_s \sum_p \sum_h [(c^1_{s,p,d,h} \times {}^1_{s,p,d,h})/\sum_s \sum_p \sum_h (c^1_{s,p,d,h} \times {}^1_{s,p,d,h})] \left(c^2_{s,p,d,h}/c^1_{s,p,d,h}\right)]$$
$$[(\times^2_{s,p,d,h}/\mathbf{E^2_{p,d,h}})/(\times^1_{s,p,d,h}/\mathbf{E^1_{p,d,h}}) - 1]$$

TABLE 1
DECOMPOSITION

MCE - SPI =	MCE – MCE(p)	Shifts in provider types
	+ MCE(p) – MCE(p,h)	Shifts in type of insurance plan
	+ MCE(p,h) – SPI	Utilization changes

That is, the indexes are the same when there is no change in utilization. For a given provider type, p, and health plan, h, $x^2_{s,p,d,h}/\mathbf{E^2_{p,d,h}}$ is the number of procedures of type s that were used to treat condition d, divided by episodes of that type (Table 1).

A final note: this decomposition allows one to quantify difference in growth rates that arise from conceptual differences in how the good is defined. In our empirical work, our data allow us to construct the MCEs but not the SPI index. So we use official price indexes instead as a proxy for the SPIs. This means that there may be additional numerical differences in the comparison of MCE(p,h) and the SPI that arise from differences in the way that the SPI and the official price indexes are constructed. The next section considers these issues.

3. Data for Index Construction and Decomposition

3.1. *BEA Deflator*

The official price index that we use for our comparisons and decomposition is an aggregate of the price deflators that BEA uses in the national accounts. In our analysis, we consider three types of commodities: services at physicians' offices hospitals (inpatient, outpatient, and emergency care), and prescription drugs. The BEA uses Producer Price Indexes (PPI) to deflate expenditures on services provided at physicians' offices, and hospitals (inpatient; outpatient and emergency room care). For prescription drugs, the BEA uses a Consumer Price Index (CPI) because it is thought that the CPI better accounts for the entry of generic drugs than the PPI does.[6] Understanding differences in the way these official price indexes are constructed and the MCE(p,h) are important in interpreting any residual differences in the decomposition of differences in the MCE and the official indexes.

The PPI 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.[7] Like the SPIs discussed above, the PPIs track spending for very granular commodities, essentially track changes in the prices of procedures holding the mix of provider types, insurance type and utilization constant.

However, there are several potentially important differences in the MCE(p,h,s) indexes and the price indexes as constructed by the BLS. With regard to the prices in the price relatives, the BLS uses a sampling design to choose specific establishments from which to obtain price quotes (physician offices, hospitals and retail pharmacies). Once specific establishments have been chosen, the BLS visits the establishment and randomly chooses a number of representative "bills." These bills contain information on the expenditures paid, the procedures that were

[6]CPI indexes are typically used to deflate consumer spending in the national accounts. In the case of medical care spending, the CPI program aims to track changes in out-of-pocket costs, not the overall revenues received by providers, which is what is relevant for the national accounts. For prescription drugs, the PPI includes only domestically produced pharmaceuticals, which excludes many generic drugs purchased by consumers so the CPI is used instead.

[7]https://www.bls.gov/ppi/ppifaq.htm#1 https://www.bls.gov/cpi/cpifact4.htm

performed, the type of insurance used, and the type of establishment from which it was obtained. In subsequent visits, the BLS asks the establishment to "price" how much that same bill would be if the treatment was provided over the last month. These price "quotes" are not transaction prices for services performed in that time period.

Second, the formula for the SPI above is a Laspeyres formula that uses weights from the base period (i.e. period 1.) to aggregate over individual prices. 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.[8] So, the formula is also different.

The data sources for the weights in the Lowe index are establishment surveys (in the case of the PPI) and the consumer expenditure survey (in the case of the CPI). Numerically, any differences in the numbers obtained from those sources and those obtained from the survey that we use to construct the MCEs may show up in the residual. However, to the extent that all the sources provide nationally-representative estimates, the differences should be small (or noise).

Finally, because the MCE aggregates are over all services/types of providers, we take care to compare the MCEs to an aggregate of official PPI/CPIs that uses comparable weights.

3.2. *MCE Indexes*

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,[9] the National Medical Expenditure Survey (NMES) for 1987,[10] and the Medical Expenditure Panel

[8]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).

[9]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: https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/08239

[10]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

Surveys (MEPS) for 1996, 2001 and 2006.[11,12] 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.[13]

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).

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 percent to 117 percent 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

[11]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: https://meps.ahrq.gov/mepsweb/

[12]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: https://meps.ahrq.gov/mepsweb/

[13]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 and Howard (2006); Roehrig and Rousseau (2011); Thorpe et al. (2004); Starr et al. (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.

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).

4. Results

4.1. *Comparisons of Price Indexes*

Numerically, we can construct an overall deflator for spending on medical care that uses the official BEA deflators for a bundle of services comparable what is constructed here using the survey data (prescription drugs, physician services and hospitals) and aggregate over these price indexes using Laspeyres weights from our survey. The resulting index tells us the average change in procedure prices, across all conditions, providers, and payment types. As shown in Figure 2, 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 5 percent growth in 1987–2001 and slows further to about 3-1/2 percent in the last period.

As detailed below, we constructed MCE price indexes for our sample period that, like the deflator plotted above, include prescription drugs, hospitals and physician services. The resulting MCEs 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 1987–2001 than in 1980–87 (3.7 percent vs 9.2 percent) and acceleration of growth in 2001–2006 (5.4 percent vs 3.7 percent). Moreover, when comparing the growth in the two indexes, the MCEs show faster growth than the PPI in 2001–2006, a counterintuitive finding that we explore here.

4.2. *Decomposition Results*

As stated above, for the earlier time periods, we can decompose the difference between MCE and PPI into only two components: shifts in provider types, 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 1.9 of the 1980 level by 1987. The observed difference

Table 2
Decomposition of Differences in the Disease Based Indexes and the BEA deflator

		1980–1987	1987–2001	2001–2006
			-----Growth rates over entire period-----	
Disease-based index	MCE	1.848	1.646	1.326
BEA deflator	PPI	1.852	1.941	1.186
Difference	MCE-PPI	−0.004	−0.295	0.140
			-----Percent of MCE growth rate-----	
Differences in MCE and PPI	MCE-PPI	−0.2%	−17.9%	10.5%
Provider shifts	MCE – MCE(p)	−12.0%	−13.9%	−3.7%
+ Insurance Shifts	MCE(p) – MCE(p,h)	11.7%	−4.0%	−0.4%
+ Utilization changes	MCE(p,h) – PPI			14.6%

Notes: 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. 4. Indexes are not chained—decomposition requires fixed base indexes.

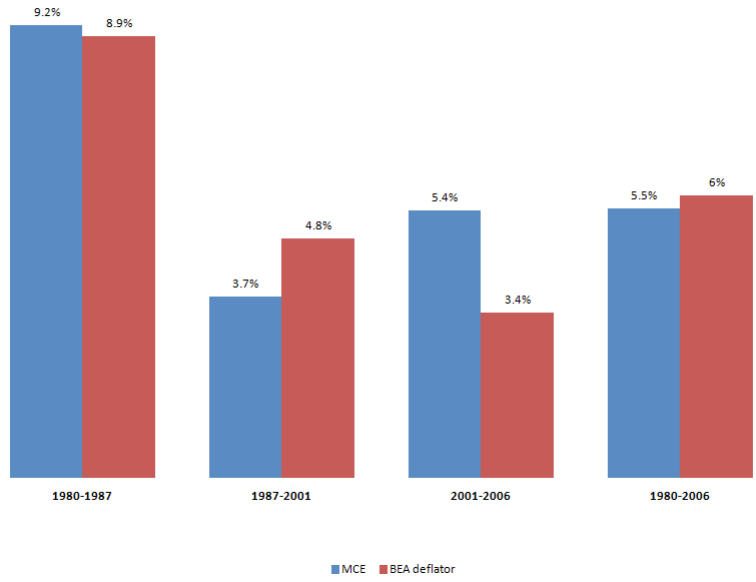

Figure 2. Growth in Process for Medical Care Spending: MCE vs BEA Deflator.
Source: Authors' calculations. [Colour figure can be viewed at wileyonlinelibrary.com]

of -.004 is made up of changes in the underlying pieces that essentially offset each other: shifts in provider types 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 the same (Table 2).

In the second period (1987–2001), the MCE index shows substantially slower growth than the BEA deflator: 1.7 percent versus 1.9 percent; about 18 percent slower. The decomposition suggests that most of this came from shifts across provider types that held down the MCE by about 14 percent and insurance shifts and utilization changes that held down the MCE by another 4 percent.

In the last period, growth in the MCE is faster by about 10 percent: 1.3 vs 1.2 percent growth from 2001–06. For this period, the data allow us to decompose the difference into the three components. The decomposition suggests that neither shifts in provider types or in insurance types can account for this difference in the growth rates; they worked to hold down spending by disease not increase it. Instead, the difference is more than explained by the residual. Though there are differences in the underlying data that might account for some of this, we think most of the movement in the residual comes from changes in utilization. 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.

TABLE 3
MANAGED CARE TIMELINE

before 1980	Most health insurance plans are conventional fee for service	
1987	Enrollment in HMOs is up to 10 percent (Pinkovskiy, 2013); enrollment in all types of managed care plans up to 25 percent (Gable *et al*.; cited in Cutler et al., 1998)	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 et al., 1998, 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 (Pinkovskiy, 2013).	
after 1997	Managed care backlash. States pass legislation to protect patients "Patients Bills of Rights" and four other types of legislation (Pinkovskiy, 2013).	Backlash towards higher cost plans implies increases in revenue per patient

The available evidence suggests that utilization shifts can be numerically important. Using a database of commercially insured patients, Dunn et al. (2014) confirmed previous research (Aizcorbe and Nestoriak, 2011) showing that indexes that account for substitution across provider types (which they call 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.

These differences in the MCE and PPI growth rates are consistent with developments in insurance markets over this period (Table 2). 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 1980–90s, with enrollment in all types of managed care rising to 25 percent by 1987 and over 75 percent 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 managed care 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.[14] We 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.

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, Pinkovskiy (2013) 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 patients in other plans as well.[15] 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 run-up 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 percent 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 (2001–06). Instead, the effect of insurance shifts was negligible in that period, despite the shifts away from managed care that occurred during the backlash.

[14]They are typically highest for uninsured patients. Within patients enrolled in health plans, Cutler et al. (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 play 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 (1997, 2002) find that HMO patients have fewer and shorted hospital stays. Eichner et al. (1999) document the importance of treatment intensity and price across health attack patients with different coverage: in their data, HMOs have 30–40 percent lower expenditures for those patients than traditional indemnity plans, with virtually all of the differences coming from lower unit prices.

[15]https://economics.mit.edu/files/8448

5. 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 (1980–87), a period where the MCE grows slower (1987–2001) and a period where the MCE shows faster growth (2001–06).

The faster growth in the 2001–06 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 provider 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.

While our analysis provides a way to analyze changes in the costs of treating disease, it does not provide a way to assess the associated benefits to patients and, hence, cannot address the important questions about whether the spending is "worth it." It should also be noted, however, that redefining the commodity provided by medical care spending in terms of the treatment of disease is a necessary first step in properly accounting for outcomes, a very difficult measurement problem that does not have an easy solution.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix: Producer Price Indexes
Table A: Data Edits to Create Consistent Time Series